Do we (need to) overpay public servants?

On the Dutch public-private wage gap and its impact on sectoral job mobility

by

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Preface

Dear reader,

In front of you lies the Master thesis report titled ”Do we (need to) overpay public servants? On the Dutch public-private wage gap and its impact on sectoral job mobility”. This quantitative analysis of the Dutch public wage policy, analysing the competitiveness of wages in the public sector, has been carried out at the Dutch Ministry of Finance, in particular at the economic staff directorate named General Financial and Economic Policy (AFEP). I would like to thank all my colleagues from this department for the opportunities to shape my own project, to be given many responsibilities, and to learn an awful lot, both within this graduation project and within other projects. In particular, I am grateful to Menno Schellekens for helping to design the research, and to Dick van der Sluijs for his commitment to supporting the data analysis. The past half year has been a unique opportunity for me to get a good impression of one of the most influential economic decision-making departments of the Dutch government.

I also would like to express my gratitude to the members of my academic committee. Starting with Dr Enno Schröder, who as my first supervisor, made sure to narrow down my enthusiasm and specify my ideas, and thus prevented me from being faced with the impossible task of researching the entire labour market. His attention to thorough analysis has enhanced the quality of this study. In addition, I would like to thank Dr Anneke Zuiderwijk- van Eijk, who, as chair and second supervisor, assisted this project with constructive feedback and an exceptional eye for detail, not only at official feedback moments but also in between.

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Executive Summary

The labour market is constantly subject to economic, socio-demographic and technological developments. As both a policymaker and employer, the Dutch government must respond to these developments. As a policymaker to promote the functioning of the labour market, and as an employer to attract sufficient qualified personnel to guarantee the provision of public services to Dutch society. Both goals are under considerable pressure due to an unprecedentedly tight labour market, leading to labour shortages in parts of the public sector. These shortages have far-reaching consequences for the functioning of the Dutch labour market and the ability to provide public services, such as the provision of care and the renewal of crucial IT systems.

The Dutch government is pursuing a labour market policy to combat these developments and mitigate negative effects. The Dutch public wage policy, determining an adequate level of public sector wages relative to private sector wages, constitutes an important aspect. The Dutch public wage policy intends to offer competitive wages in the public sector to attract sufficiently qualified personnel to provide public services. The government has the reference model in place for this, but there is limited knowledge of to what extent the reference model leads to competitive wages in reality. This study addresses this knowledge gap and, as the first quantitative evaluation of the Dutch reference model, looks at the research question:

> *How does the Dutch public wage policy translate into public-private wage differentials and sectoral shifts?*

An answer to this research question is sought by means of empirical econometric analysis, coupled with a thorough theoretical foundation. Oaxaca-Blinder decomposition methods, adapted to the specifics of the Dutch labour market, have been applied to analyse the public-private wage differentials to assess the competitiveness of public sector wages. Correlation analysis is applied to analyse the relationship between these wage gap estimates and sectoral job mobility to assess the influence of public-private wage differentials on the ability to attract qualified personnel in the public sector. Together, this forms an evaluation of the reference model, and thus the current public wage policy, addressing the questions of whether public sector wages are competitive with private sector wages and whether this (non)competitiveness can be a cause of shortages in the public sector.

The findings indicate that the current public wage policy does not lead to competitive public wages. While wages are reasonably competitive for the weighted average public servant, this is not the case when looking at specific personal human capital characteristics. Depending on one's capacities, one earns relatively more or less in the public sector than in the private sector. The reference model is too generic to be competitive for individuals and is only reasonably competitive when looking at the average. Application of compensation policies, as was done in 2015 and 2016, leads to a serious deterioration of public sector competitiveness. It is also established that these considerable wage differences can be a cause of shortages of qualified personnel in the public sector, including healthcare and ICT personnel.

The Dutch government should ask itself whether it wants to offer these non-competitive wages. There are egalitarian reasons for this approach, but there is a risk that there will be shortages of qualified personnel in the public sector. To respond to this, the reference model should be examined more closely, other options for attracting sufficient personnel in the public sector should be investigated, and options for increasing productivity in the public sector should be investigated. Academic points for future research are to apply other methods to the rich data set used in this study and to conduct further research into the causality between wages and sectoral job mobility, also in relation to other Public Service Motivation (PSM) and intrinsic motives.

Contents

Preface iii

Executive Summary v

1 Introduction 1
- 1.1 Research problem . . . 3
- 1.2 Research questions . . . 5
- 1.3 Research relevance . . . 5
- 1.4 Report outline . . . 7

2 Theoretical Background 9
- 2.1 Wage determination theories . . . 9
  - 2.1.1 Supply and demand theory . . . 9
  - 2.1.2 Bargaining power theory . . . 9
  - 2.1.3 Efficiency wage theory . . . 10
  - 2.1.4 Human capital theory . . . 10
  - 2.1.5 Interim conclusion: Wage determination theories . . . 10
- 2.2 Public-private labour and wage differentials . . . 11
  - 2.2.1 Reasons for wage disparity . . . 11
  - 2.2.2 Towards the ”adjusted” public-private wage gap . . . 11
  - 2.2.3 Sector selection: Public Service Motivation or Wage? . . . 15
  - 2.2.4 Interim conclusion: Public-private labour and wage differentials . . . 17
- 2.3 On the Dutch (public) wage system . . . 17
  - 2.3.1 A brief history of the Dutch public wage policy: Towards normalisation and competition . . . 17
  - 2.3.2 Current Dutch public wage policy: The reference model . . . 19
  - 2.3.3 Other instruments: The broader legal framework . . . 20
  - 2.3.4 Interim conclusion: Dutch public wage policy . . . 21
- 2.4 Concluding notes: Answering the first sub-question . . . 21

3 Analysis Specification 23
- 3.1 Explanation and hypothesis . . . 23
- 3.2 Econometric methods . . . 23
  - 3.2.1 The public-private wage gap . . . 24
  - 3.2.2 A ”back-of-the-envelope” calculation: The impact of the wage gap on sectoral job mobility . . . 27
- 3.3 Data . . . 28
  - 3.3.1 Points of attention . . . 28
  - 3.3.2 Overview of obtained data . . . 30
  - 3.3.3 Data preparation . . . 31
- 3.4 Model Specification . . . 34

4 Wage Gap Estimation 39
- 4.1 Basic statistics and trends . . . 39
- 4.2 The adjusted public-private wage gap . . . 41
  - 4.2.1 Regression model estimates . . . 42
  - 4.2.2 Wage gap estimates . . . 44
- 4.3 Robustness analysis . . . 46
  - 4.3.1 Basic definition of wages . . . 46
  - 4.3.2 Narrow definition of the public sector . . . 47
  - 4.3.3 Exclusion of yfte weights . . . 47

4.4 Concluding notes: Answering the second sub-question . . . 49

5 Sectoral Job Mobility Analysis **51**
5.1 Sectoral job mobility analysis . . . 51
5.2 An application to occupation shortages . . . 53
5.3 Concluding notes: Answering the third sub-question . . . 54

6 Discussion **55**
6.1 Interpretation of the findings . . . 55
6.2 Relevance of the study . . . 56
6.3 Limitations of the study . . . 57

7 Conclusion **61**
7.1 Answering the research questions . . . 61
7.2 Relevance and contributions . . . 63
7.3 Recommendations for the Ministry of Finance . . . 64
7.4 Avenues for future research . . . 65

A Literature review process **75**

B Detailed construction of the Oaxaca-Blinder decomposition **77**

C Details of data preparation **83**

D Details of wage gap estimation results **93**
D.1 Basic statistics and trends . . . 93
D.2 The public-private wage gap . . . 95

E Details of sectoral job mobility results **99**
E.1 Sectoral job mobility analysis . . . 99

List of Figures

2.1 Collective labour agreement wage development 19

3.1 Graphical representation of the three-folded public-private wage gap equation 26

4.1 Total raw wage trend 41
4.2 Raw wage trend splitted on quantiles 41
4.3 Raw wage trend splitted on gender 42
4.4 Oaxaca-Blinder decomposition of the public and private sector wage gap 44
4.5 Oaxaca-Blinder unexplained wage gap splitted by personal characteristics 45
4.6 Oaxaca-Blinder unexplained wage gap along distributions 46
4.7 Robustness check: Basic definition of wages 47
4.8 Robustness check: Narrow definition of the public sector 48
4.9 Robustness check: Unweighted OLS regression 48

5.1 Correlation heatmap between wage gap estimates and sectoral shift balances 52
5.2 Correlation heatmap between wage gap estimates and sectoral shift balance for the Healthcare and ICT education field 54

D.1 Gini coefficient of the public and private sector 95
D.2 Correlation heatmap of regression variables 96

List of Tables

1.1 Research approach . . . 5

2.1 Methods applied to measure the public-private wage gap . . . 12

3.1 Results of data preparation from the original dataset to the merged and filtered (final) dataset . . . 33
3.2 Overview of all included variables . . . 36

4.1 Summary statistics overview . . . 40
4.2 Regression coefficients of the weighted OLS estimation . . . 43
4.3 Oaxaca-Blinder unexplained wage gap splitted by education field . . . 46

5.1 Summary statistics of the public sector and shifters for 2021 . . . 52
5.2 Wage gap estimates and shift balance for the Healthcare and ICT education fields . . . 53

A.1 Search strategy . . . 75
A.2 Literature review process . . . 76

C.1 Results of limiting all datasets to only individuals active in the labour market . . . 84
C.3 Overview of all included variables of Gbapersoontab dataset . . . 84
C.2 Overview of all included variables of Spolisbus dataset . . . 85
C.4 Results of the data preparation for the education dataset (Hoogsteopltab) . . . 86
C.5 Overview of all included variables of Hoogsteopltab dataset . . . 87
C.6 Overview of all included variables of Betab dataset . . . 88
C.7 Results of merging datasets with the so-far merged dataset . . . 89
C.8 Results of exclusions from merged dataset towards the final dataset . . . 90
C.9 Amount of individuals shifting per year . . . 91

D.1 Full summary statistics . . . 93
D.2 Regression coefficients of the WLS model . . . 95
D.3 VIF scores for the public and private sector for 2021 . . . 97
D.4 Estimation of wage differentials, with a breakdown by unexplained gap (public- and private advantage), explained gap and total gap . . . 97

E.1 Full summary statistics of the public sector and shifters for 2021 . . . 99

1

Introduction

The labour market is a topic of significant interest to individuals, economists, and policymakers alike. As people spend a considerable amount of their lives engaged in labour, it is an essential aspect of society (Borjas, 2015). In the Netherlands, the average person spends around 42.5 years of their life in the labour market, with 72.2% of the population currently active in the labour market and working an average of 32.1 hours per week (CBS, 2022a; Eurostat, 2022; Ministry of Finance, 2022). As Ehrenberg et al. (2021) notes, "the employment relationship attracts a good deal of attention as one of the most fundamental relationships in our lives". Economists, in particular, are interested in labour economics, the study of the exchange of labour services for wages, which encompasses a broad range of topics, including labour supply and demand, wage determination, and the role of labour policy in promoting employment and income redistribution (Cahuc et al., 2014). Understanding the fundamentals of labour economics is essential to comprehending a wide range of social problems and developing effective policy (Ehrenberg et al., 2021). This in turn underscores its importance to policymakers, as the labour market is intertwined with major societal issues such as wealth, unemployment, and income inequality. To quote labour market professor Ton Wilthagen about Dutch society, "We have several very large challenges ahead: the housing market, energy transition, care, education, you name it. You are not going to solve any of those problems without people. The labour market is society's Achilles' heel." (NOS, 2022a). The Dutch government puts emphasis on labour market policy, recognising that effective policy is essential for the proper functioning of the labour market (Ministry of Finance, 2022).

The government is paying more attention to the labour market due to economic, socio-demographic and technological developments. The labour market is affected by factors such as globalisation, technological change and demographic shifts (Frey et al., 2017). To adapt to these changes, public policy plays a crucial role. An exemplary issue is the ageing Dutch population, which leads to labour shortages and increases the pressure on those still working to support them (European Commission, 2022). The Dutch Scientific Council for Government Policy (WRR) has warned of a serious shortage that will continue to increase (WRR, 2021). To address this, the government has implemented several policy directions, including direct financial measures such as cutting back on healthcare services and providing extra funds for higher wages for healthcare personnel (AD, 2021; NOS, 2022d). Indirect measures include conducting research into possible applications of technology in healthcare and making healthcare-related studies more attractive (Gupta strategists, 2022; NOS, 2021b).

Labour market policy aims to improve the efficiency of the labour market and address any market failures or negative social consequences that may arise from inadequate regulation of the labour market (CPB, 2016b). As part of its public responsibility, the government provides various services to society, from care and education to income redistribution through taxes, subsidies, and allowances. People are needed to provide these services and, for this, the government acts as an employer. In fact, the government is the largest employer in the Netherlands (CBS, 2021a). The above-mentioned example shows that various developments can lead to undesirable situations in which the government must act to secure its goals. For instance, a shortage of healthcare workers can hinder the government's ability to provide adequate public services. The government has various tools at its disposal, each with its advantages and drawbacks. For example, raising wages can have an immediate effect, while implementing technology in healthcare may take years (Gupta strategists, 2022).

At present, the Dutch government is grappling with significant tightness in the labour market, resulting in acute labour shortages in public sectors and with severe implications for the provision of public services to society (FD, 2023a; NOS, 2022c). The labour market tension, indicated by the ratio of job vacancies to the number of unemployed people who could potentially work, rose from 0.41 in 2020 to 1.43 in 2022, following the reopening of the Dutch economy after COVID-19 lockdowns (CBS, 2022c). This implies that there are more job openings than there are people to fill them. The shortages are concentrated in certain public sectors, such as healthcare, education, and technical professions (NOS, 2022b). The impact of these shortages on the provision of public services to Dutch society is significant. In the case of healthcare and education, the effect is self-evident. For technical professionals, the shortage is also disastrous for the delivery of vital services to Dutch society (AG Connect, 2022b). A survey involving 52 government organisations reveals that a scarcity of technically skilled workers leads to stalled projects and consequent social disruption.

The shortage of technically skilled personnel in the Dutch tax authorities provides a striking example of how it can disrupt the provision of public services. The tax authorities are responsible for collecting taxes from taxpayers and heavily rely on IT systems to carry out their tasks. The Dutch tax authorities suffer from a huge shortage of technically skilled personnel (AG Connect, 2022a). This shortage makes it impossible to innovate their outdated and fragmented ICT landscape (FD, 2023b). This problem is so severe that no tax changes can be implemented during the current government term of four years, as State Secretary of Finance, Van Rij (2022), informed the House of Representatives of the Netherlands. Labour market professor Ton Wilthagen also has a few things to say about the major IT problems at the tax authorities, ”If IT does not work properly, social disruption, uncertainty and legal inequality arise. The IT of the government plays a crucial role. If this does not work, you undermine legal order and legal certainty for citizens. That is no small matter.” (AG Connect, 2022b).

The labour market shortages lead to a plethora of headlines and cry for distress, necessitating effective policy interventions. For instance, 2022 has been dubbed ”the year of workforce shortages,” with experts warning that the shortages are disrupting society at large (NOS, 2023b). Moreover, Social-Economic Council (SER) crown member Bas ter Weel, in an interview with the FD (2023a), has issued an alarming message that the public sector is on the verge of collapse, necessitating strategic labour policies. Indeed, several researchers and policy experts have emphasised the need for strategic policy and choices to combat shortages. The government faces a daunting challenge as both policymaker and employer, requiring them to devise ways to attract more people to work in the labour market in general and to incentivize them to work in the public sectors where shortages are particularly acute (CPB, 2011; NOS, 2022a). The Work Regulation Committee, a committee set up to identify policy options for labour market problems, has identified multiple policy options mostly aimed at stimulating labour market participation (The Work Regulation Committee, 2020). Financial incentives, such as wage policies, have been commonly used by the government to allocate labour across sectors. For instance, in 2022, healthcare personnel received an extra 1.5% in wages relative to other sectors due to the shortages and the high workload (AD, 2021). Such wage policies, focused on financial incentives, lend themselves well to responding to crises in the short term.

However, wage policy is not only important for short-term crisis resolution but even more so for long-term effective policy. After all, the challenge of steering the labour market, creating an efficient allocation of labour across sectors, and securing a sufficient workforce to guarantee public services is a constant challenge. This may prevent the allocation problems encountered today. To return to a previous example; for the Dutch tax authorities, low salaries for higher positions are rigged up as a problem for the shortage of ICT managers, ”They would like to earn more than the salary scale that the government now offers” (AG Connect, 2022b). Public wage policy, aimed at offering adequate wage levels in the public sector relative to the private sector, is an important mechanism in this respect as the Dutch government has a direct influence on the level of public wages (Bradley et al., 2017). However, the allocation of employees across sectors is an interesting issue regarding public wage policy. Economically speaking, the labour market inherently is a unique market characterised by rigidities and tightness on both the supply and demand sides (Ehrenberg et al., 2021). The government wants to attract enough staff to secure its services, which argues for higher wages in sectors where the need is greatest (NOS, 2022a). At the same time, as the labour market is a scarce market, too high wages in the public sector can disrupt market forces. This in turn argues for comparable wages in the public and private sectors (CPB, 2016b). Nonetheless, allowing public wages to deviate from private wages may be justified, and wage differentials do not necessarily lead to a move towards the public or private

sector, as both providers and demanders of labour may have different motivations (Taylor et al., 2011). For example, one worker may value earning money, while others value helping people, and companies may have a profit maximisation motivation, while the government may have different motives (Melly, 2005).

This research focuses on analysing the Dutch public wage policy, which, as we will see, aims to set competitive wages for public sector workers in comparison to their private sector counterparts. Competitive wage-setting entails determining appropriate wages based on factors such as human capital, job conditions, market conditions, and competition (Borjas, 2015). Competitive wage-setting in the public sector thus involves offering comparable salaries to employees based on their qualifications and skills relative to what they could earn in the private sector. Both excessively high and low wages in the public sector are considered non-competitive and can have negative consequences. The primary focus of this research is to examine the Dutch government's reference model, the main instrument for the implementation of the Dutch public wage policy, comparing the government's policy with the actual wage disparities observed between the public and private sectors. The report aims to establish connections between theoretical explanations of wage differences, the government's stance on its public wage policy, observed public-private wage disparities, and their impact on employee allocation across the public and private sectors.

1.1. Research problem

Exploring the Dutch wage policy, specifically, the determination of adequate public wages in relation to private wages, is in several aspects an interesting exercise that can bring added value. These aspects can roughly be divided into two separate parts: the policy aspect and the scientific aspect. Both aspects contain research problems, shortcomings in current policy or scientific knowledge that this research addresses. These research problems are specified below for both aspects. Subsequently, a research problem is formulated that combines the policy and scientific aspects. The research problems follow from the theoretical background of Chapter 2 - this can be considered a brief summary.

Policy aspect: There has not been a quantitative evaluation of the Dutch reference model

The Dutch government's public wage policy is largely based on the reference model, which determines the yearly public wage development. The government has a rationale behind this policy as it plays an important role in attracting and retaining qualified workers in the public sector, which competes with the private sector for labour. There are different rationales with varying reasons on how to approach this competition. Although the Dutch government has never explicitly stated its rationale, it appears to aim to offer comparable wages in the public sector relative to the private sector. This rationale would translate into a public wage policy setting competitive public wages. To achieve competitive wage-setting, the government has the reference model in place.

However, this reference model has never been evaluated, leaving important questions unanswered. Such as "Are public sector wages, in reality, competitive to private sector wages?", "For which groups of employees is this the case or not?", And, "Could this be a source of shortage issues?". Answering these questions is essential for evaluating whether the current Dutch public wage policy is effective and whether wage disparities are contributing to labour shortages. For several decades now, evidence-based policy-making and evaluation have been considered increasingly important in shaping good policy (van Veenstra et al., 2017). Sanderson (2002) recognises two forms in which evaluation supports policy-making: i) promoting *accountability* and looking for evidence that policy is working effectively, and ii) promoting *improvement* and looking for evidence that policy interventions would promote policy effectiveness. Both are important and often the second follows the first form.

This report serves as a policy evaluation that attempts to answer the arising questions by using data on wages in the public and private sectors to analyse public-private wage differences. This evaluation mainly concerns testing the effectiveness of the Dutch reference model, the first form of policy evaluation described by Sanderson (2002). Policy scholars underline that such data-driven policy evaluation increases the legitimacy of the policy pursued and that it leads to better policy (e.g. van Veenstra et al., 2017).

Ensuring good policy, and perhaps even better policy, is crucial for the proper functioning of the labour market and preventing labour shortages and associated social problems. The reference model plays a key role in Dutch public wage policy, with its correct functioning being critical in attracting

skilled personnel to the public sector. Evaluating the reference model is an essential first step towards improving the Dutch public wage policy and ensuring its effectiveness. The scientific domain may hold answers to the questions arising from this policy aspect.

> **Scientific aspect:** Little attention is paid to the measurement of public-private wage differences in the Netherlands

There has been an abundance of research on public-private wage differentials (e.g. Biesenbeek et al., 2019; Michael et al., 2020) - in the scientific field mostly under the heading of the public-private wage gap. The question of whether public wages are competitive to private wages has arisen in labour economics since the 1970s and remains topical and interesting due to the evolving labour market and the emergence of new econometric methods.

Research on the public-private wage gap underlines the challenge of identifying genuine earnings differences between public and private sector employees due to the heterogeneity of the individuals working in these sectors (Depalo et al., 2015; Makridis, 2021). One ought to compare person *A* with a certain background *X*, with person *B* with background *Y*. To tackle this challenge as well as possible, several different methods are applied. This leads to discord in the results of much quantitative research on the public-private wage gap (Christofides and Michael, 2013). Too often, little attention is paid to this challenge in the Netherlands.

This report supplements this research problem in two ways. First, it maps out the challenges and different methods, providing a substantial explanation of the issues and methodologies. Second, it applies novel data and a novel method to the Netherlands. This research applies proven methods using rich and reliable administrative data, which includes every employee in the Dutch labour market. The method takes into account the characteristics of the Dutch economy, including the emerging trend of part-time workers and (public) sector-specific jobs. The impact of these adjustments is tested by means of robustness analyses.

By providing a comprehensive explanation of the issues and methodologies, and by performing a sound methodological application using novel data and methods, this report aims to enrich the scientific literature on the public-private wage gap. It has been a while since such a level of detail has been applied, and there is still no uniformity in best practices regarding methods and data. A sound scientific analysis could potentially serve the needs of the policy aspect.

> **Combined aspect:** Scientific research on public-private wage differences is to a limited extent related to public wage policy

The questions mentioned within the policy aspect are ideal to answer with wage gap research. The question of whether wages in the public sector are competitive to those in the private sector, and for whom, has been heavily explored by economists analysing the public-private wage gap.

However, most research ends there - almost no attention is paid to the implications of this wage gap research on the labour market, or how this relates to policy. The scientific domain on public-private wage differences feels somewhat like an ivory tower, in which limited relationships are established between scientific outcomes and policy implications. Barring a few exceptions, the link to actual policy is limited (e.g. Michael et al., 2020). For instance, little research has been conducted on the subsequent question posed above on whether wage differentials between the public and private sectors could be a source of sectoral shortage issues. Most wage gap researchers assume this causal relationship without any research on this specific topic (e.g. Bonaccolto-Töpfer et al., 2022).

A missed opportunity since wage gap estimates are a textbook example of evidence-based research, which can be of great added value for the policy aspect (van Veenstra et al., 2017). This way, scientific research on the public-private wage gap could closely serve the needs of the policy aspect for an evaluation of public wage policy.

This can be seen as a third research problem in which the scientific and policy aspects come together. In this report, a serious attempt is made to relate the scientific analysis to the policy needs for a quantitative evaluation of the reference model as part of the Dutch public wage policy. This is important for both aspects because it not only provides a policy evaluation for the policy aspect but also provides an impetus for the scientific aspect to relate outcomes to policy.

1.2. Research questions

To address the research problems raised, the following main research question has been formulated:

> *How does the Dutch public wage policy translate into public-private wage differentials and sectoral shifts?*

To answer this research question, the research approach shown in Table 1.1 is applied. The research question is answered by employing three sub-questions. These sub-questions are answered in the indicated chapter. A discussion, linking the outcomes of the analysis with Dutch public wage policy, follows in the discussion of Chapter 6 and a concrete answer to the main question follows in the conclusion of Chapter 7.

Sub-question	Method	Keywords	Chapter
SQ1: *What are the rationales of the Dutch government for wage differentiation between public and private wages?*	Literature review	Wage theory; Wage gap research; Sectoral mobility; Dutch public wage policy; Reference model	2
SQ2: *To what extent do public and private sector wages differ for the period 2010 to 2021?*	Econometric analysis	Public-private wage gap; Regression; Oaxaca-Blinder decomposition; Quantile decomposition	4
SQ3: *To what extent can the public-private wage differentials explain labour market shortages?*	Econometric analysis	Sectoral mobility; Correlation; Shortages; Healthcare; ICT	5

Table 1.1: Research approach

1.3. Research relevance

This research is relevant in several aspects, which are discussed below. First, the scientific and societal relevance are described. Subsequently, the relevance with regard to the master study of which this thesis forms part, Engineering and Policy Analysis (EPA), is discussed. Finally, the relevance of the Ministry of Finance, the party for which this study is conducted, is described. Despite the fact that a ministry is naturally linked to societal relevance, the ministerial relevance focuses more on how this research helps the ministry specifically.

Scientific relevance

This study utilises administrative data to assess the wage gap between the public and private sectors, utilising detailed microdata from *Statistics Netherlands* (CBS). This study stands out due to its use of comprehensive administrative data, which covers nearly five million workers in the most recent year. This is in contrast to most studies that rely on survey data with a smaller number of respondents, and which is prone to measurement errors. The use of large amounts of data is becoming more popular in labour economics, and this study demonstrates both the possibilities and challenges that arise from this approach (Heckman et al., 2008; Horton et al., 2015). It can serve as a starting point for future research that seeks to utilise administrative data and identify potential issues that require attention when utilising administrative data.

Also, this study addresses the challenge of accurately measuring the Dutch public-private wage gap, which has received little attention despite numerous studies on the subject. This study aims to fill this gap and provide a more comprehensive review of the literature. It is among the first studies in the Netherlands to analyse the wage gap across the income distribution and respond to recent developments in the labour market, such as the growth of flexible part-time work. As such, this study provides future research with information to address measurement issues and possible tools to incorporate labour market developments.

In addition, this study is one of the few that provides policy advice based on observed public-private wage gap estimates. Being the first quantitative evaluation of the Dutch reference model, this research is both scientifically relevant and informative for policymakers. It encourages future research to also identify policy implications that arise from public-private wage gap estimates.

Societal relevance
The societal relevance relates to the ”grand challenge” of effective public wage policy, and with it, an effective organisation of the labour market. Since most individuals spend a significant amount of their time working, improving the organisation of the labour market can benefit a large number of people in society. By quantitatively evaluating the reference model, this study offers insights into the functioning of the Dutch public wage policy and provides policy recommendations for its improvement.

Moreover, the constantly evolving Dutch labour market, and recent labour market shortages, make it all the more relevant to assess the Dutch public wage policy. This study covers the period between 2010 and 2021, which includes significant events such as the global economic crisis since 2008, the euro crisis of 2010, years of steady growth, and the ongoing impact of the corona crisis (NOS, 2017). The growing labour shortage in the Netherlands is a recent development that adds to the significance of this research at this particular moment (NOS, 2023b). In times of scarcity, the issue of competitive wage-setting and efficient allocation becomes even more critical. This study bridges the gap between public-private wage differentials and possible shortages in public sectors. The government aims to establish a ”fair” society, and competitive public wages are crucial to achieving this goal.

Masters' relevance
The Engineering and Policy Analysis (EPA) masters' programme is focused on addressing ”grand challenges” - wicked problems in a complex, dynamic environment and in need of better policy-making (de Bruijn et al., 2018). According to the EPA master's thesis guidelines, research should evaluate decision-making quality regarding grand societal challenges in the context of the socio-economic and political environment. This study of public-private wage differentials, sectoral job mobility, and potential labour shortages fulfils each of these requirements.

The grand challenge of implementing effective public wage policy and efficient labour allocation across sectors is an ever-present issue. However, it becomes even more critical in times of tight labour markets, as is currently the case. Hence, taking an analytical perspective on evaluating policy is ideal for addressing this challenge in the context of an EPA study. Combining analytical skills with sound theoretical and socio-economic/political understanding, this research, facilitated by both data analysis and econometric analysis, aims to evaluate current policy and provide policy advice to improve decision-making quality (Ehrenberg et al., 2021). Data-driven policy-making is expected to lead to better policy and increased legitimacy. Additionally, as Wooldridge (2015) notes, econometric analysis is frequently used to evaluate policy.

Ministerial relevance
For this study, an internship is performed at the Dutch Ministry of Finance, specifically in the Directorate of Financial and Economic Policy (AFEP). The ministry's role is to ensure the financial stability of the Netherlands, it is responsible for budgeting and financial and economic policy-making, including the preparation of the annual Budget Memorandum and national budget (Ministry of Finance, 2023). AFEP is involved in all financial and economic policy-making activities, advising ministers and senior management on current economic policy issues and considering their broader effects on the economy, market, and society, covering both expenditure and income.

This study is of interest to the ministry for two reasons. First, the ministry and the AFEP department are interested in the public-private wage differential as they have considerable control over the budget allocated for public wages. The Ministry of Finance wants to ensure that civil servants receive efficient wages and are not ”overpaid”. Thus, research into public-private wage differentials directly relates to their primary responsibility of establishing an efficient public wage budget (CPB, 2016b). Second, the use of large and reliable data sources in financial and economic policy-making is becoming increasingly important and is believed to improve the quality of policy-making (van Veenstra et al., 2017). The ministry considers the application and analysis of large amounts of data crucial to this end. The creation of a powerful source of broad and detailed data on wages, socio-demographics and educational backgrounds provides insights into a wide range of issues, including upcoming trends, such as age development and general mobility. Additionally, the data and methodology could be used to understand wage inequality more broadly, including differences between men and women or by origin. This research serves as a foundation for further research into labour market policy.

1.4. Report outline

The report consists of six additional chapters. Chapter 2 provides a theoretical foundation that covers wage determination, public-private sector differences, measurement of the public-private wage gap, and the impact of wage differentials on the choice of the public sector. More importantly, it describes the Dutch public wage policy, with a short historical description, and with more attention to the reference model specifically and to the broader legal framework. Chapter 3 describes the analysis specifications, including the applied methodology, and the collected and prepared for the quantitative analysis. Chapter 4 presents the results of the public-private wage gap analysis, including basic statistics and trends, wage gap estimates, and robustness analysis. In Chapter 5, the wage gap estimates are used to examine its effects on sectoral job shifts, particularly for healthcare and ICT occupations, which are experiencing severe labour market shortages. Chapter 6 discusses the relevance and implications of the results on Dutch public wage policy. Finally, Chapter 7 answers the research question, identifies limitations, and suggests future research directions.

2

Theoretical Background

This chapter provides theoretical background on public wage policy and its rationale, answering the first sub-question: ”What are the rationales of the Dutch government for wage differentiation between public and private wages?”. Broad literature is used to examine what rationales the government has for determining its public wages compared to private wages. This is done based on three parts: 1) wage determination theories are described, 2) reasons for and empirically observed public-private sector wage differences are described and compared to sectoral mobility, and 3) the Dutch public wage policy and its rationale, with its established reference model, are described. This chapter is accompanied by Appendix A, in which the literature review process is explained.

2.1. Wage determination theories

This section covers four well-known wage determination theories. While these theories may not provide a direct answer to the research question posed, they do inform our understanding of why wages might differ and what underlying thoughts are present in calculations of public-private wage gaps. This section covers four well-known theories, briefly summarising the theories' characteristics, mindset and application without delving into their precise operation.

2.1.1. Supply and demand theory

Supply and demand theory is a fundamental principle of economics that is commonly associated with classical economics. This theory asserts that wages are determined by the balance between the supply of labour, the number of people willing to work, and the demand for labour, the number of job openings. Classical economics is a school of thought that emphasises the role of market forces in determining economic outcomes. It proposes that prices (wages in the labour market) are determined by the interaction of supply and demand in markets and that markets tend to reach a state of equilibrium where the quantity of goods and services (labour in the labour market) produced is equal to the quantity demanded (A. Smith, 1887).

Despite not being explicitly mentioned in studies of public and private wages, the supply and demand theory is often underlying current theories and thinking. For instance, this theory helps explain the hypothesis that higher wages in the public sector are the result of labour market shortages, where the demand for labour exceeds the supply of labour. In this situation, a higher wage setting would bring balance to the demand and supply of labour, thus restoring equilibrium.

2.1.2. Bargaining power theory

The theory of bargaining power is closely related to the supply and demand theory and is often linked to classical economics. It focuses on the role of workers' and employers' relative bargaining power in determining wages. If workers have more bargaining power, they can negotiate higher wages, while employers with more bargaining power can negotiate lower wages (Galbraith, 1967).

This theory is more often used in studies of public and private pay differences (e.g. Keith Bender et al., 2002). For example, some researchers have found that public sector bargaining structures, the presence of strong labour unions in the public sector, lead to higher public wage premiums (e.g. Bell

et al., 2007; Bonaccolto-Töpfer et al., 2022). Others argue that union wage premiums, which give a higher wage to those who are members of a union, are typically lower in the public sector than in the private sector due to the government's strong bargaining power, particularly for jobs that only exist in the public sector (e.g. Disney, 2007). Workers in these jobs have no choice but to work in the public sector, which weakens their bargaining position. Although these findings are not directly consistent, they do show the potential importance of wage bargaining in wage setting.

2.1.3. Efficiency wage theory

Efficiency wage theory suggests that companies may pay more than the usual market rate to motivate their employees to work harder and be more loyal, which can increase overall productivity (Shapiro et al., 1984). This theory is often connected with Keynesian economics because it focuses on the connection between worker productivity and wages. However, Westley et al. (2006) argued that efficiency wage theory is not traditionally part of Keynesian economics, but forms an aspect of New- and Post-Keynesian Schools of thought that explain market imperfections.

This theory is little referred to in comparison to the wage bargaining theory. Though, this theory could explain the difference in wages. For example, Krueger (1988) said that offering higher wages to public sector employees can boost morale and result in better employee selection. However, it's also argued that other factors, such as Public Service Motivation (PSM), the internal motivation to work in the public sector and to contribute to society, are more important (J. L Perry et al., 2008; Taylor et al., 2011).

2.1.4. Human capital theory

According to the human capital theory, employees with more education, training, and experience tend to earn more money than those without because they have more valuable skills and knowledge that they can bring to their jobs (Melton, 1965). This theory is often linked with neoclassical economics, which is a branch of classical economics that puts a lot of emphasis on individual decision-making when it comes to economic outcomes. Within the human capital theory and wage determination, special attention should be given to the Mincerian equation. This equation is a mathematical formula that explains how wages are determined by taking into account a person's skills, knowledge, and experience. This Mincerian equation, in its simplest form, is defined as:

$$W_i = Z_i\beta + u_i \tag{2.1}$$

where W_i is the hourly wage of worker i, Z_i is a vector of individual characteristics, β is a vector of coefficients, and u_i is a disturbance term (Mincer, 1974).

The Mincerian equation, and the human capital theory behind the equation, have become a standard tool in the study of labour economics and have been the basis for much wage determination and wage gap formulas. Many researchers have used it to create wage equations for different groups of people (e.g. Keith Bender et al., 2002; Biesenbeek et al., 2019; Christofides and Pashardes, 2002; Michael et al., 2020). The Mincerian equation is also an important part of the Oaxaca-Blinder equation, which is widely used to study the differences in wages between different groups of people (Oaxaca, 1973). Overall, the human capital theory and the Mincerian equation are very important when it comes to understanding of how wages are determined.

2.1.5. Interim conclusion: Wage determination theories

The discussed theories provide a theoretical framework for wage setting. They do not advocate for a specific public wage policy but support systems of thought underlying wage-setting policy. Supply and demand theory supports a competitive wage-setting with the private sector, as too low public wages would lead to an insufficient supply of labour in the public sector. As the private and public sectors are competing for the same pool of workers, workers will opt for the private sector if public wages are insufficient. Wage bargaining theory allows for higher or lower wages depending on the bargaining power of the government or the public/private sector union. Efficiency wage theory could explain higher wage settings in either the public or private sector to increase employee loyalty and productivity. The human capital theory advocates for wages based on employee skills, with public and private "equals", comparable in terms of relevant experience and education, receiving comparable pay. These theories often inform research approaches and pursued policies. They will be referenced in the remainder of this report when applicable.

2.2. Public-private labour and wage differentials

While the above-mentioned theories give rise to a certain public sector wage determination, the extensive literature may show a different picture for reality. This section explores wage disparities between the public and private sectors and is divided into three parts: 1) qualitative reasons for public-private wage differences, 2) an overview of existing research on public-private wage differentials, and 3) a focus on public-private sector selection with a particular emphasis on the role of wages and Public Service Motivation as determinants of employment in the public sector.

2.2.1. Reasons for wage disparity

In theory, human capital suggests that people with equal jobs in the public and private sectors should earn the same. However, in reality, this may not be the case. There are various reasons why public and private sector wages could differ. This can be explained by examining the goals and constraints of these sectors.

Private-sector firms, unlike public-sector organisations, are driven by profit maximisation, which leads them to offering wages that are ”efficient” and reflect workers' productivity (Sławińska, 2021). Private sector employers who prioritise goals other than efficiency, such as being a ”good” employer, may eventually lose competitiveness in the market (Melly, 2005). This profit maximisation is in line with supply and demand theory and human capital theory (Melton, 1965; A. Smith, 1887). The wage is equal to the marginal product of labour, meaning that if employees demand too high a wage, demand will shrink and unemployment will rise (Keynes, 1937). Similarly, if wages are too low, the supply of labour will decrease. Of course, there are exceptions to this, as we are not in a perfect market, examples are given by the wage bargaining theory. Nonetheless, this does show the mindset of the market agents and explain the observed behaviour of both employees and private-sector employers (Fontaine et al., 2020).

This does highlight the importance of adequate wage levels in the public sector as employees would otherwise opt for the private sector. However, public sector wages are influenced by factors beyond efficiency and profit constraints, known as political constraints (Fogel et al., 1974). These political constraints can best be summarised by four components: budgetary constraints, macroeconomic performance and stability, redistribution of resources, and satisfying interest groups for electoral gains (Fontaine et al., 2020). First, the government must manage public salaries efficiently to maximise social welfare. The available budget forms the most apparent constraint, especially during economic hardship (Bender, 1998). As such, Southern European countries had to apply wage cuts to meet EU and IMF conditions for financial support (Biesenbeek et al., 2019; Michael et al., 2020). As we will see, this can seriously limit wage growth in the public sector. Second, achieving optimal macroeconomic performance and stability remains one of the most significant economic objectives of the government, and public wage policy can play an important role in this (Lamo et al., 2013). If the wages offered in the public sector surpass those in the private sector, individuals may opt for higher-paying public sector positions instead of private sector roles that may be crucial for economic growth (Krueger, 1988). Third, public wage policy can be a tool for combating inequality, the government presenting itself as a ”good” employer and incentivising the private sector to follow (Lausev, 2014; Melly, 2005). For instance, by providing ample compensation to low-skilled personnel and offering good maternity leave schemes, the government sets the tone and, as private sector counterparts compete for the same employees, they must adapt to this. Fourth, less commonly acknowledged, but also claimed by some, is that governments can also attract voters through their public policy (Matschke, 2003). As a consequence of these constraints, public-sector labour markets might behave differently from their private-sector counterparts.

2.2.2. Towards the ”adjusted” public-private wage gap

This section addresses empirical research on the question of whether public and private wages are comparable in reality. It appears not to be the first time this question has been posed. In fact, there exists a great plethora of research on the public-private wage gap - the first studies dating back to the 70's (e.g. Fogel et al., 1974; S. P. Smith, 1976). I dare not venture to give a comprehensive overview.

Rather, this section is written towards the ”adjusted” wage gap, the wage differential that cannot be accounted for by personal characteristics and capabilities and that reflects the real wage difference between the public and private sector; the wage differential that is due to differences in the way people are

valued or paid. This ”adjusted” wage gap reflects whether public sector wages are really comparable to private sector wages. It first attempts to discuss some issues and possible methods to address these issues, after which it discusses observed wage differences in the Netherlands. This section employs a concise table to provide structure. Table 2.1 lists the most prominent methods used to estimate the public-private wage gap, along with relevant contributors and a brief summary of their pros and cons.

Methodology	Relevant studies	Pros	Cons
Raw wage gap: mean comparison without covariate controlling	Bonaccolto-Töpfer et al., 2022 Ernest Berkhout et al., 2013 Heitmueller, 2006	Straightforward application	Selection bias; Omitted variable bias
Standard regression: single OLS with public/private sector dummy	Blackaby et al., 2018 Berkhout et al., 2006	Straightforward application	Assumes similar pay structures; parameter homogeneity among sectors; Selection bias
Oaxaca decomposition: separate OLS for each sector to find the mean	De Castro et al., 2013 Ernest Berkhout et al., 2013 Oaxaca, 1973	Allows different pay structures; Intuitive interpretation	Selection bias; Only mean estimates
Quantile regression decomposition [1]**:** division into quantiles to estimate multiple OLS	Michael et al., 2020 Chernozhukov et al., 2013 Canay, 2011 Machado et al., 2005	Decomposition beyond the mean	Hard to match end-of-distribution observations
Switching regressions: model sector choice	van Ophem, 1993 Hartog et al., 1993 Dustmann et al., 1998	Deals with selection bias	Needs complex data
Propensity score matching: Match ”similar” public and private sector individuals and compare on ”treatment”	Heyma et al., 2010 O'connell, 2009 Gibson, 2007 Ramoni, 2004	Non-parametric technique	Large part of control group left-out; different interpretation

Table 2.1: Methods applied to measure the public-private wage gap

The issues in measuring the wage gap

Identifying the ”adjusted” wage gap between public and private sector employees is challenging due to two issues: heterogeneity among workers' characteristics, and the ability to decompose the wage gap beyond the mean. To deal with these issues, different methods are proposed, leading to differences in, and sometimes contradictory, outcomes. The magnitude of the wage gap varies substantially depending on the explanatory variables used, the way variables are specified, the particular sub-sample analysed and the statistical methodology used in the estimations (Flannery et al., 2018). But, issues on rightly measuring the public-private wage gap were addressed earlier already. As Lee (2004) rightly pointed out, most have ignored the issues of unobserved heterogeneity among workers.

Heterogeneity refers to observed, and unobserved, differences in characteristics of individuals and their rightful wage. Heterogeneity pertains to differences in the quality of the employee, but it is extremely challenging to measure the quality of the employee that justifies his or her wages - being aware of this heterogeneity and trying to incorporate characteristic differences is important (Rattsø et al., 2020). Rattsø et al. (2020) showed there is a large variation dependent on education level, geography and gender. Others also account for the field of education, occupation, or age (e.g. Bonaccolto-Töpfer et al., 2022; Makridis, 2021). The exclusion of important variables to measure the correct wage is also known as omitted variable bias (Biesenbeek et al., 2019). A special characteristic of heterogeneity

[1] There are multiple methods developed on quantile regression, the most prominent being an extension from Oaxaca decomposition and fixed effects regression.

among workers is their internal preference to work in either the public or private sector, and accordingly, the endogenous selectivity of the sector. Workers may have internal preferences and skills, disrupting the random decision of sorting for either the public or private sector (Makridis, 2021). Identifying genuine earning differences, accounting for heterogeneity, is challenging and too simple comparisons could prompt spurious implications for public policy.

To correctly control for heterogeneity, researchers apply novel approaches concerning both methodology and data. As a starter, and perhaps obsolete as development, is the use of micro-data, mainly in the form of survey data instead of macro-data (Lausev, 2014). The main drawback for macro-studies is the inability of worker-specific data, while these have been argued to be crucial for measuring the adjusted wage gap. Micro-studies use individual worker-level data in the Mincerian equation to account for differences in worker and job characteristics between the two sectors (Mincer, 1974). Nonetheless, panel data is now preferred to survey data, as survey data is sensitive to measurement errors (Biesenbeek et al., 2019).

But an even greater focus is on the application of novel methods. Table 2.1 provides an overview. Some studies apply single equation models, including a public sector dummy and OLS estimation - a method prone to both selection bias, parameter bias, and omitted variable bias (Ernest Berkhout et al., 2013; Bonaccolto-Töpfer et al., 2022). To better account for the heterogeneity among workers, many apply a version of the popular Oaxaca-Blinder decomposition (Oaxaca, 1973). The Oaxaca-Blinder decomposition attributes any public- and private-sector wage differentials to either difference in characteristics of workers employed in the two sectors (the explained wage gap) or difference in the way employees are rewarded in the public and private sectors (the unexplained wage gap) (Michael et al., 2020); a line of thinking that has strong ties to the human capital model and also the reason why Oaxaca-Blinder decomposition research apply Mincerian equations. It is this unexplained wage gap that represents the adjusted wage gap and that is of interest from a policy evaluation perspective.

However, the standard Oaxaca-Blinder decomposition only provides information about average differences, while these do not tell the whole story, according to many studies. Belman et al. (2004) investigated the dispersion on the wage distribution and argued that such average differentials fail to measure the adjusted wage comparability. In short, Belman et al. (2004) argued, ”If average earnings in the public and private sectors are identical, earnings need not be comparable. If one-half of the wage distribution gains a public wage premium, while the other half of the distribution receives a public wage penalty, the average differential will be close to zero, suggesting comparability when, in truth, no workers are being paid comparably”. So, statistical measures based on average effects might mask important differences for different subgroups or along the distribution of wages (Hospido et al., 2016). If the wage gap is high for the low-skilled and low or negative for the high-skilled, inefficiencies may be at work at both ends of the wage distribution (Gomes, 2018).

As a resolution to these distribution effects, quantile decomposition methods are proposed. Melly (2006) applied quantile regression decomposition to illustrate the importance of endogenous sector selection - correcting for endogenous sector choice reverses the findings concerning the mean premium but preserves the more compressed structure of the public sector earnings distribution. Other researchers applied fixed effect quantile regression to incorporate both issues (e.g. Bonaccolto-Töpfer et al., 2022; Canay, 2011; Makridis, 2021). Bonaccolto-Töpfer et al. (2022) proposed a progressive approach to quantile regression - a fixed effect quantile regression using panel data. The advantage of fixed effect quantile regression is that it controls for time-invariant unobserved heterogeneity.

But a much larger horde of researchers performs a quantile decomposition regression application of the Oaxaca-Blinder decomposition (e.g. Chernozhukov et al., 2013; Machado et al., 2005; Michael et al., 2020). To this respect, it is noteworthy mentioning (Chernozhukov et al., 2013). Their methodology allows for decomposing the wage gap into characteristics (explained) and coefficients (unexplained) components, as in the Oaxaca-Blinder decomposition. Without getting into details on the exact operation, the method shows some advantages. First, it is a tried-and-tested method, with several articles over multiple decades specifically explaining the method and multiple studies on the wage gap applying the method, though not for the Netherlands specifically. Second, if specified correctly, it largely deals with the heterogeneity issue mentioned. Third, it applies the intuitive Oaxaca-Blinder decomposition to extract the unexplained wage differential - according to the human capital model capturing the adjusted wage gap. This unexplained wage gap is the gap that is interesting from a policy perspective (Michael et al., 2020). Last, also pertaining to the split of the wage gap into an explained and unexplained wage gap, intuitively interpretable results are generated.

The definition of wages

The last unspoken subject to arrive at the adjusted wage gap is the correct definition of wages. By far, most researchers apply log hourly wages as the definition of wages - the standard in Mincerian equations (Mincer, 1974). Applying logarithms of wages allows for measuring ”per cent” changes in wage, an intuitive interpretation (Wooldridge, 2015). Without explaining this, a log-level model is applied that accomplishes this. Almost every study mentioned above uses the log wages (e.g. Biesenbeek et al., 2019; Bonaccolto-Töpfer et al., 2022; Makridis, 2021). However, it is important to maintain a good definition of wages, which also includes financial fringe benefits, such as the payment of a thirteenth month but also a company car or money earned from overtime (Biesenbeek et al., 2019).

Another strand of literature refers to ”lifetime” compensation, taking into account income not only now, but also over the rest of one’s life. Researchers see the lifetime compensation, which includes pensions, as the correct definition of wages. Recent papers attempt to calculate the ”lifetime” wage gap and thereby taking into account all fringe benefits, including pension premia, job security, and workplace practices, such as career opportunities and the level of intellectual stimulation. Makridis (2021) studied the role of fringe benefits and workplace practices, suggesting that differences in workplace characteristics behave as compensating factors behind the differences in pay. Several researchers mentioned the idea that one should measure lifetime values of the wage gap, referring to the commonly known wage gap as the ”naive” wage gap (Bradley et al., 2017; Postel-Vinay et al., 2007). Gomes and Wellschmied (2020) identified the public wage premium over the life cycle using an equilibrium model for the United States, the United Kingdom, France and Spain, finding that job-security and pension premia are important forms of compensation to public-sector workers. The life-cycle public-sector compensation seems substantially larger than estimated by the ”naive” wage premia, increasing from just 9% to 47% for non-college UK government workers, and from 2% to 8% for college US government workers.

However, defining lifetime compensation has its shortcomings. Makridis (2021) only focused on science and engineering graduates, which of course greatly limits the results and conclusions in significance. The equilibrium model of Gomes and Wellschmied (2020) takes limited account of heterogeneity and sector selection, possibly leading to an overestimated wage differential. It is difficult to fully measure lifetime earnings, which means that this ”adjusted” lifetime wage gap would always be prone to omitted variable bias. If one wants to include job security, which is a reasonably qualitative variable, one also wants to include other qualitative variables, such as advancement opportunities, independence or responsibility. Makridis (2021) accounted for these variables and concluded that these characteristics behave as compensating factors behind the differences in pay. Accurate and large-scale measurement of these qualitatively variables requires a great deal of effort and dedication and these variables are not monitored on a large scale and repeatedly by *Statistics Netherlands*.

An application to the Netherlands

Now that all aspects of measuring the adjusted wage gap are discussed, it is time to shine a light on research about the Netherlands. Public-private wage differentials have been of concern in the Netherlands to both policymakers and researchers, resulting in multiple studies, both by scientists on their own and on behalf of government agencies (Biesenbeek et al., 2019). This phenomenon gained first interest after decoupling public and private wages in 1982, resulting in a public sector penalty, especially for younger workers (van Ophem, 1993). In contrast, Hartog et al. (1993), applying the same switching regression model as van Ophem (1993), concluded that both public and private sector employees would earn less if they were to switch sectors. Before this, some researchers also tried to investigate the wage differentials and in which they often observed a public wage penalty (Schippers, 1986; Van Schaaijk, 1986).

Since around the turn of the century, the Ministry of the Interior and Kingdom Relations has regularly commissioned research into public-private pay differences. Zaidi et al. (1998) found an average wage premium of about 10 per cent, though not controlling for worker characteristics. One year after, Alessie et al. (1999) applied a regression model to control for worker characteristics. Most studies afterwards have been carried out by the Economic Research Foundation (SEO), affiliated with the University of Amsterdam, which conducts independent applied research on behalf of government and industry. During 2001-2010, this includes the studies by Berkhout et al. (2004), Berkhout et al. (2006), and Hoogendoorn (2001), all of which applied standard regressions to find that wage differentials varied across different sub-sectors of the public sector.

A more recent strand of SEO reports applied propensity score matching. Under the header ”The wages earned?”, the first report using matching techniques was published in 2010 on behalf of the Ministry of the Interior and Kingdom Relations. Their results showed small wage gaps between most sub-sectors and corresponding ”equals” in the market sector (Heyma et al., 2010). This report indicates that the public wage premium on average deteriorated over the years 1996 to 2005. But when this average is broken down into higher educated and lower educated, different trends become visible - the lower educated began to earn more and more in the public sector compared to their private sector counterparts, while the higher educated in the public sector faced an increasingly large penalty. An observation in line with legitimate egalitarian reasons - the government taking up the role as a ‘good’ employer, leading to public sector pay compression (Lausev, 2014; Melly, 2005). Then, in 2017, a repeat study is published by SEO. This study does not specifically look at low and high education but a breakdown is made per sub-sector and on professional level (van der Werff et al., 2017). Nevertheless, this repeat study shows the same trend. The wage development in the national government, which mainly employs higher educated people, showed that the market wages of relevant counterparts rose faster than public wages between 2006-2016 (Heyma et al., 2010). This egalitarian trend seems empathetic to the government as a ”good” employer and suppresses perverse market wages, but it can also have undesirable consequences - the public sector losing its competitiveness for higher educated people. This danger is certainly lurking when considering the article of Zeilstra et al. (2014), which stated that the public sector in the Netherlands does not show any wage leadership.

But also outside these commissioned reports, research has been done into Dutch public-private wage differences, in which other methods have been applied. Focused on the Netherlands, Ernest Berkhout et al. (2013) applied Oaxaca-Blinder decomposition to find a public wage penalty, while the raw wage gap is about 12% for 2009. A cross-country study by the researchers of the European Commission found no significant wage gap for the Netherlands (De Castro et al., 2013). Also, both studies support the notion of public sector pay compression along with educational attainment. Per contra, a positive wage gap was found by Christofides and Michael (2013), who also used an application of Oaxaca decomposition. In 2020, Michael et al. applied Oaxaca decomposition, as well as quantile regression, to find the same results - a positive ”unexplained” wage gap of about 5%. During this same period, Sławińska (2021) found a much smaller wage gap. A quantile decomposition shows that, across the income distribution, the higher earners are better off in the private sector while the opposite is true for the lower earners (Michael et al., 2020). The most recent study specific to the Netherlands dates from 2019, which analysed public and private wages up to 2017 (Biesenbeek et al., 2019) - just before the labour market tightened. What is striking from this research, and which goes against almost every research mentioned above, is that men have a larger public wage premium than women. Meanwhile, they did confirm the public sector wage compression along the wage distribution.

2.2.3. Sector selection: Public Service Motivation or Wage?

Pressing questions that then arise are ”What influence do lower wages in the public sector have on the choice to work in the public sector?”, or more general, ”What reasons do people have to work in the public sector?” I am not the first to wonder about this either - this question taps into a completely different branch of literature. It might be wise to start with the question of why people choose the public sector in the first place. Subsequently, the role played by wages is discussed.

The role of Public Service Motivation

The motivation to work in the public sector is often captured by the notion of Public Service Motivation (PSM). PSM refers to the strong norms and emotions of public sector workers to perform public services - the drive to work for the public good, rather than for personal gain. These public-spirited individuals are believed to put considerable effort into their work (Alonso et al., 2001; Brewer, Selden, and Facer II, 2000). James L Perry et al. (1990), as one of the most prominent researchers regarding PSM, underlined several motives for PSM including both altruistic and rational motives, among which career advancement and financial compensation. Since the article of James L Perry et al. (1990), a lot of research has been done on this phenomenon, which is also the reason why J. Perry et al. (2015) released an article in 2015 about the current state of affairs. As an example of the many studies, Georgellis et al. (2011) concluded that a significant share of individuals moves to the public sector because of the higher likelihood of fulfilling their urge to perform meaningful public services, indicating PSM played a significant role in sector-sorting - a finding supported by other researchers (e.g. Holt,

2018).

PSM contradicts wage efficiency theory. Taylor et al. (2011) researched this contradiction, noting that PSM contests the primacy of wages as a driver of worker effort, while the efficiency wage theory dictates that wages above the market rate ensure maximum effort (Shapiro et al., 1984). This study contains several interesting results. First, efficiency wages were found for many countries, with positive wage premia for public sector workers. Second, it emerged that PSM is strongly tied to effort, confirming the existence and significance of PSM - being pursuant to other researchers (e.g. Alonso et al., 2001; Brewer and Selden, 1998; Bright, 2007). It is also concluded that wages play a significant role concerning worker effort. However, this does not address specifically the sector selection choice that lies before us.

Also important is that the degree of PSM varies widely for different groups. As Taylor et al. (2011) states: not everyone in the public sector workforce can be expected to have high levels of PSM. Individuals at higher levels within an organisation tend to possess stronger altruistic and service-oriented values and PSM motives than those at lower levels (Bøgh Andersen et al., 2012). Also, the type of occupation is of importance to this matter, as is shown for Scandinavian countries (Kjeldsen, 2012). J. Perry et al. (2015) indicated that such interests also play a role among healthcare workers and the highly educated.

The role of wages

This subject becomes more relevant to this study when one looks more closely at its relationship to wages, a relationship that has also been investigated for some time. Within studies of public-private wage differences, the link between the wage gap and the ability to recruit workers is often assumed. For example, Bonaccolto-Töpfer et al. (2022), without investigation, suggested that pay disparities between public and private sector employees can lead to difficulties in attracting and retaining the necessary personnel for the public sector to provide essential services. Lucifora et al. (2006) also makes the direct connection between the relative public wages and the recruitment of personnel. According to Bonaccolto-Töpfer et al. (2022), compensation matters for both public and private sector recruitment, making the composition of the public-private wage gap an important policy issue. However, this direct causal relationship is sometimes questioned in other studies focusing on PSM.

Some studies do not see raising public wages as a solution for attracting public sector workers. Makridis (2021) showed that, if anything, government employees earn more than their private sector counterparts. Also, he concluded that increasing public sector wages has a limited impact on attracting or retaining public sector personnel and that job satisfaction or workplace practices, among which bureaucracy and poor management practices, are more plausible reasons for the shortages in the public sector. However, this study concerned data from the United States, where the government's image is substantially different. In the Netherlands, the government is described as a favourite employer (Intelligence Group, 2022). Asseburg et al. (2020) held the hypothesis that PSM is a stronger predictor of public sector attraction than rewards, after which, however, it was stated that money does play an important role in recruitment.

A small group of researchers has done research specifically into wage gaps and sector sorting. Blank (1985) developed a probit model to analyse workers' choice between the public and private employment sectors, showing that, other things equal, public employment is preferred by "protected" groups. At that time, highly educated and more experienced workers were more likely to choose the public sector, though the research also indicated that sectoral choice is influenced by more than wages. A little over two decades later, significant sorting effects were found using correlation and regression on quitters and entrants of the public sector (Borjas, 2002). Now, it is found that high-skilled workers tend towards the private sector, mainly due to the compression of wages in the public sector. Though, research is inconclusive on the exact relationship. Researchers confirm that there is a demand for more research, including focused research that disaggregates and unbundles the public service motivation construct on wages for instance (J. Perry et al., 2015; Taylor et al., 2011).

An application to the Netherlands

In the Netherlands, it is mostly assumed that there is a strong relationship between adequate public wage levels and the ability to attract employees in the public sector (Uijlenbroek et al., 2015). This competitive mindset is reflected in reports from, among others, the Netherlands Bureau for Economic Policy Analysis (CPB) and a specially appointed investigation committee (CPB, 2016a; The Work Regulation

Committee, 2020). However, very limited research has been carried out into the specific causality in the Netherlands. As an exception to this, researchers of the CPB examined the relationship between public sector wages and mobility and emphasised that there are important selection and implicit incentives, relating to PSM, to work in the public sector (CPB, 2011). It also suspects an important role for wages, but cannot perform the desired econometric analysis due to limitations in available data. Also, Van Der Steeg et al. (2015) evaluated the effects of higher teacher pay on teacher retention. Specifically for teachers, it was found that higher wages had a limited effect on retaining and attracting staff, but that it has more influence on the influx of students who enter teacher training. This would emphasise that wage policy can help in steering the allocation of workers across sectors, albeit indirectly and with a time lag.

2.2.4. Interim conclusion: Public-private labour and wage differentials

The above story draws important conclusions for this research. There exist legitimate reasons for public sector wage differences. The public sector is subject to politically motivated constraints, such as budget constraints and egalitarian reasons, which may explain a compressed wage distribution. Measuring the ”adjusted” wage gap between the public and private sectors is challenging due to heterogeneity among workers and the choice for the public sector, leading to contradictory results. It appears that the breakdown beyond just the mean is an important approach to observing real comparability. There is a demand for more research into the relationship between sector attraction and wage differentials, as current research is scarce and inconclusive. The intrinsic motivation to help society is important for sector selection, but adequate wages are also important in attracting personnel to the public sector. Further research into the role of wages may yield new insights.

2.3. On the Dutch (public) wage system

After highlighting relevant theories and applied scientific research, it is important to gain more knowledge and insight into Dutch labour market policy. This section examines the rationale of the Dutch government for setting public and private wages through wage policy. After all, this research should ultimately result in solid policy advice, which is only possible if it is clear how the government thinks about public and private sector jobs, and if it is clear what the Dutch government can and cannot do concerning the public labour market policy. To achieve this understanding, this section highlights three topics. It starts with a brief historical perspective of the development of public and private wages. This is followed by an explanation of the current public wage policy. Since these wage policies mainly concern collective wages, a broader perspective is needed. This broader perspective is filled in with an explanation of other instruments on how the Dutch government could influence wages and working conditions.

2.3.1. A brief history of the Dutch public wage policy: Towards normalisation and competition

As mentioned, wage development in the public sector was decoupled from wage development in the private sector in 1982. From this point on, wages have developed differently. Before 1982, the index of growth of private sector wages was directly applied to public sector wages (Hartog et al., 1993). Its goal was that wages in the public and private sectors paid similarly for similar jobs (van Ophem, 1993) - being most consistent with the human capital model. It should also be noted that, vis-à-vis the market, there was a more one-sided relationship between the government and its employees, with the government having a strong position of power (van der Meer et al., 2019). This one-sidedness by the government regarding its civil servants is also characterised by the special civil service status, appointing a civil servant instead of concluding an employment contract - a unilateral instead of a bilateral legal act (Sprengers, 2019). Under pressure from the poor state of public finances, wages in the public sector were frozen in the first half of the 1980s (Zeilstra et al., 2014). This poor state of public finances arose after a period of economic setbacks (1973-1982), preceded by a period of unprecedented economic growth (1950-1973) and which resulted in an incredibly ”expensive” welfare state with an extensive social system (CPB, 1985). A system which turned out to be unaffordable in the face of economic hardship and thus harmful to the economy and society (The Work Regulation Committee, 2020). The Netherlands was forced to cut expenditures, a constraint defined as legitimate reason (Bender, 1998). This was all part of the reforms of the Lubbers cabinet, which resolved the

welfare state crisis of the 1980s (PDC, 2022). After decoupling, public wages lagged behind private wages, especially for the highly educated. This was the reason more attention was paid to wage differentials during that period (Hartog et al., 1993; van Ophem, 1993). During this period, and the entire history before, the government determined the working conditions and imposed them unilaterally (van der Meer et al., 2019).

The sector model, as is known today, albeit in a modified form, was introduced in 1993. In consultations between the government as employer and the representative organisations of the civil servants, this new consultation model was established. This system arose from Minister van Dijk's ideas to achieve greater equality and decentralisation in the consultations between the national government and the trade unions (Zeilstra et al., 2014). The new sector model was born from these progressive ideas, with the recognition of independent employment condition negotiations starting in eight sectors: five central government sectors (State, Police, Education, Defence and Judiciary) and three decentralised sectors (Provinces, Municipalities and Water Boards) (van der Meer et al., 2019). This was the first step towards the normalisation of public labour relations, in which wages were not imposed unilaterally but in negotiations between employers and workers' representatives. As civil servants enjoy a special status, these collective labour agreements concerned legal status regulations. It should be noted that during this period in the market sector, a process of decentralisation of wage formation took place too, with the government gradually withdrawing more and more (van Liempt, 2000). In the decades that followed, the sector model was assessed positively on several occasions - and some legislative amendments were implemented. More social security has been implemented, with laws for disability, sickness and unemployment (Becking, 2001). The normalisation led to the much-desired customisation and thus the greater quality of employment conditions policy (van der Meer et al., 2019). However, as mentioned in the 2001 budget memorandum, the wage compression in the public sector was noticed, with the observation that there is a strong shortage of personnel in the government sectors (Ministry of Finance, 2001) - from a historical perspective, apparently, not an unknown phenomenon.

So, the government could no longer unilaterally adjust the employment conditions, but it still has a great deal of influence in determining the government budget (CPB, 2016b) - the budget available for higher wages or more employees, for instance. For the public wage policy, it uses two mechanisms: the reference model and additional labour productivity discounts - the reference model forms the basis and is explained in more detail later on. But important for now in a nutshell: the reference model determines the development of the governmental labour budget based on the development of labour costs in the private sector, reimbursed to employers to use as available budget in wage negotiations with public trade unions (Ministry of the Interior and Kingdom Relations, 2017). This model has a competitive approach, intending to maintain an equal trend between wages in the public and private sectors. There are, however, also possibilities for deviations. Due to budgetary or labour market considerations, this has also been done with some regularity.

In the last decade, there have been differences in wage developments between the public and private sectors. The global economic crisis of 2008 brought about major changes, once again causing a huge shortage of financial resources, as a result of which the available budget for the public sector had to be cut. Since the fourth Balkenende cabinet, attempts have been made to find financial resources in the national budget for practically all cost items - without hesitation, public employment conditions formed an important cost-cutting item (van der Meer et al., 2019). As a result, public wages were frozen in the period 2011-2014 (Biesenbeek et al., 2019) - lagging behind market wages by 3.4 per cent (Zeilstra et al., 2014). In 2015, a wage agreement was reached with part of the trade unions to cumulatively increase the wages of 2015 and 2016 by 5.05 per cent - an attempt to close the gap with the private sectors, where the wages increased by 1.3 and 1.4 per cent in 2015 and 2016 respectively (CPB, 2016c). In the following years, public collective labour agreement wages developed competitively to private sector wages, with a slightly stronger increase in the public sector. This can be seen in Figure 2.1, showing wage development since 2010[2].

As a final point, it is important to mention that the Netherlands has taken another step towards normalisation by establishing a new legal position for civil servants, as much as possible in line with the market sectors. Since 2020, private employment law applies to most civil servants, just as it has always

[2]Mind that these are index figures, where 2010 serves as a benchmark (100) and the development in subsequent years concerns the relative growth compared to 2010. So, the fact that public collective labour agreement development exceeds private collective labour agreement development in 2022 does not mean that wages are actually higher. This depends on the initial level of wages in 2010, the reference year, and is difficult to quantify. Section 2.2.2 provides extensive reasoning on this matter.

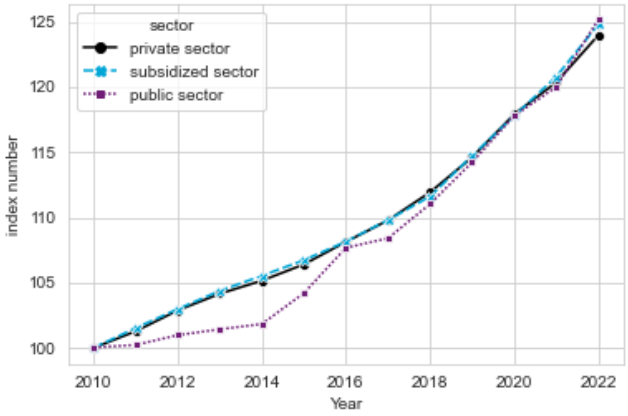


Figure 2.1: Collective labour agreement wage development of the public sector, subsidised sector and the private sector in index numbers, period 2010-2022 (CBS, 2022b)

been the case for employees in the private sector (Rijksoverheid, 2019). Instead of appointment as a civil servant, there is now an employment contract and the employment conditions are largely laid down in collective agreements. This is done in consultation with employers and trade unions, being in line with the private sector. Prior, the terms and conditions of employment were laid down collectively under legal status regulations, which were called into question by social scientists (Sprengers, 2019). Government employers are free to conclude a collective labour agreement. The same rules apply to them as to market employers. However, civil servants still enjoy official status. Every employee employed by a government employer remains a civil servant. The government is there for the common good. That is why the special rules for civil servants remain in place, such as a duty of confidentiality and a ban on receiving donations (Rijksoverheid, 2019). These adjustments logically follow the route towards normalisation, in which the government increasingly behaves like an ”ordinary” employer, just like businesses.

2.3.2. Current Dutch public wage policy: The reference model

As previously mentioned, public wage policy primarily pertains to collective wage agreements and focuses on determining the government’s budget for wage expenditure. Since 1997, the reference model has been used to determine the budget for public sector wages (Zeilstra et al., 2014). This reference model is examined in more detail in this section.

This reference model is a prime example of the competitive approach of the government towards its public wage policy. This model calculates the government’s labour budget based on the labour costs in the private sector, allowing employers to use it as an available budget for wage negotiations with public trade unions, aiming to keep public wages comparable to private wages (Ministry of the Interior and Kingdom Relations, 2017). While the annual wage increase in the public sector is supposed to mirror that in the private sector, it is not that straightforward - the reference model comprises several components, including personal wage agreement space based on performance.

However, the model’s most significant feature is the possibility of incidental changes or policy deviations. This option has frequently been applied between 2010 and 2021 due to budget constraints from the global economic crisis of 2008 and the Eurocrisis of 2009 and 2010 (Biesenbeek et al., 2019). During 2011-2014, public wages were frozen, and compensation policies were implemented in 2015-2016 to address the lagging competitiveness of public wages (CPB, 2016c). The reference model enables the development of employment conditions in line with the market but also allows for deviations on policy grounds.

Two evaluations of the reference model have been conducted, with one moderately positive but critical by the government and another primarily critical one by researchers. The government’s perspective on the model is qualitative, evaluating it through an actor’s perspective. The model is viewed positively as objective and transparent with room for negotiation, but timing and policy deviations are cited as challenges leading to uncertainty (Ministry of the Interior and Kingdom Relations, 2017). The

researchers are more critical of the model, particularly of the deviation option. They suggest that productivity incentives are better suited to reducing wage costs and increasing efficiency in the public sector (Uijlenbroek et al., 2015).

However, these evaluations do not encompass the entire approach of the public wage policy and the reference model. The competitive approach that lies behind the model is not discussed, nor is there a quantitative evaluation of wage developments in the public sector compared to the private sector. The evaluation also does not address possible responses of the reference model to labour shortages. This while a letter from minister Remkes (2007), in response to independent advice of ROP (2006) and SER (2006), showed that this issue is high on the political agenda. Around 2007, even before the crisis, there was a threat of shortages in healthcare and education if the labour market tightened (CPB, 2016b). The ROP (2006) concluded that the shortages of higher educated people will be high and recommends that government employees should offer the same pay development as employees in the private sector to avoid shortages. This applies in particular to the highly educated. The crisis prevented this shortage at the time, but this shortage and associated shortages are now there. Unfortunately, the question of how to respond to these shortages, for example through public wage policy and the reference model, has not been addressed. Perhaps it was not necessary at the time due to the crisis, but now this case is different.

2.3.3. Other instruments: The broader legal framework

Section 2.3.1 and 2.3.2 mainly relate to collective wage negotiations, and this certainly constitutes the most important aspect of wage policy in the Netherlands. However, with the public wage policy, the government actually operates at three levels: national (as a legislator), collective (as social partners), and individual (as an employer). The legislator sets preconditions, social partners negotiate collective labour agreements, and employers and employees discuss wages and benefits for specific employment relationships. Each level is discussed briefly, but a detailed report by the CPB provides further information (CPB, 2016b). To get a complete picture of which possible policy instruments the government has at its disposal, it is essential to explain all these areas.

As a legislator, the government sets minimum employment conditions, including for those working in the private sector. The reason for this interference is threefold: external effects for society are not taken into consideration in individual wage negotiations, mandatory conditions can save costs compared to continuous negotiation, and there is a desire to ensure a certain minimum level for all employees (CPB, 2016b). Well-known examples to protect employees are legal rights on working hours and numbers of vacation and leave days, legal rights to maternity, parental and care leave. This gives the government direct influence on employment conditions in the private sector. For wages, the most influential set of instruments is the determination of the minimum wage, the statutory minimum wage that an employer must pay to its employee depending on their age (CPB, 2016b). The minimum wage has a direct and targeted impact on the bottom of the wage distribution and is often used as a tool to compensate for inflation. This instrument also has an indirect effect - many benefits, such as the state pension, are linked to the minimum wage (Rijksoverheid, 2022b). The minimum wage has steadily increased since 2010 and the age of eligibility has gradually been reduced (Rijksoverheid, 2022a). The state pension age, the age at which people receive a basic pension from the central government, is also an important instrument for the size of the labour market.

In the Netherlands, wage negotiations mainly occur at the collective level. Only public collective agreements are directly influenced by the government through the determination of the available budget. Separate collective labour agreements exist for different public sectors, such as the central government and education. However, the government can influence wage negotiations beyond just the public wage agreements. Employers and employees negotiate collectively about wages and working conditions in sectoral and company agreements. This approach covers about 6 of the 7 million employees in the country and saves costs, limits externalities, and promotes equality. In principle, the collective agreement only counts for those who are part of the negotiations, present as employer or member of the employee representative, are free to choose the level of negotiation themselves. While the government has no say in the level of wage negotiation, it can make a collective agreement binding for an entire industry, also in the private sector (Ministry of Social Affairs and Employment, 2023a).

Individual wage negotiations are the least influenced by the government, especially in the private sector. For the public sector, in addition to general collective agreements, workers negotiate a personalised component with their employers, taking into account their qualifications and demand in the

labour market (Biesenbeek et al., 2019). Legislation and payroll taxes indirectly influence wage profiles and top wages in the private sector. In the Netherlands and other countries, top salaries have been the subject of social debate for many years (De Volkskrant, 2022). The government can indirectly curb top salaries through tax arrangements and by not having age-dependent severance payments declared generally binding (CPB, 2016b). Also, older workers, who have more bargaining power, typically have higher wages although the extent of their productivity is debated (CPB, 2011). The government has instruments to limit age-related benefits, such as penalising age-related extra days off.

2.3.4. Interim conclusion: Dutch public wage policy

The section above provides insights into the history and current state of the Dutch public wage policy. The government has normalised its relationship with civil servants and public trade unions serve a similar role to private labour unions. The government adopted a competitive market approach to public wage policy with the introduction of the reference model. However, recent budget shortages have led to deviations from this approach including the wage freeze and the compensation policy afterwards. There have been evaluations of the public wage policy and the reference model, but only qualitatively and not all-encompassing. The government can also exert power over wages other than budgeting for collective wage negotiations through legislation and individual agreements. Understanding the government's power towards public wage policy in this regard is crucial for providing effective policy advice.

2.4. Concluding notes: Answering the first sub-question

The necessary insights regarding public wage policy, provided by the theoretical background of this chapter, accomplish an answer to the first sub-question: "What are the rationales of the Dutch government for wage differentiation between public and private wages?".

The Dutch government aims to implement a competitive public wage policy, with comparable wages between the public and private sectors - being in line with the human capital model. The reference model, which includes the possibility of a policy-related deviation, serves as the main instrument. This policy deviation has been used with good regularity, particularly during economic downturns, which has been established as a legitimate reason for wage discrepancies. However, very limited documentation and evaluation of Dutch public wage policy and the reference model is available or performed.

Numerous methods have been used to study public-private wage differences, but they show that calculating these wage differences is not straightforward. A public wage premium is often found, but not for all groups. The Oaxaca-Blinder decomposition, which is also characterised by the human capital model and the Mincerian equation, seems to be the most applied and suitable method for this purpose. However, less research has been conducted into the impact of wage differences on sectoral job mobility, and the causal relationship between wage differences and personnel recruitment or withdrawal is often assumed, but PSM also plays a role.

Despite the knowledge and literature about Dutch public wage policy, there are still some shortcomings. There has not been a quantitative evaluation of the reference model investigating actual public wages in relation to private wages. Additionally, the technical operation of the model and the differentiation of wages for different public sectors and sub-groups remain unknown, with little documentation on the precise approach and technical operation of the reference model.

There is potential for the scientific domain that conducts research into public-private wage differences to fill these policy shortcomings with scientific knowledge. While the wage gap has been studied heavily, there has been limited follow-up research into its impact on public wage policy. An Oaxaca-Blinder decomposition, revealing the unexplained wage gap, would fit well in this regard. Scientific research also falls short in the limited explanation for sectoral mobility, any shortages, and the role of wage differentials in this respect.

This report aims to address these shortcomings by providing a first quantitative evaluation of the public wage policy in the Netherlands through econometric analysis. Public and private wage differentials are analysed and related to public wage policy and sectoral mobility. The competitiveness of public wages for different groups within the government is examined. The impact of the policy between 2010 and 2016, during which the government made use of the "incidental" policy deviation within the reference model every year, is given special attention. Finally, the link between the wage gap and sectoral mobility is examined, particularly in relation to shortages in healthcare and technically trained personnel in the public sector, two specific shortages that lead to major problems in society.

3

Analysis Specification

This chapter presents the analysis specification for the quantitative analyses, providing all the tools to carry out the analyses in this report. The structure follows the four components proposed by Wooldridge (2015): explanation and hypothesis, econometric methodology, data explanation, and model specification. The methodology section details the approach to estimating the public-private wage gap and examining the relationship with sectoral job mobility. The data section outlines the challenges of implementing the methodology, the obtained data, and the data preparation steps. A standard model specification is provided for linear regression models, which underpin the analysis.

3.1. Explanation and hypothesis

According to Wooldridge (2015), a first crucial step in conducting empirical analysis is to define and hypothesise a clear research question, which could involve testing government policy. For this study, the research question is ”How does public wage policy translate into public-private wage differentials and sectoral shifts in the Netherlands?”. The hypothesis is formed based on the theoretical background of Chapter 2.3.

It is hypothesised that the Dutch government aims to implement a competitive public wage policy using the reference model, which suggests comparable wages between the public and private sectors once differences between the sectors and human capabilities are accounted for. Specifically, when corrected for job characteristics, one would suspect comparable wages for people with comparable human capital characteristics. The Dutch public wage policy with the implementation of the wage freeze between 2010 and 2014 and the compensation policy from 2014 to 2016 are expected to have had an impact on the competitiveness of public wages.

It is also hypothesised that there exists a relationship between wage gaps and sectoral job shifts to and from the public sector to the private sector. The hypothesis is that noncompetitive wages, either too high or too low public wages compared to the private sector, have an impact on the ability to attract qualified personnel and may lead to shortages. Although there are other reasons to switch sectors, such as the PSM, wage is expected to play an important role. This relationship can diverge between occupational groups, as one occupational group may be more ”mobile”, having more substitution options in other sectors, than another occupational group.

This concerns all hypotheses to bring about the analysis specification. For econometric policy analysis, there is often no need to formulate a formal conceptual framework (Wooldridge, 2015). Theory and common sense suffice. With the sharp research question, theoretical knowledge and hypotheses lined up, it is time for a description of the econometric methods that are applied.

3.2. Econometric methods

In this section, two methods addressing both hypotheses are explained: 1) measuring the public-private wage gap, and 2) measuring the impact of the wage gap on sectoral job mobility. Section 3.2.1 describes the methodology for measuring the wage gap. Section 3.2.2 outlines the method for examining its relationship with sectoral job mobility. This second method has a substantially less scientific underlying basis and is thus pronounced as a ”back-of-the-envelope” calculation.

3.2.1. The public-private wage gap

Public-private wage gap estimation is applied to test the hypothesis that public wages are comparable to private wages, suggesting a competitive public wage policy. The extensive search for the ”adjusted” wage gap in Section 2.2.2 provides us with the required knowledge to select a suitable methodology. This section argues for this methodology and explains the operation of the precise methods.

To test the hypothesis of competitive public wages, the method must fulfil several conditions. First and foremost, it should approach the ”adjusted” wage gap, measuring the wage gap not caused by differences in characteristics between the public and private sectors, but by differences in public and private wage structures. Second, it should be able to measure the wage gap for different groups, for different ages or along the wage distribution. Third and not least, it should be a method that is simple in its application and that has stood the test of time.

This study applies an Oaxaca-Blinder decomposition technique to measure the ”adjusted” public-private wage gap - the pay gap that is due to differences in pay structures. The Oaxaca-Blinder decomposition is a statistical technique that breaks down the mean wage difference between two groups into two parts. The first part is the ”explained” component which reflects differences in employee composition, including human capital characteristics such as educational background, age, gender, and origin. This difference in employee composition pertains to differences in personal characteristics - human capital characteristics, among which educational background, age, gender, and origin (De Castro et al., 2013). This explained wage gap is estimated through multiple linear regression, which bears a close resemblance to a Mincerian equation. The Oaxaca-Blinder decomposition methodology is thus strongly linked to the human capital model (Machado et al., 2005). The second part is the ”unexplained” component which reflects differences in the pay structure between the public and private sectors that cannot be explained by differences in employee composition (De Castro et al., 2013). It is this unexplained wage gap, the difference in pay structure, that is of interest in evaluating the Dutch public wage policy. If there is a significant unexplained wage gap this means employees with equal productivity are rewarded differently in the public sector in comparison to the private sector. This is relevant to the public wage policy, as then either a deliberate choice has been made to reward differently, or a noncompetitive wage level has been chosen unintentionally. Since no evaluation has yet been carried out on this Dutch public wage policy, this is certainly possible.

The Oaxaca-Blinder decomposition and the extension to different forms mean that the wage differences can be estimated for different groups. The technique looks at the wage differences between two groups, these groups can be defined themselves. This can be broken down by level of education, for example. In addition, Chernozhukov et al. (2013) proposed a modification of the Oaxaca-Blinder decomposition that makes it possible to estimate the wage gap along the wage distribution. This makes it possible to see whether the public wage policy determines competitive wages for subgroups. After all, as Belman et al. (2004) says: ”If one half of the wage distribution gain a public wage premium, while the other of the distribution receive a public wage penalty - the average differential will be close to zero, suggesting comparability when, in truth, no workers are being paid comparably”.

The original Oaxaca-Blinder decomposition is a technique which is intuitively appealing and has been widely used over a long period and applied to multiple countries. For instance, the modification along the wage distribution has also been devised by Machado et al. (2005), and applied widely (e.g. Michael et al., 2020). Although the method has not been applied to the Netherlands for a long time, it can be said that it has stood the test of time.

This makes the Oaxaca-Blinder decomposition, measuring the unexplained wage gap, eminently suitable to see whether the Dutch government actually sticks to its intended policy of competitive wage-setting. Discovering the unexplained wage gap offers the perfect opportunity to evaluate this intended public wage policy in the Netherlands.

Though the Blinder-Oaxaca methodology is a novel method with the intuitive results that this research aims for, it should be performed with care. This methodology is prone to omitted variable bias. If not enough human capital characteristics are included, the wage gap is not correctly divided into explained and unexplained parts (Woodcock, 2008). Therefore, it is important to make proper consideration which human capital characteristics and controlling variables to include.

Decomposition at the mean

The original Oaxaca-Blinder decomposition distinguishes the mean wage gap into an explained and unexplained (or adjusted) wage gap (Oaxaca, 1973). Cahuc et al. (2014) provides a straightforward ex-

planation of the Oaxaca-Blinder decomposition, the specification below follows this line of explanation, focusing directly on the public-private wage differences relevant in this study. Appendix B provides an explanation containing all intermediate steps and derivations to arrive at the Oaxaca-Blinder decomposition equation.

Assume that there exist two mutually exclusive groups, that is, individuals belonging to either one group or the other but not both; in this case either the public sector or the private sector. Let $\ln W_{Si}$ and X_{Si} be respectively the wage and the vector of observed human capital characteristics of an individual i belonging to any sector S. The wage equation for this sector is given by:

$$\ln W_{Si} = X_{Si}\beta_S + \epsilon_{Si} \quad \text{, where: } X_{Si} = [1, x_1, x_2, ..., x_n] \tag{3.1}$$

where β_S represents the vector of coefficients to be estimated and ϵ_{Si} represents the normally distributed individual error term. This, in fact, concerns a Mincerian equation. This way, one can formulate separate wage equations for the public sector P with individuals i and private sector M with individuals j by:

$$\begin{aligned} \ln W_{Pi} &= X_{Pi}\beta_P + \epsilon_{Pi} \\ \ln W_{Mj} &= X_{Mj}\beta_M + \epsilon_{Mj} \end{aligned} \tag{3.2}$$

These two distinct wage equations for each sector allow us to estimate the explained public-private wage gap; the impact of the human capital characteristics on wages for both sectors. This also allows us to estimate the difference between the average values of the wage logarithms of the public and private sectors. Assuming $E(\epsilon) = 0$ and replacing the expected values of covariates by their group means, this public-private wage gap, denoted by G, can be estimated as:

$$G = \ln(W_P) - \ln(W_M) = \bar{X_P}\widehat{\beta_P} - \bar{X_M}\widehat{\beta_M} \tag{3.3}$$

Rewriting Equation 3.3 gives the well-known Oaxaca-Blinder decomposition at the mean. For this, Oaxaca (1973) defined two terms: $\Delta\bar{X} = \bar{X_P} - \bar{X_M}$ and $\Delta\widehat{\beta} = \widehat{\beta_P} - \widehat{\beta_M}$. Applying these terms, interim steps of which are shown in Appendix B, the Oaxaca-Blinder decomposition can be written as:

$$G = (\bar{X_P} - \bar{X_M})\widehat{\beta_P} + \bar{X_M}(\widehat{\beta_P} - \widehat{\beta_M}) \tag{3.4}$$

where $\bar{X_P}$ and $\bar{X_M}$ represent the average values of the vectors of human capital characteristics of the public sector and private sector respectively. The first term of the decomposition, $(\bar{X_P} - \bar{X_M})\widehat{\beta_P}$, represents the "explained" wage gap, reflecting the difference in composition between the public and private sector for all observed human capital characteristics. The second term of the decomposition, $\bar{X_M}(\widehat{\beta_P} - \widehat{\beta_M})$, represents the "adjusted" wage gap, reflecting the difference in pay structure between the public and private sector. It builds a counterfactual: "What would private sector employees be paid if they had the same returns to human capital characteristics as public sector employees?".

This counterfactual, however, raises a serious problem: the explained wage gap depends on the reference group chosen to build this counterfactual (Cahuc et al., 2014). Equation 3.4 suffers the widely-known "index number" problem, meaning that the choice of the reference group may affect the ratio of explained to unexplained portions of the gap (Oaxaca, 1973). If the returns to individual characteristics of the public sector, represented by $\widehat{\beta_P}$, are different from the private sector, the portion of the explained wage gap, $(\bar{X_P} - \bar{X_M})\widehat{\beta_P}$, would change if the reference group is reversed. Similarly, the adjusted wage gap, $\bar{X_M}(\widehat{\beta_P} - \widehat{\beta_M})$, depends on $\bar{X_M}$ (Sen, 2014).

Several variants have been devised on this original Oaxaca-Blinder decomposition to overcome this dependence, one of which will be applied in this study. Regarding this variant, researchers propose a more general form of the Oaxaca-Blinder decomposition. The idea is no longer to take any one group as a reference but to take the pooled sample, containing both all public and private sector employees, as the reference group and then look at the differences between both groups, i.e. the public sector employees and the private sector employees (Christofides and Michael, 2013). This means a third wage equation is estimated for the pooled sample in addition to the separate wage estimations of the public and private sectors. This revision avoids the arbitrary dependence of the "index number" problem and derives a "non-discriminatory" structure Oaxaca and Ransom (1994).

This adaptation, implementing a pooled sample as the reference group, is often referred to as the three-folded wage gap. For the pooled sample N, denoting the estimated vector of coefficients of the pooled mean as $\widehat{\beta_N}$, this thee-folded wage gap estimation is given by:

$$\ln \bar{W_P} - \ln \bar{W_M} = (\bar{X_P} - \bar{X_M})\widehat{\beta_N} + \bar{X_P}(\widehat{\beta_P} - \widehat{\beta_N}) + \bar{X_M}(\widehat{\beta_N} - \widehat{\beta_M}) \tag{3.5}$$

consisting of three parts: the explained wage gap, $(\bar{X}_P - \bar{X}_M)\widehat{\beta_N}$, the unexplained public sector advantage, $\bar{X}_P(\widehat{\beta_P} - \widehat{\beta_N})$, and the unexplained private sector disadvantage, $\bar{X}_M(\widehat{\beta_N} - \widehat{\beta_M})$. Now, it is the combination of the second and third part that represents the total unexplained, or adjusted, wage gap of Equation 3.4 - the public sector advantage, plus the private sector disadvantage.

This three-folded public-private wage gap equation will serve as the foundation for the mean decomposition analysis. To aid in comprehension, a visual representation of Equation 3.5 is depicted in Figure 3.1, displaying solid black lines for the wage equation of both public and private sectors and a blue line for pooled wage equation. The dotted lines represent the distinct gaps. Each individual component of the three-folded wage gap is shown in the figure.

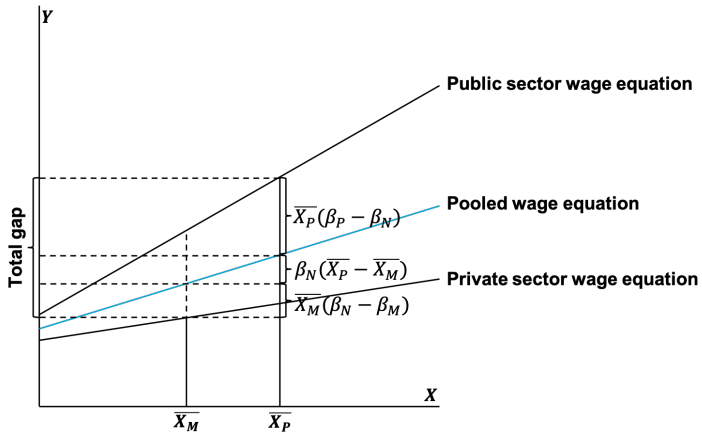


Figure 3.1: Graphical representation of the three-folded public-private wage gap equation

The general literature uses the unexplained private disadvantage, $\bar{X}_M(\widehat{\beta_N} - \widehat{\beta_M})$, the third term shown in Equation 3.5. The private disadvantage requires caution in interpretation (Michael et al., 2020). This study, however, prefers to use the unexplained private advantage instead. This unexplained private advantage is easily rewritten from the unexplained private disadvantage as $\bar{X}_M(\widehat{\beta_N} - \widehat{\beta_M}) = -\bar{X}_M(\widehat{\beta_M} - \widehat{\beta_N})$. As a result, the interpretation of the unexplained public advantage is the same as the interpretation of the unexplained private advantage. This improved interpretability will mainly come into play when the wages turn in favour of the private sector - which may be the case within this research. The complete three-folded equation, considering the unexplained private advantage, applied in this research is thus given by:

$$\ln \bar{W}_P - \ln \bar{W}_M = (\bar{X}_P - \bar{X}_M)\widehat{\beta_N} + \bar{X}_P(\widehat{\beta_P} - \widehat{\beta_N}) - \bar{X}_M(\widehat{\beta_M} - \widehat{\beta_N}) \tag{3.6}$$

Quantile decomposition using a counterfactual approach

To obtain a more detailed analysis of the wage gap beyond the mean, different methods have been proposed. In addition to focusing on subgroups, such as only highly educated individuals, these methods can provide a picture of the distribution over an entire distribution. Fortin et al. (2011) presents an overview of different decomposition methods beyond the mean and discusses limitations - this section will therefore not go into more detail on these methods.

This study uses the approach proposed by Chernozhukov et al. (2013) which employs linear regressions for specified quantiles and estimates the marginal density function of wages using counterfactual distributions. This method is focused on the wage distribution of employees in the private and public sectors, and how it would change if they switched sectors. The counterfactual approach of any functional decomposition, as proposed by Chernozhukov et al. (2013), can be captured as:

$$F_{W(P|P)} - F_{W(M|M)} = [F_{W(P|P)} - F_{W(M|P)}] + [F_{W(M|P)} - F_{W(M|M)}] \tag{3.7}$$

where, in the spirit of Oaxaca (1973), the left-hand side represents the total wage differential, the first term on the right-hand side is due to differences in the wage structure (the unexplained gap) and the second term is a composition effect due to differences in characteristics (the explained gap).

Equation 3.7 consists of three distinctive elements: 1) the observed distribution function of the public (P) sector employees $F_{W(P/P)}$, 2) the observed distribution function of the private (M) sector

employees $F_{W(M/M)}$, and 3) the unobserved counterfactual distribution function of private sector workers had they faced the public sector's wage schedule $F_{W(M/P)}$. Estimating this unobserved counterfactual distribution, and implementing this distribution along the wage distribution in Equation 3.7, forms the basis of the counterfactual approach.

In short, this unobserved counterfactual distribution function is estimated by implementing the following equation:

$$\widehat{F}_{W(M|P)}(w) := \int_{X_P} \widehat{F}_{W_M|X_M}(w|X) d\widehat{F}_{X_P}(x) \tag{3.8}$$

which consists of two components: 1) the conditional quantile distribution function $\hat{F}_{W(M|X)}(w|X)$, and 2) the empirical covariate distribution function $\widehat{F}_{X_P}(x)$. Assuming that we have k samples of individuals: $(W_{Pi}, X_{Pi}) : i = 1, 2, ..., n_k$; one estimates the covariate distribution $\widehat{F}_{X_P}(x)$ using the empirical distribution function:

$$\widehat{F}_{X_P}(x) = n_k^{-1} \sum_{i=1}^{n_k} 1\{X_{Pi} \leq x\} \tag{3.9}$$

and to estimate the conditional quantile distribution function, various modelling choices are described by Chernozhukov et al. (2013). Within this study quantile regression, the most regular method, is applied. To estimate the conditional quantile regression distribution, Chernozhukov et al. (2013) proposes:

$$\begin{aligned} \hat{F}_{W(M|X)}(w|x) &= \epsilon + \int_{\varepsilon}^{1-\varepsilon} 1\{x'\hat{\beta}(\theta) \leq y\} d\theta \quad \text{, where:} \\ \hat{\beta}(\theta) &= \arg\min_{b \in \mathbb{R}_x^d} \sum_{i=1}^{n} \left[\theta - 1\{Y_i \leq X_i' b\}\right] + \left[Y_i - X_i' b\right] \end{aligned} \tag{3.10}$$

giving the formula for the coefficient estimates of the quantile regression. ϵ represents the trimming parameter, a small constant that avoids estimation of tail quantiles; $\hat{\beta}(\theta)$ is the Koenker et al. (1978) quantile regression estimator of the θth quantile. It is obtained by minimising the sum of weighted absolute deviations between the response variable and the predicted values, which basically is a minimisation problem. This method should only be used with continuous dependent variables, which is the case in this research with log hourly wages (Chen et al., 2016).

This theory, without having gone into great detail, provides all necessary functions and procedures to estimate the Oaxaca-Blinder decomposition along the wage distribution. Appendix B provides more detail on the exact implementation and intermediate steps.

3.2.2. A "back-of-the-envelope" calculation: The impact of the wage gap on sectoral job mobility

As a final step in the analysis, a short analysis is conducted on the impact of wage gaps found on the number of people moving to and from the public sector. However, this step is not a fully developed methodology and it is intended to indicate a possible relationship rather than a fully substantiated methodology. Hence, a "back-of-the-envelope" calculation. The study's goal is to conduct a preliminary analysis to see whether wage differences can explain the shortages in certain types of employees.

To properly investigate the impact of wages on job mobility between sectors, researchers would need to consider all independent variables that can influence this decision. However, as known many factors, such as PSM motives, can influence a person's choice of employer or sector and these factors can be difficult to quantify. Therefore, a thorough analysis of the impact of wages on job mobility between sectors is outside the scope of this study.

Nevertheless, an initial assessment of whether such a relationship could exist is made by employing a simple correlation analysis. Correlation analysis investigates the strength and sign of the causality. It is important to control for all other relevant variables to measure any causality. Without controlling for relevant variables, causality can be suggestive and rarely compelling. The "ceteris paribus" condition - other (relevant) factors being equal - is of great importance to establish causality (Wooldridge, 2015).

Assuming this "ceteris paribus" condition, a cautious statement can be made about this causality. This assumption can be supported by the argument that many of the independent variables mentioned as reasons for job shifts, such as career advancement, are fairly rigid in nature and are not expected

to have changed substantially over a period of twelve years. Simple correlation analysis, with due awareness of the method's limitation, can say something about a possible connection. This assumption is maintained for this "back-of-the-envelope" analysis. The limitations of this approach are discussed in Chapter 6.

3.3. Data

This section details the steps involved in collecting and preparing data for the econometric methods described. The section discusses: 1) points of attention for analysing Dutch public-private wage differences, 2) the origin and quality of the obtained data, and 3) the data preparation process.

3.3.1. Points of attention

Some points require attention when analysing the Dutch public-private wage gap, and they need to be discussed before any meaningful analysis can occur. These are insurmountable issues when measuring comparable wages to emerging trends in the Netherlands that must be taken into account. Such issues have been addressed in other studies (e.g. Biesenbeek et al., 2019; Depalo et al., 2015). Five of the most significant ones are discussed below. The personal choices made to concur with the issues in this study may differ from those in other studies due to the study's approach and the unique characteristics of the Dutch labour market. To validate the choices made, and to measure the impact of another possible choice, a robustness analysis is performed in Section 4.3. Each of the issues below describes whether and how a robustness check is implemented.

Definition of wages

In Section 2.1, it is emphasised that an accurate definition of wages is crucial when measuring employee wages. This is particularly relevant in the Netherlands as there is a significant difference in the nature of working hours and bonus payment between the public and private sectors (Ernest Berkhout et al., 2013). The most commonly used definition is the natural logarithm of gross hourly wages, which includes any extra financial compensation in addition to the contracted wage.

The natural logarithm of gross hourly wages is applied within this study as the definition of wage. Gross hourly wages are calculated by dividing the total gross annual wage, including any variable payments, by the net number of working hours. The net number of working hours is determined based on contractual hours, possible overtime and holiday allowances, including age-related, paid leave days, specified in collective bargaining agreements (CBS, 2022h). This definition allows for a fair comparison of wages between public and private sector workers, as it accounts for the differences in paid holidays and allowances versus variable payments such as bonuses (Biesenbeek et al., 2019). This choice is in line with the other studies (Ernest Berkhout et al., 2013; Depalo et al., 2015).

One can also choose to only look at the contractual hourly wages or, if possible, one can try to take a step towards the "lifetime" compensation as proposed by Gomes (2015). Unfortunately, data on pension accrual is not widely available and is associated with limitations making it not an option within this research. Looking only at the contractually agreed wages and hours is an option though. In the robustness analysis, the study will consider contractually agreed hourly wages excluding any bonuses or overtime.

Sector specific jobs

There are jobs that almost only occur in a specific sector. Examples are teachers, healthcare workers or military personnel. The question that arises in this respect is: "Can we compare the wages of these people with the wages of relevant counterparts in the market?" In short, there are three options: 1) compare sector-specific jobs, if even possible, with only a very small sample of private sector counterparts, 2) compare individuals based on personal characteristics, or 3) leave these types of jobs out of the analysis. It should be clear that the latter option is preferably avoided. For the first two options, as Ernest Berkhout et al. (2013) indicated, the choice depends on the question posed. "Do you want to compare the same jobs?", or "Do you want to compare what people could earn in the private sector?".

In this study, the second option is chosen, which means that people with sector-specific jobs are included in the analysis. This approach is different from that of Biesenbeek et al. (2019), who excluded these unique jobs from their analysis. To compare these people properly, their educational background, including the highest level attained and the corresponding field, is included. As a result, it becomes

possible to ask questions such as: ”Do individuals with a healthcare educational background in the public sector earn comparable wages to those with a healthcare background in the private sector?”. A significant number of healthcare professionals have probably left the public sector due to the high workload, which partially explains the shortages in this sector (NOS, 2021a). Nevertheless, their educational background in healthcare remains unchanged. Thus, people with sector-specific jobs and educational qualifications can still be compared. This is why they are included in the analysis, which enables the investigation of occupation-specific shortages.

To address this choice, a robustness analysis is conducted. For this purpose, a narrower definition of the public sector is used, and occupational groups specific to the sector are excluded from the analysis. This robustness check is performed in conjunction with the next issue.

Definition of the public sector

Defining the public and private sectors is an important consideration for this research. The definition used has a significant impact on the scope and outcomes of the analysis. According to Ernest Berkhout et al. (2013), the definition of the public sector can be political or economic. The political approach focuses on government entities themselves, while the economic approach focuses on comparing the public and private sectors.

This research adopts an economic approach and includes a broad definition of the public sector, encompassing civil servants such as teachers, healthcare workers, and police. The specific education required for these occupational groups is controlled by including study background. Any sector not covered by the public sector Collective Labour Agreements are considered part of the private sector, contrary to other studies (Biesenbeek et al., 2019) who adopts a political approach.

To test the robustness of the chosen definition, a narrow political definition is also analysed. This narrow definition, based on Biesenbeek et al. (2019), includes only the national decentral government, including provinces and municipalities, and excludes sector-specific occupations such as healthcare, defence, and education. This issue, along with the prior issue of including sector-specific occupations, is addressed in the robustness analysis.

Upcoming trend: Part-time workers

The Netherlands is at the forefront of a global trend towards a high number of part-time workers. Despite government advisory bodies calling for flexible and part-time working to be limited, around 40% of workers in the Netherlands have part-time contracts (CBS, 2023a). This trend has prompted a shift in research focus, with a move away from analysing only full-time workers towards including part-time workers (Berkhout et al., 2006).

To address this, this study includes a weighting factor in the analysis, which takes into account the differences between the hours worked by an individual at a given company. The factor is called the yearly full-time equivalent (yfte). It ensures that differences between full-time and part-time workers are not overlooked, and those who work for multiple companies, simultaneously or sequentially, within a year are not counted twice in the analysis. The yfte is calculated by dividing the total number of hours worked by an individual at a given company by the full-time equivalent of 1720 hours, as assumed by the Ministry of Social Affairs and Employment (2023b).

An alternative approach could have been taken by focusing solely on the primary employment of individuals, excluding any secondary jobs and only considering those who have worked a sufficient amount of hours within a year. As a robustness check, only the job in which individuals have worked the highest number of hours is considered, with a minimum requirement of 860 hours, which is half of the yfte. The part-time factor, or an individual's yfte, is then excluded in this check.

Upcoming trend: Self-employed workers

Another notable trend in the Netherlands is the high number of self-employed workers who operate as independent contractors without employees. As of 2021, there were 1.1 million self-employed individuals in the Netherlands who considered this their primary occupation and did not employ anyone else (CBS, 2021b). Such individuals often cite the desire for freedom and control as one of the reasons for choosing self-employment, and financial motives also play their part (The Work Regulation Committee, 2020). However, this type of work lacks security, which is viewed as undesirable by the government's main advisory bodies and needs to be addressed (Sociaal-Economische Raad, 2021; The Work Regulation Committee, 2020).

Unfortunately, the analysis in this study excludes self-employed individuals because their sector of operation, public, private, or both, cannot be determined, and their pay structure, job security, and pension accrual differ significantly from those of regular employees. Therefore, comparing their hourly wages would result in unfair outcomes. This decision is consistent with other Dutch studies, such as the SEO reports (Heyma et al., 2010). Since there is no alternative, this choice cannot be tested for robustness through a robustness analysis. However, its impact will be discussed further in the discussion in Chapter 6.

3.3.2. Overview of obtained data

To obtain the necessary data on wages and employee heterogeneity, various administrative datasets are used, all of which are made available confidentially by *Statistics Netherlands* (CBS). This section describes these datasets.

CBS is responsible for gathering and analysing statistical data for the Dutch government. The statutory task of CBS is to gather and analyse statistical data on behalf of the Dutch government for practical, policy-making and scientific purposes, and to disseminate the information derived from this research (CBS, 2023b).

CBS has an extensive system of administrative register data, known as the System of social statistical datasets (SSD), a ”big data” system that offers wonderful new opportunities. The SSD comprises a vast amount of data on individuals, households, employment, benefits, pensions, education, hospital stays, crime, housing, vehicles, and other related information (Bakker et al., 2014). It is considered the most crucial source for official social statistics in the Netherlands, and its remote access availability makes it a popular choice among social sciences researchers. For a detailed explanation of how this system is set up, the contents, and possibilities, readers are referred to Bakker et al. (2014), who have written a well-arranged article about these matters.

Though, it is convenient to briefly draw attention to the quality of data within the SSD and how it relates to this research. The quality of data is generally measured across different dimensions, Bakker et al. (2014) recognises relevance, timeliness, accuracy and reliability, comparability and coherence, accessibility and clarity - being very similar to others (e.g. Huang, 2013). According to Bakker et al. (2014), accuracy and reliability, both measures of uncertainty, are methodologically yet impossible to assess correctly. Furthermore, while the SSD data are often assumed to cover the entire population, the definition of the population is restricted to the registered population. While there are techniques to estimate the total population size, they involve strong assumptions. This particularly adds up when merging several separate datasets, and thus extrapolation for the entire population is not applied in this research - interpretation problems would be severe. So, the results should only be considered for those within the analysis, which is already applicable due to the data preparation described in Section 3.3.3. Despite these quality assessment issues, the information gathering, as well as the quality of the data, is considered to be of high quality - though, this is mainly based on own interpretation of the data during data preparation.

Microdata refers to linkable administrative data at a personal, company, and address level that is made available to universities, scientific organisations, planning offices, and statistical authorities in the Netherlands for statistical research under strict privacy conditions. To ensure privacy and prevent the disclosure of personal information, all results are displayed at an aggregated level. The microdata used in this research was obtained through an affiliate of the Ministry of Finance, and all conditions set by CBS have been strictly adhered to (CBS, 2023b). All results are based on my own calculations using non-public microdata from CBS and are only exhibited publicly after approval by CBS. This microdata is often referred to as panel data, characterised by the possibility to follow the same people over several years - which makes sense when trying to report on the entire population. A panel data (or longitudinal data) set consists of a time series for each cross-sectional member in the data set (Wooldridge, 2015). Panel data is considered a preferred data form (Rattsø et al., 2020).

Five different data sources are used to perform the quantitative analyses, each with its own origin and all made available by CBS. These include:

- **Spolisbus** forms the core dataset, which comprises wage data sourced from the Dutch policy administration (CBS, 2022h). The Policy Administration maintains a record of all income relationships in the Netherlands that are subject to wage tax and national insurance contributions, including wages and benefits. To filter for job-related data, only records that satisfy the definition

of a job is included, which is defined as an employer-employee relationship of authority, involving at least one hour of paid work per week. The database contains both quantitative and qualitative data on the jobs and wages of all employees in Dutch companies, including details of foreign employees subject to the Dutch tax system, who are required to pay wage tax and national insurance contributions.

- **Gbapersoontab** contains data on personal characteristics, such as gender, birth date and origin. The dataset includes all individuals listed in the Municipal Personal Records Database (BRP), both residents or non-residents (CBS, 2022e). Since the dataset contains highly personal and sensitive information, it must be handled with utmost care. Only the variables that are strictly necessary for analysis are used, while all other variables are excluded from consideration and analysis.

- **Hoogsteopltab** represents the highest achieved level and field of education of the Dutch population on 1 October of the relevant year. The data is compiled from multiple sources, including the Central Register of Registrations in Higher Education (CRIHO), education registers for primary and secondary education, and the Occupational Population Survey (EBB) (CBS, 2022f).

- **Onderwijstab** contains the participants in education in the relevant school or academic year. The file provides the primary enrolment for all types of education, including primary, secondary, and higher education (CBS, 2022g).

- **Betab** includes data from companies on the economic activity, size classification, and location of companies. It is compiled from data provided by companies to the Policy Administration and the ABR (CBS, 2022d).

3.3.3. Data preparation

This section describes the data preparation - the process from loading the original data files to a well-prepared, tailored and combined dataset ready for analysis. This exercise contains four steps: 1) loading, analysing and cleaning individual datasets, 2) merging datasets into one comprehensive dataset, 3) limiting the dataset to only the target population, and 4) creating the subsequent sector mobility dataset, including individuals who have switched sectors, public to private and vice versa, between or within a year.

As Wooldridge (2015) indicated, it is crucial to devote time and attention to data preparation and explanation. Particularly when use is made of a nonstandard dataset, as is the case with the administrative CBS data, it should be described in such a way that other searchers can, in principle, imitate the data preparation. A detailed explanation of all steps, including considerations, can be found in Appendix C. This section, and Table 3.1, summarises the main results of data preparation.

Individual datasets

To prepare all the individual datasets for merging, several steps are required. Because the datasets are large in size and therefore data-intensive, it is advisable to limit the amount of data required as much as possible. Two measures are taken for this: 1) all variables not used in the analysis are excluded, and 2) all individuals who are not active in the labour market are excluded. The data files contain, in addition to the relevant variables for this study, many variables that are not relevant for this study. Similarly, the data files contain many individuals who are not of interest in this study (think children, the elderly, and non-residents). Disregarding these variables and individuals from the start saves data space.

After that, a few standard steps in data preparation are followed, one of which leads to a fairly large problem that is highlighted here. First, missing (NaN) values in variables are examined, concluding that there are no missing values in the datasets. If an individual is in one of the datasets, then this individual also has a value for each variable included in that dataset. Second, inconsistent values within a variable are examined, also over the years. This is the step where problems arise - within the Opleidingstab, the education level and education field variable is missing for the years 2010 to 2012 and the education field variable has inconsistent values for the years 2013 to 2018. Luckily, consistent values for the education field variable could be extrapolated from the education field variable of the years 2019 to 2021. This leads to very limited data loss. This was, unfortunately, impossible for the years 2010 to 2012, since no inconsistent values are present in these years either. This results in only

two resolutions remaining: 1) excluding these years from the entire analysis, or 2) seriously limiting the number of persons to be considered from the years 2010 to 2012. Obviously, the first resolution is highly undesirable. The second solution involves only including individuals in the years 2010 to 2012 who are also present in the year 2013, the first year for which the necessary variables are present. Although the population for the years 2010-2012 will become smaller - in 2010, 726 thousand individuals are excluded due to this problem - further analysis does concern the entire desired period. In Appendix C the attempt and procedure to solve these problems are described in detail.

Subsequently, new variables are created for each dataset that will serve as input for the analysis - this also involves adjusting existing variables to more structured input values. A few examples are given to illustrate this step. As such, a new variable is created for the log hourly wages in the Spolisbus dataset by using total wages and total hours worked. This is the dependent variable within the public-private wage gap methodology. It is also determined whether a company is located in an ”urban” area - read the five largest cities in the Netherlands - for which an urban dummy is created. According to several studies into the wage gap, urbanity is an important control variable (e.g. Blackaby et al., 2018; Rattsø et al., 2020). For each categorical variable and the determination of the number of categories, a trade-off is made between statistical power (with variation between categories on the influence on wages) and model complexity (with the increased chance of overfitting or multicollinearity). For example, education level is structured into five levels: primary, secondary 1 and 2, and tertiary 1 and 2. The split between secondary 1 and 2 has been chosen for the education level since there is a ”compulsory” education level in the Netherlands, a level that requires one to attend school until age 18 if not disabled. This border lies between Secondary 1 and 2. The split between Tertiary 1 and 2 is made because it is expected that the full completion of tertiary education, the acquirement of a university master’s or doctorate, results in a higher salary than ”only” completing a university bachelor’s degree.

Merging of datasets

The next step involves merging these individual datasets into one comprehensive dataset. Taking the Spolisbus file as a basis, relevant variables from other datasets are concatenated based on matching with either Personal or Company ID. The merged file contains only the persons whose variables can be merged. So, if there are persons in the Spolisbus file of whom, for example, no education data are available, then these persons are excluded from the analysis - this can drastically reduce the number of people in the merged Spolisbus dataset. The individual steps and the number of excluded persons, as well as the total number of persons in the final analysis, are described in Appendix C - Table 3.1 provides a compact overview.

Merging leads to very limited or no loss for the Gbapersoontab and Betab datasets, as they have an extremely high coverage ratio. The same cannot be said for the Hoogsteopltab, which has a lower coverage ratio. This excludes a considerable part of the population, especially for the years 2010 to 2012. For example, in 2010 more than half is excluded by merging and in 2021 this is limited to just under 27 per cent. The Onderwijstab is not used for merging - this will be used in the next step to exclude people from the analysis.

Preparation of final dataset

To arrive at the final dataset for analysis, a few groups need to be excluded. During this preparation of the final dataset, the total dataset is limited to only the persons for whom the analysis has to be carried out. This mainly concerns considerations to make the analysis, the comparison of the public and private sectors, more representative and therefore fairer. People who can ’skew’ the values of one of the two sectors, making the comparison less representative, are excluded. These groups include current students, individuals earning below the minimum wage, those under the minimum age limit for the minimum wage, those who have reached the state pension age, and those who have ”unknown” values. Each of these groups in other studies is also excluded (e.g. Ernest Berkhout et al., 2013; Biesenbeek et al., 2019).

Current students, who tend to work mainly in the private sector with lower wages, can be excluded using the Onderwijstab dataset. Extremely low earners, defined as those with an annual income below the minimum wage, are also excluded each year based on the minimum wage set by the national government. Individuals under the minimum age limit for the minimum wage are excluded, as the age limit changed from 23 years in 2010 to 21 years in 2021. To keep the results comparable over the years, all individuals under the age of 23 are excluded from the analysis. Individuals who have reached the

state pension age, which has risen from 65 years in 2010 to 67 years in 2021, are excluded from the analysis as their working conditions may have changed. Besides, civil servants are no longer allowed to work once they reach the state pension age, and thus these individuals can only work in the private sector with different working conditions, making their inclusion in the analysis unfair (Binnenlands Bestuur, 2018). Then, interns and employees who fall under the Sheltered Employment Act (WSW) are excluded. Interns have an educational motivation - they most often have already been excluded, as current students are excluded and minimum wages are applied. WSW employees often receive a subsidy, in addition to the employer also receiving a subsidy. As a result, the employment contract has a different interaction that can disrupt the relationship that is actually being investigated. Finally, individuals with an ”unknown” background are excluded. ”Unknown” is a legitimate value for the variable education field, but it says nothing about human capabilities. This exclusion has some impact with the exclusion of more than 150 thousand people in 2021. This mainly concerns people with a migration background whose educational background is unknown.

The dataset after exclusion is ready for analysis of the public-private wage gap - however, for the analysis of the sectoral job mobility analysis, there is still a step to be taken. The dataset after exclusion consists of employer-employee level data. For analysing the number of people moving to and from the public sector, only those who change sectors within or between consecutive periods are of interest. Fortunately, the data also covers the dates to which the employment relationship relates. From this, it can therefore be determined which persons have made the transition from a public/private sector to the other sector.

Another crucial question then arises, namely how the total number of shifters is measured. There are several options for this: based on the number of people or based on the amount of ”FTE”, the number of working hours and spelt out as full-time equivalent. This FTE has strong similarities with the ”yfte”, but the big difference is that the FTE is not corrected for the number of hours worked in a whole year and is therefore more representative. By way of comparison, if a person with a full-time job changes sectors in March, the person has an FTE of one for his prior job, while the ”yfte” is many times less than one. The sectoral shift balance concerns the number of people or FTE that have moved to the public sector, minus the number of people or FTE that have moved away from the public sector. The number of people and FTE, as well as the characteristics of this particular group of people, are shown in Section 5.1.

Year	Original	Merging	Filtering
2010	8.525	3.879	2.402
2011	8.585	4.161	2.669
2012	8.504	4.461	2.997
2013	8.406	5.389	3.737
2014	8.379	5.428	3.802
2015	8.456	5.535	3.886
2016	8.588	5.893	4.172
2017	8.805	6.150	4.339
2018	9.056	6.396	4.513
2019	9.233	6.597	4.540
2020	9.145	6.648	4.617
2021	9.328	6.833	4.747

[1] The numbers concern the number of (unique) individuals in the dataset;
[2] The numbers are in millions, 4.747 is therefore 4.747 million.

Table 3.1: Results of data preparation from the original dataset to the merged and filtered (final) dataset

Representativeness of the dataset

In preparing the data for analysis, two main problems were encountered: missing education variables for 2010 to 2012 and loss of observation when merging the education and wage datasets. These setbacks led to data loss, so it’s important to assess how this affects the representativeness of the sample for the population.

The group excluded due to missing education variables is small but does concern a specific group. For 2010, 726 thousand, less than 8% of the total population, is excluded by only including individuals who are also present in the year 2013. However, this excludes individuals who are not in the dataset in 2013 and who are in the dataset from 2010 to 2012. The excluded group mostly consists of older people nearing retirement or those who have stopped working for other reasons. Though this group is small, the exclusion concerns specific groups and thus leads to a decrease in the representativeness of the sample.

The group excluded due to merging the education (Hoogsteopltab) and wage (Spolisbus) datasets is larger but more random. In 2010, the year with the most data loss, about half of the sample is excluded. This means, half of the individuals in the Spolisbus dataset are not in the Highestopltab dataset and are therefore excluded during the merge and thus not included in the analysis. Based on the variables in the Spolisbus dataset, no specific groups seem to be excluded. The wage distribution before and after merging is virtually the same. Slightly more immigrants, both first and second generation, are excluded by the merge. However, the problem is that you cannot properly determine whether specific groups are being excluded that are detrimental to representativeness since relevant variables are missing for this group. It is therefore not possible to make a conclusive statement about the consequences for the representatives.

To fully assess the impact on representativeness, a more thorough analysis should also be performed. The group that is excluded, especially a large group during the merge, should be examined more closely and other variables that have not been examined at the moment should also be examined. For example, it may now be that the group that is excluded mainly has a specific education level or - field, or that the group of immigrants that is excluded mainly involves immigrants of a non-Western origin. There is no room for this analysis within the scope of this study. Such an analysis would require time and falls outside the study's scope, it is more closely related to the quality assessment of the SSD datasets of *Statistics Netherlands*. This problem is acknowledged and is discussed as a limitation in the discussion of chapter 6.

3.4. Model Specification

The Oaxaca-Blinder decomposition, and its application, rely on linear regression. To complete the analysis specification, all that remains is to specify this linear model. The methodology and data section provides all the necessary ingredients to specify the model used for the analysis. The correlation analysis does not require a model specification.

The Oaxaca-Blinder decomposition uses Mincerian equations. The Mincerian equation takes the form of a standard multiple linear regression of the form:

$$Y_i = X_i\beta_X + Z_i\beta_Z + \epsilon_i; \text{ where: } X_i = [1, x_1, x_2, ..., x_n] \tag{3.11}$$

containing three types of variables - Y_i, X_i and Z_i - and an error term ϵ_i. Y_i is the dependent outcome variable and is specified in Mincerian equations by the natural logarithm of the hourly wage. This dependent outcome variable is explained by the variables of interest X_i, human capital characteristics in the Mincerian equation, and the controlling variables Z_i, job characteristics in the Mincerian equation. As this study applies weighted OLS regression, this error term ϵ_i is estimated to cancel out for the weighted mean - instead of the "normal" mean for a normal OLS regression. These weights result from applying the "yfte", the yearly full-time equivalent, as described in Section 3.3.

To complete the model specification, the variables of interest and controlling variables need to be defined. Careful consideration must be made here, and only those variables that are in line with the relationship to be investigated should be included (Wooldridge, 2015). Including too few independent variables lead to omitted variable bias while including too many variables can also lead to other biases (e.g. collider bias) and violation of assumptions such as multicollinearity.

Explanatory variables, also known as variables of interest, are hypothesised to be related to the outcome variable and are included to explain the variation in the outcome. In this research, personal human capital characteristics are included as explanatory variables, since it is hypothesised that these variables influence the wage that an individual earns - being in line with the human capital model and the Mincerian equation. Controlling variables are included in the model to control for their effects on the dependent variable. These are job characteristics, variables that affect wages, and variables whose distribution is expected to be different for the public and private sectors. Controlling variables are not

directly of interest to the stated hypothesis, but are important to establish a valid causal relationship. If they are not included, the causal relationship that is found is not interpretable. After all, there are still controlling variables that explain the relationship, or part of it, and which is not due to the independent variables. Table 3.2 provides an overview of all variables that are included in the analysis, including a general description and references to two studies, one that emphasised the significance of the variable, and one that included this variable in their analysis. A reference is preferably made to an old, well-known study if applicable, and, a recent study in the Netherlands. A distinction is made between outcome, explanatory and controlling variables. Also, the possible values are presented in the table.

Multicollinearity issues have been considered regarding the estimation of the regression models. Multicollinearity occurs when there is a high correlation between the explanatory or controlling variables in the regression analysis and which impacts the interpretation of the regression coefficients. Specifically, there exist two types of multicollinearity, structural multicollinearity and data multicollinearity - the first referring to multicollinearity due to how the model is specified, and the second referring to correlation in the data itself (Kutner et al., 2004). In other words, structural multicollinearity is a byproduct of the model that we specify rather than being present in the data itself.

To prevent structural multicollinearity issues, two steps have been taken. First, the age and age^2 are centred. age^2 is inserted to control for any non-linear effects of age, known as a polynomial term. This polynomial introduces multicollinearity, as age and age^2 are heavily correlated. To overcome this issue, age is centred around the mean value of age. This involves subtracting the average age from an individual's age ($age_i - a\bar{g}e$). Then, this centred age is squared to obtain the centred age^2. Individuals can be given a "negative" value for age as a result, ensuring little to no correlation between age and age^2, since the square of a negative number becomes positive again. However, this has important consequences for the interpretation. Second, all categorical variables are one-hot encoded through dummy encoding and reference levels have been chosen for each categorical variable. For each categorical variable, apart from the reference level, a separate dummy variable is created, taking a value of one if individual i has that particular value for that variable and zero otherwise. This dummy coding prevents multicollinearity problems. This centring, dummy coding, and the inclusion of a reference level are important for the interpretation of the coefficients - more on this interpretation in Section 4.2. For now, it suffices to know that the starting point in this research is to take the most generic or common value as the reference level. This always concerns the first value mentioned in Table 3.2, and numbered with a zero. With these two steps, structural multicollinearity is curbed. Section 4.2 tests for any data multicollinearity.

The model specification can be completed by implementing these variables for the X and Z vectors in the mathematical Equation 3.11, resulting in the following mathematical model specification:

$$\begin{aligned}\ln(wage_i) = \beta_0 + \beta_1 age_i + \beta_2 age_i^2 + \beta_{C1} C(gender_i) + \beta_{C2} C(origin_i) + \beta_{C3} C(education\ level_i) \\ + \beta_{C4} C(eduaction\ field_i) + \beta_{C5} C(full\text{-}time\ code_i) + \beta_{C6} C(contract\ duration_i) \\ + \beta_{C7} C(employer\ size_i) + \beta_{C8} C(urbanity_i) + \epsilon_i\end{aligned} \tag{3.12}$$

where some things need to be explained for the sake of clarity. First, an intercept term β_0 is added to the model. This is a constant and, mostly due to the addition of the reference levels, is important for the interpretation of the coefficients. Second, the model includes mostly categorical variables, denoted by a capital C and which take on a limited number of possible values and which are dummy coded. For each value of the categorical variable, except for the reference level, a separate dummy variable is created and a separate β is estimated. Third, for each individual, there is an associated error term ϵ_i that represents the difference between the predicted and observed values of the dependent variable. This error term is multiplied by the weighting factor $yfte$. As such, the β coefficients are estimated in such a way that the weighted mean of the error term is zero. This approach essentially gives more importance to individuals who have worked more hours. This model is applied for the WLS regressions in the Blinder-Oaxaca decomposition in the remainder of this report.

This model specification is used to estimate the regressions for the Oaxaca-Blinder decomposition. Specifically, three regressions are estimated per year for this decomposition, following Equation 3.6: one for the public sector, one for the private sector, and one pooling the public and private sectors. If broken down into a subgroup, this variable will of course be omitted from the regression. After all, there is then only one value left for this variable and this intercept is already captured with a constant. Including this variable would result in perfect multicollinearity with this constant.

Table 3.2: Overview of all included variables

Variable	Relevant studies	Possible values
Dependent outcome variable		
Log hourly wage is the hourly wage with bonuses, extras and overtime	(Mincer, 1974) (Biesenbeek et al., 2019)	Continuous: 0 →∞
Explanatory variables		
Age (and age^2) of an individual represents experience, which is an important human capital variable. The age^2 is to measure the non-linear effects of age.	(Becker, 2009) (Krueger, 1988) (Biesenbeek et al., 2019)	Continuous: 23 →64
Gender of an individual, the most well-known and most discussed variable that affects wages. The gender wage gap is probably even larger in scientific terms than the public-private wage gap.	(Weichselbaumer et al., 2005) (Krueger, 1988) (Biesenbeek et al., 2019)	Categorical: 0. Male 1. Female
Origin of the individual, Dutch or non-dutch, is related to command of the Dutch language.	(Becker, 2009) (Krueger, 1988) (Biesenbeek et al., 2019)	Categorical: 0. Native 1. Immigrant, first generation 2. Immigrant, second generation
Education level is the highest achieved level of the individual. Education is known as the most important human capital determinant.	(Becker, 2009) (Mincer, 1974) (Biesenbeek et al., 2019)	Categorical: 0. Primary, ISCED level 0/1 1. Secondary 1, ISCED level 2 2. Secondary 2, ISCED level 3 3. Tertiary 1, ISCED level 4/6 4. Tertiary 2, ISCED level 7/8
Education field is the education field corresponding to the highest achieved education level of the individual. Education is known as the most important human capital determinant.	(Becker, 2009) (Mincer, 1974) (Biesenbeek et al., 2019)	Categorical: 0. Generic programmes 1. Education 2. Arts and humanities 3. Social sciences, journalism and information 4. Economics and econometrics 5. Business and administration 6. Law 7. Natural sciences, mathematics and statistics 8. Information and Communication Technologies 9. Engineering, manufacturing and construction 10. Agriculture, forestry, fisheries and veterinary 11. Health and welfare 12. Services 13. Security services
Controlling variables		
Full-time code of the contract of the employee according to the number of weekly hours contractually agreed to work. It is found there exists a relationship between hours worked and hourly wage.	(Bick et al., 2018) (Biesenbeek et al., 2019)	Categorical: 0. Full-time 1. Part-time

Table 3.2: Continued, Overview of all included variables

Variable	Relevant studies	Possible values
Contract duration of the contract of the employee. It is believed in the Netherlands this has a big impact.	(Hospido et al., 2016) (Biesenbeek et al., 2019)	Categorical: 0. Infinite 1. Definite
Employer size is the number of employees working for the employer. There exists literature on the employer-size wage gap, in which a strong relationship is found.	(Green et al., 1996) (Biesenbeek et al., 2019)	Categorical: 0. 0-9 employees 1. 10-49 employees 2. 50-99 employees 3. 100-199 employees 4. 200-499 employees 5. 500-1999 employees 6. 2000+ employees
Urbanity refers to the geographical location of the employer, urban representing the four ”traditional” large cities in the Netherlands (Amsterdam, Rotterdam, The Hague, Utrecht). It is found that employees earn higher wages in cities and the geographical distribution of jobs is different between the public and private sectors.	(Gould, 2007) (Mincer, 1974) (Rattsø et al., 2020)	Categorical: 0. Non-urban 1. Urban

4

Wage Gap Estimation

This chapter presents the results of analysing the public-private wage differentials in the Dutch labour market between 2010 and 2021, answering the second sub-question: ”To what extent do public and private sector wages differ for the period 2010 to 2021?”. A constructive answer is given to this question using three sections: 1) basic statistics and wage trends, 2) the public-private wage differences using decomposition methods, and 3) a robustness analysis to test the choices made in the analysis. Though the evaluation of the reference model takes place in the discussion of Chapter 6, the results in this chapter are already lightly associated with the reference model and the Dutch public wage policy. Some interpretation is needed to build the storyline. The results in this main body support this storyline, Appendix D provides extra results.

4.1. Basic statistics and trends

This section delineates the characteristics of the public and private sectors, exposing composition- and wage disparities by comprising relevant basic statistics and raw wage trends.

Table 4.1 summarises the salient statistics that describe the characteristics of the public and private sectors and their differences over time. All basic statistics are shown in Appendix D. The table reveals that on average, wages in the public sector are higher than in the private sector and have increased more over time. However, the spread of wages is substantially greater in the private sector and has grown shockingly in a twelve-year period. It is worth noting that these figures reflect raw wages and may be driven by sector-specific attributes and differences.

Significant differences between the two sectors are indeed visible. For instance, men are underrepresented in the public sector compared to women while the opposite holds for the private sector. The public sector also has a higher proportion of individuals of Dutch descent, including native and second-generation immigrants. The public sector also has a large contingent of highly educated personnel, reflecting the demand for skilled individuals. Moreover, there are fewer individuals with a ”generic” education working in the public sector, as specialised knowledge and skills are typically required. The group with a generic education has also decreased enormously between 2010 and 2021. Interestingly, the private sector has a relatively high proportion of workers with a background in education. This supports the notion that including educational background is of importance when comparing wage differences for sector-specific jobs, as discussed in Section 3.3.1. Regarding the controlling variables, full-time employment is slightly higher in the private sector, which could be due to the higher percentage of men in the private sector. There are noteworthy differences in contract duration, with a higher percentage of infinite contracts in the public sector. Finally, the private sector logically employs more individuals overall, and the ratio of employed individuals to full-time equivalents in both sectors is not much apart.

Having observed sectoral composition differences, the focus now shifts to wage differences between the public and private sectors. Upon examining the basic statistics, three key points emerged: 1) overall differences in wages between the two sectors, 2) changes in wage development over the years, 3) and wider wage dispersion in the private sector. The remainder of this section delves deeper into these notable characteristics.

	Public		Private	
Variable	**2010**	**2021**	**2010**	**2021**
Dependent outcome variable				
Hourly wage	24.38 (8.38)	29.29 (10.51)	22.00 (15.52)	25.00 (36.20)
Explanatory variables				
Age	39.15 (10.07)	42.74 (11.08)	36.89 (10.00)	40.71 (11.39)
Gender (male)	47.42%	45.72%	59.28%	58.47%
Origin				
Native	85.60%	82.95%	82.82%	78.97%
Immigrant, first generation	6.12%	6.89%	8.73%	11.03%
Immigrant, second generation	8.28%	10.17%	8.45%	10.00%
Education Level				
Primary & secondary	11.77%	10.92%	23.69%	25.19%
Tertiary 1	53.20%	53.95%	58.13%	57.99%
Tertiary 2	35.03%	35.13%	18.18%	16.82%
Education field				
Generic programmes	14.89%	6.55%	23.45%	11.90%
Education	30.96%	26.08%	3.18%	2.65%
Health and welfare	9.40%	11.42%	11.93%	14.58%
ICT	1.77%	2.70%	3.17%	3.41%
Controlling variables				
Full-time	64.20%	59.56%	67.47%	63.25%
Contract duration (Infinite)	77.16%	81.13%	69.60%	72.22%
Counts				
Number of individuals	0.46	0.81	2.00	4.03
number of yfte	0.41	0.74	1.84	3.74

[1] The table has continuous, categorical and count variables, including respectively weighted means with standard deviations in parentheses, percentages indicating the occurrence of a particular value, or the total count in millions;
[2] The target population consists of all workers in the Netherlands with an employee contract, excluding students, people younger than 23 or older than 64, and people with an internship contract;
[3] The reported representative sample concerns approximately 46% of the entire target population in 2010 and 73% in 2021.

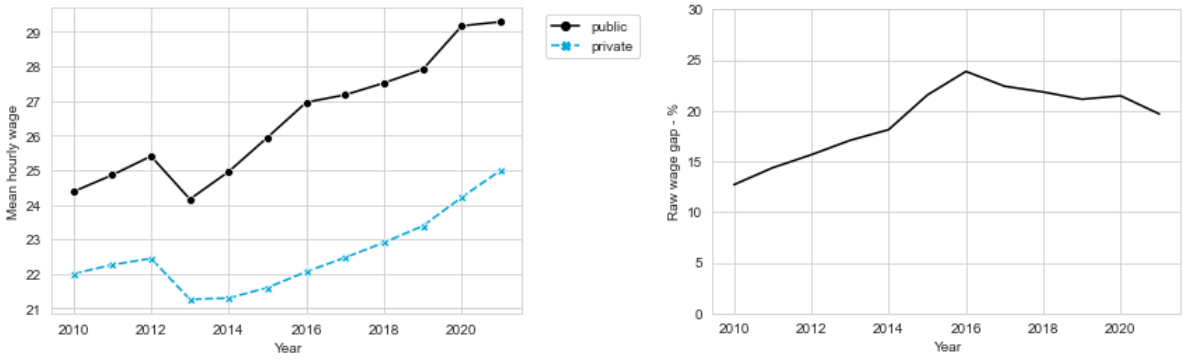
Table 4.1: Summary statistics overview

As can be seen in Figure 4.1a, wages in both sectors have changed. From 2010 to 2014, in the aftermath of the global economic crisis and the Euro crisis, wage growth was limited in both the public and private sectors. In 2015 and 2016, wages in the public sector rose rapidly. However, the private sector experienced a less prominent increase, resulting in diverging wages in 2015 and 2016 as can be seen from Figure 4.1b. In the years 2017 to 2021, this accumulated difference is partially made up.

The difference in the distribution of wages can be investigated by looking at different quantiles, as is done in Figure 4.2. The wage trends of the 0.1 and 0.9 quantiles show great diversion, as Figure 4.2a plots. This diversion is, as expected, greater for the private sector, though the dispersion is not as visible as one would suspect. What is striking is that the public sector has a much higher wage for the lower earners, presented by quantile 0.1. Perhaps most striking is the wages for quantile 0.9 - the highest earners. Here too, public sector wages are still slightly higher, while perhaps extreme incomes in the private sector are expected to be higher. It turns out that the 0.9th quantile does not yet concern extreme incomes and is similar to approximately 65 thousand euros on a yfte basis.

The degree of dispersion can more easily be determined by calculating the ”Gini coefficient”. The Gini coefficient is a measure of income distribution across a population and is expressed as a number between zero, perfect equality, and one, perfect inequality (Ceriani et al., 2012). For 2021, the Gini coefficient of the public sector is consistent at around 0.18 and that of the private sector is at around 0.28, a difference of over 55%. So, the wage dispersion is indeed smaller in the public sector. The trend of the Gini coefficients between 2010 and 2021 is shown in Appendix D.

Lastly, it is interesting to investigate to what extent this diversion occurs between certain groups. The most discussed is the gender wage gap, gaining attention in the Netherlands in past years. Figure 4.3 shows the differences between men and women. It should be clear that the average wage of both

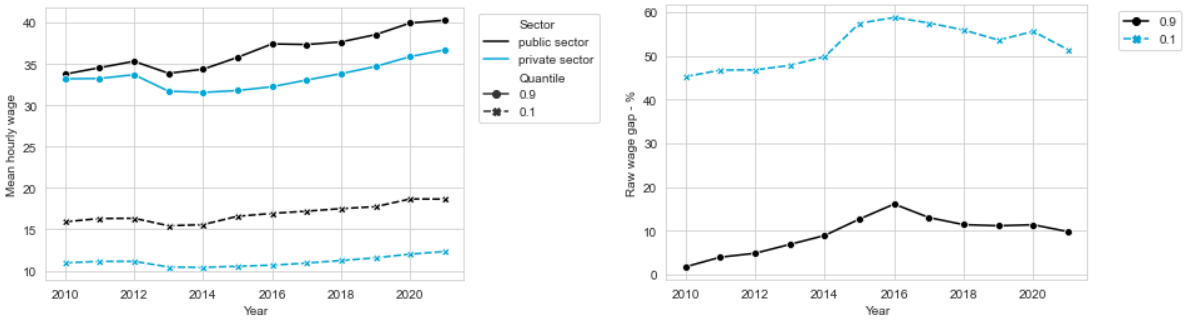


(a) Weighted average hourly wages [2]

(b) Raw percentage wage gap [3]

[1] The figures concern the entire sample in the analysis;
[2] The weighted average concerns a weighting of individuals for the number of hours worked in the year (yfte);
[3] The raw percentage wage gap concerns the percentage difference between the weighted average wage of the public sector compared to the private sector.

Figure 4.1: Total raw wage trend



(a) Weighted average hourly wages [2]

(b) Raw percentage wage gap [3]

[1] The figures concern the entire sample in the analysis, of which quantiles 0.1 and 0.9 are being compared;
[2] The weighted average concerns a weighting of individuals for the number of hours worked in the year (yfte);
[3] The raw percentage wage gap concerns the percentage difference between the weighted average wage of the public sector compared to the private sector.

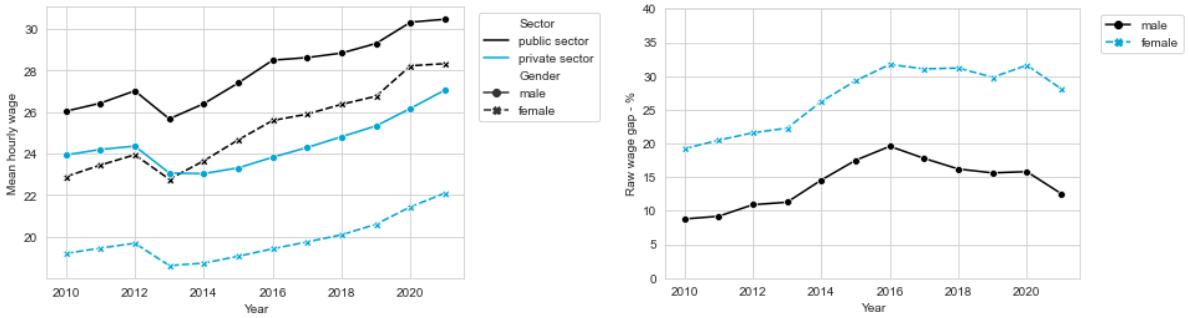
Figure 4.2: Raw wage trend splitted on quantiles

genders is closer together in the public sector. Perhaps the government has egalitarian reasons and wants to reduce wage discrimination on the basis of gender, identified as a legitimate reason in Section 2.2.1. Other segregation, for example by type of employment or level of education, shows the same trend. The main point has been made here and it would therefore be rather repetitive to show each of these splits.

There seem to be major differences between the sectors, in composition, wage, and dispersion. Wages appear to be higher and the spread between subgroups appears to be smaller in the public sector compared to the private sector. So, it appears wages are not comparable. It also appears that this comparability fluctuated between 2010 to 2021, with an increase between 2013 and 2016. However, the word ”appear” is used with intent, as human capital characteristics have not yet been controlled for. This can change the picture that has just emerged. Therefore, no conclusions can be drawn yet. The next section, with the application of the Oaxaca-Blinder decomposition, will be more conclusive.

4.2. The adjusted public-private wage gap

The trends presented above have not yet been controlled for differences in personal human capital characteristics, which will be done using the Oaxaca-Blinder methodology. As regression models are



(a) Weighted average hourly wages [2]

(b) Raw percentage wage gap [3]

[1] The figures concern the entire sample in the analysis, split by gender;
[2] The weighted average concerns a weighting of individuals for the number of hours worked in the year (yfte);
[3] The raw percentage wage gap concerns the percentage difference between the weighted average wage of the public sector compared to the private sector.

Figure 4.3: Raw wage trend splitted on gender

used in the Oaxaca-Blinder decomposition, the regression coefficients of individual variables are presented first. The results of the decomposition are shown afterwards, starting with the mean and followed by breakdowns into subgroups and along the wage distribution, continuing the storyline and evaluation of the Dutch public wage policy.

4.2.1. Regression model estimates

To perform the Oaxaca-Blinder decomposition, separate weighted OLS regressions are performed per sector. The specification of these models is described in Section 3.4. Table 4.2 shows the results, including the R^2 and the individual regression coefficients of the human capital characteristics. The entire list of coefficients is presented in Table D.2 of Appendix D.

It is important to clarify the correct interpretation. Firstly, in a log-level model, the regression coefficients represent the estimated impact of a specific human capital characteristic on the average individual's wage level. As such, the coefficients should be interpreted as semi-elasticity, which means that a percentage change in the independent variable will cause a proportional change in the dependent variable. For categorical variables used in this model, the interpretation of coefficients is more straightforward, where the coefficient represents the percentage change in the wage level when the categorical variable applies. Secondly, for categorical variables, the constant term represents the estimated wage when all reference levels apply. The coefficients of categorical values indicate the influence with respect to the reference level, which has no coefficient and is included in the constant. The reference level for each categorical variable is shown in Table D.2. Thirdly, regarding age, the constant term represents the estimated wage for the average age, as the age variable is centred around the mean.

Three points are important for the interpretation of the coefficients. First, in general, the regression coefficients should be interpreted as the estimated influence of a specific human capital characteristic on the level of an average individual's wage. As a log-level model is applied, the dependent variable is expressed in natural logarithm and semi-elasticity holds. For a semi-elasticity model, the coefficient should be interpreted as: "the $(\beta * 100)\%$ change in y (wage) when x (independent variable) increases by one unit" (Wooldridge, 2015). Since mostly categorical variables are used in this regression model, this log-level definition makes the interpretation of the coefficients rather intuitive as: "the $(\beta * 100)\%$ change in y (wage) when x (categorical variable) applies". Secondly, for categorical variables, the coefficients of categorical values indicate the influence with respect to the reference level, which has no coefficient and is included in the constant. The constant term represents the estimated wage when all reference levels apply. The reference level for each categorical variable is shown in Table D.2. Thirdly, regarding age and age^2, the constant term represents the estimated wage for the average age, as the age variables are centred around the mean.

Table 4.2 illustrates the goodness-of-fit, the constant, and the coefficients of the human capital characteristics of the regression estimates. The table shows that a higher age has a similar positive impact on wages in both sectors. Additionally, men receive higher wages than women, and this disparity

is more significant in the private sector. Education has the most substantial influence, where the highest level of education leads to an increase in wages of around 50 to 70 per cent compared to primary education. This influence has also grown over the years. The education field has a bit of a mixed impact on wages. Economics is the most positive educational background on wages, and this effect is more significant in the private sector. For the healthcare and ICT backgrounds, the table indicates that healthcare does not differ much between the public and private sectors, while an ICT background has a more significant effect in the private sector.

Table 4.2: Regression coefficients of the weighted OLS estimation

	Public		Private	
Variable	2010	2021	2010	2021
R^2	0.45	0.45	0.44	0.44
Constant	2.84	3.02	2.76	2.89
Age	0.017	0.014	0.016	0.012
Age^2	-0.001	-0.001	-0.001	-0.001
Gender (Male)				
Female	-0.07	-0.05	-0.12	-0.11
Origin (Native)				
Immigrant, 1st generation	-0.10	-0.10	-0.14	-0.14
Immigrant, 2nd generation	-0.01	-0.02	-0.02	-0.03
Education Level (Primary)				
Secondary 1	0.09	0.16	0.08	0.12
Secondary 2	0.27	0.30	0.19	0.21
Tertiary 1	0.34	0.46	0.32	0.40
Tertiary 2	0.50	0.67	0.60	0.73
Education field (Generic programmes)				
Education	-0.04	-0.09	-0.02	-0.11
Arts and humanities	-0.05	-0.15	-0.12	-0.22
Social sciences, journalism and information	0.02	-0.09	0.19	-0.08
Economics and econometrics	0.13	0.01	0.25	0.19
Business and administration	0.01	-0.10	0.05	-0.05
Law	0.08	-0.05	0.12	0.00
Natural sciences, mathematics and statistics	-0.02	-0.11	0.03	-0.03
Information and Communication Technologies	0.00	-0.10	0.05	-0.03
Engineering, manufacturing and construction	-0.01	-0.11	-0.03	-0.11
Agriculture, forestry, fisheries and veterinary	-0.06	-0.20	-0.10	-0.21
Health and welfare	0.01	-0.06	0.03	-0.04
Services	-0.06	-0.18	-0.10	-0.18
Security services	-0.11	-0.16	-0.17	-0.22

[1] The regression coefficients concern the explanatory variables, all human capital characteristics, estimated in the weighted OLS regression estimation for the Oaxaca-Blinder decomposition of the mean;
[2] Age and age^2 are centred on the mean age (public sector: 39.15 in 2010 and 42.74 in 2021, private sector: 36,89 in 2010 and 40.71 in 2021). The reference level for each categorical variable is shown in parentheses. The constant represents the estimated logarithmic wage for the combination of all reference levels and the mean age;
[3] The target population consists of all workers in the Netherlands with an employee contract, excluding students, people younger than 23 or older than 64, and people with an internship contract;
[4] The reported representative sample concerns approximately 46% of the entire target population in 2010 and 73% in 2021;
[5] Each coefficient is significant for significance level p<0.01.

The regression models are estimated with consideration of potential multicollinearity issues. Structural multicollinearity was addressed by correctly defining the regression model using centred continuous variables and dummy encoding for categorical variables, as described in Section 3.4. Data multicollinearity, which occurs when explanatory and controlling variables are correlated in the data, is tested using mutual correlation and Variance Inflation Factor (VIF) scores. VIF scores are a statistical concept used to measure the severity of multicollinearity in regression analysis. Appendix D presents

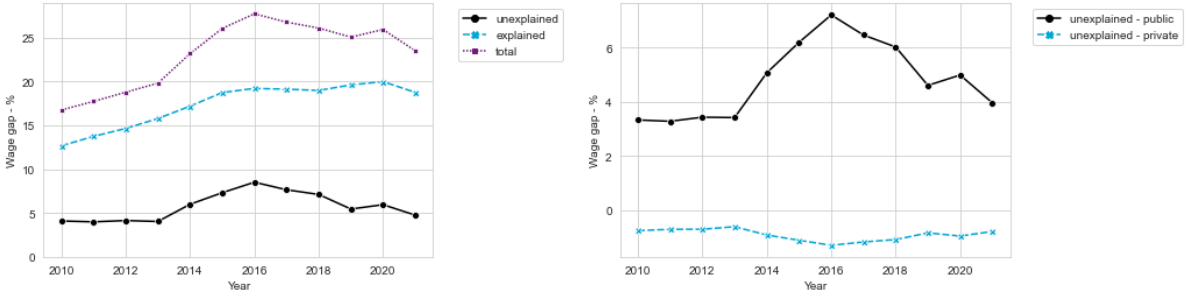
the results of the correlation and VIF scores, which indicate that there are no multicollinearity issues as the correlations are below 0.5 and the VIF scores are well below 10. This ensures the reliability of the interpretation of the coefficients presented above. Furthermore, multicollinearity would not have posed a problem for any additional analysis, since it only affects the interpretation of individual coefficients and not the overall estimation and goodness-of-fit (Wooldridge, 2015).

4.2.2. Wage gap estimates

The Oaxaca-Blinder decomposition concerns the breakdown of the total wage gap into an explained and unexplained gap, both public sector advantage and private sector advantage - as formulated in Equation 3.6. Figure 4.4 illustrates this decomposition from 2010 to 2021.

The first thing that stands out about Figure 4.4a is that the wage gap can largely be explained by differences in human capital characteristics. The total wage gap amounts to 24% in 2021, of which more than 19% is explained. Though, a considerable 5% cannot be explained by human capital characteristics. This means that public servants earn an average of 5% more, regardless of their capabilities, 4% of this 5% is explained by the unexplained public advantage, and 1% is explained by the private disadvantage.

In addition, the increase over the years is striking, the wage gap is ”only” a small 17% in 2010 and increases to 27% in 2016, before falling slightly to 24%. This can partly be explained by the human capital variables, but partly not. The increase between 2014 and 2016 in particular seems inexplicable by human capital characteristics. Figure 4.4b shows a sharp increase in the unexplained public advantage, more than doubling between 2013 and 2018. In subsequent years, this wage gap narrows again. Wages thus are reasonably comparable for the weighted average individual.



(a) Total wage gap splitted by explained and unexplained wage gap [2] (b) Unexplained wage gap splitted by public and private advantage [3]

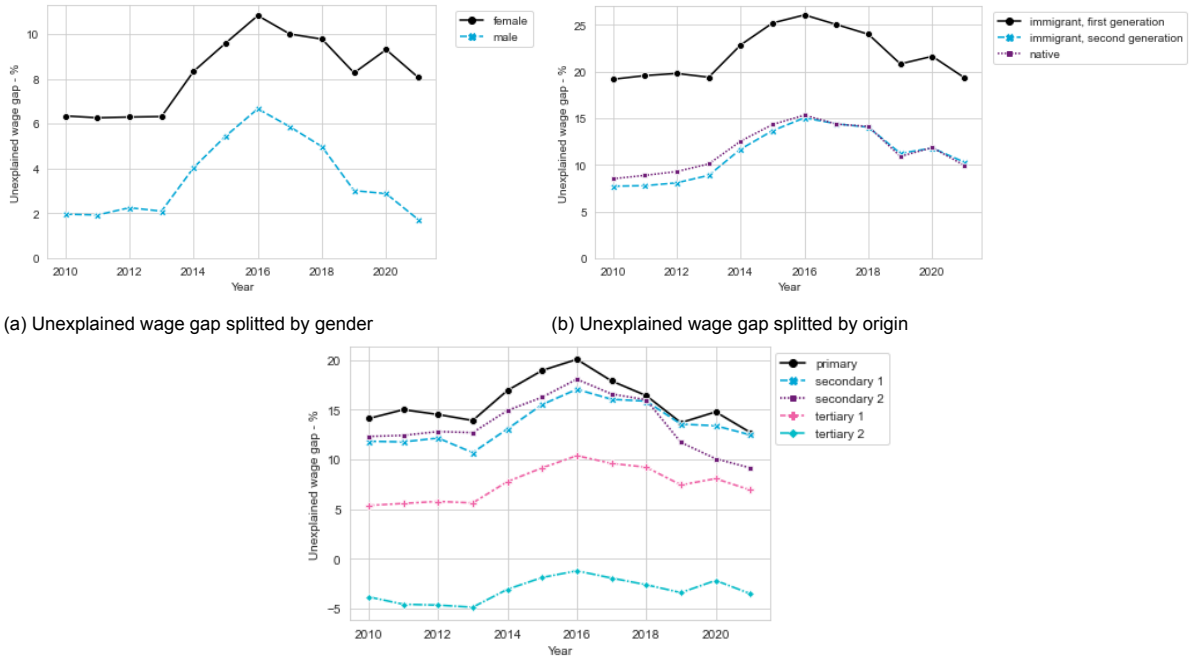
[1] The figures concern the entire sample in the analysis;
[2] This decomposition concerns the three-folded Oaxaca-Blinder decomposition of the mean, decomposing the wage gap into an explained and unexplained wage gap;
[3] The unexplained wage gap consists of the public sector advantage minus the private sector advantage, which two are shown on the right.

Figure 4.4: Oaxaca-Blinder decomposition of the public and private sector wage gap

However, if average earnings in the public and private sectors are comparable, earnings need not be comparable. If one half of the wage distribution gains a public wage premium, while the other of the distribution receives a public wage penalty - the average differential will be close to zero, suggesting comparability when, in truth, no workers are being paid comparably (Belman et al., 2004). Hence, it is important to dissect the wage gap for subgroups.

Figure 4.5 shows the wage gap for different subgroups based on personal characteristics. Looking at the gender differences in Figure 4.5a, it is striking that women experience a much higher public wage premium. The public sector pays women better than the private sector. However, it has also been found that men are paid better in general. Women are less ”undervalued” in the public sector. Also striking is the breakdown by origin in Figure 4.5b. The wage gap for native Dutch people and second-generation immigrants is almost identical, while first-generation immigrants receive a considerably higher public premium. This could be explained by the fact that first-generation immigrants do not have a good command of the Dutch language and therefore have fewer opportunities in the labour market.

Looking at the educational characteristics, even greater differences can be observed. The breakdown by level of education shown in Figure 4.5c indicates large differences. Here, people with primary



(a) Unexplained wage gap splitted by gender

(b) Unexplained wage gap splitted by origin

(c) Unexplained wage gap splitted by education level

[1] The figures concern the entire sample in the analysis, split by (a) gender, (b) origin, or (c) education level;
[2] This decomposition concerns the three-folded Oaxaca-Blinder decomposition of the mean, showing only the total unexplained wage gap.

Figure 4.5: Oaxaca-Blinder unexplained wage gap splitted by personal characteristics

and secondary 1, the level below the basic qualification within the Netherlands, receive a wage premium of almost 15%, while the highest education group, tertiary 2, is faced with a public penalty of over 4%. Table 4.3 shows the great differences in adjusted wage gaps for each education field for three years: 2010, 2016 and 2021. Economists in the public sector, as a lower limit, pay a public penalty of over 17%, while people with an artistic background, as an upper limit, receive a public premium of almost 20%. The development over time also differs strongly per educational background. While economists pay a fairly constant penalty, that of security services rose significantly between 2010 and 2016 and then fell again between 2016 and 2021. At the same time, education background did increase between 2010 and 2016 but did not decrease in subsequent years.

Finally, it is interesting to look at the differences across a particular distribution. The wage gap can be further broken down over distributions, for which one does not look at the wage gap over the years but at the wage gap over the distribution for specific years. Figure 4.6 shows two of these distributions for the years 2010, 2016 and 2021. Figure 4.6a pictures the distribution over age. There are no very obtrusive trends in this, though, the wage gap is larger at the beginning of someone's professional career and at the end of someone's professional career.

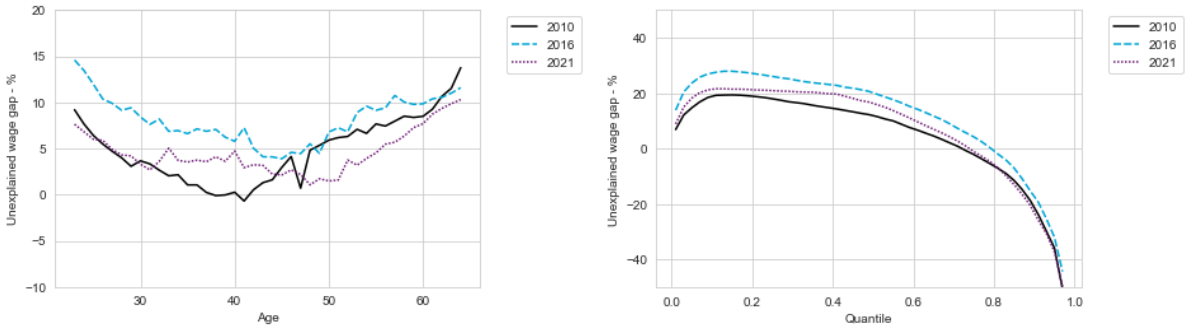
It becomes more interesting if one looks at the income distribution, for which the counterfactual quantile decomposition has been applied. The results of the wage decomposition can be seen in Figure 4.6b. This clearly shows that individuals at the lower end of the income distribution have a high adjusted wage gap and the gap narrows as they move further along the distribution. The highest earners pay a public penalty and are therefore financially better off in the private sector. Over the years, it is striking that this distribution is most skewed for 2016, as can now be expected. 2010 and 2021 do not differ much from each other, only around the median is the adjusted wage gap higher in 2021.

These distributions, together with other subgroup breakdowns, provide evidence that wages in the public sector are not comparable with wages in the private sector. There is a group that receives a large public premium, while another group faces a public penalty. This suggests that wages in the public sector are not comparable. Over the years, this wage gap fluctuates heavily with a strong increase between 2013 and 2016, which leads to the conclusion that this comparability has indeed fluctuated considerably over the period 2010 to 2021.

Education field	2010	2016	2021
Generic programmes	13.5%	18.9%	12.4%
Education	6.3%	13.0%	13.0%
Arts and humanities	15.3%	24.0%	19.5%
Social sciences, journalism and information	2.4%	7.6%	4.0%
Economics and econometrics	-16.0%	-15.4%	-17.5%
Business and administration	3.2%	9.2%	4.4%
Law	-5.5%	-1.7%	-5.8%
Natural sciences, mathematics and statistics	-1.5%	1.6%	-3.5%
Information and Communication Technologies	-0.6%	4.2%	-3.0%
Engineering, manufacturing and construction	7.4%	11.5%	6.2%
Agriculture, forestry, fisheries and veterinary	11.2%	18.1%	13.5%
Health and welfare	8.8%	13.6%	13.9%
Services	14.4%	21.6%	11.6%
Security services	17.9%	24.7%	8.3%
Total	4.1%	8.5%	4.7%

[1] The figure concerns the entire sample in the analysis, but split by education field;
[2] This decomposition concerns the three-folded Oaxaca-Blinder decomposition of the mean, showing only the total unexplained wage gap.

Table 4.3: Oaxaca-Blinder unexplained wage gap splitted by education field



(a) Unexplained wage gap along the age distribution [2]

(b) Unexplained counterfactual wage gap along the income distribution [3]

[1] The figures concern the entire sample in the analysis, split by (a) age or (b) percentiles;
[2] The left figure (a) concerns the three-folded Oaxaca-Blinder decomposition of the mean, showing only the total unexplained wage gap;
[3] The right figure (b) concerns the counterfactual quantile Oaxaca-Blinder decomposition along the income distribution, showing only the total unexplained wage gap.

Figure 4.6: Oaxaca-Blinder unexplained wage gap along distributions

4.3. Robustness analysis

A robustness analysis is conducted to justify the analysis choices made in Section 3.3.1 and compare their impact to alternative choices. Three key choices are analysed for robustness: wage definition, public sector definition, and usage of weights. The analysis is based on mean Oaxaca-Blinder decomposition to avoid excessive plots.

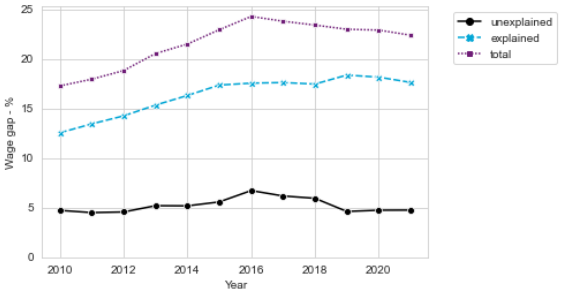
4.3.1. Basic definition of wages

Within the analysis, an hourly wage including any variable payments is applied. However, one can also apply an hourly wage without any variable payments, the contractually agreed hourly wage. This robustness check uses contractually agreed hourly wages in response to the discussed point of attention: ”definition of wages”.

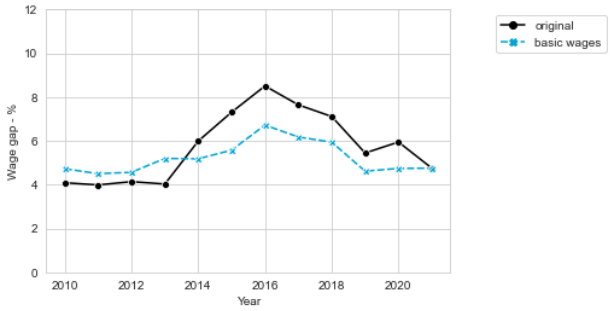
Luckily, in the Spolisbus dataset, a variable is included that only contains the contractually agreed wage, as well as the contractually agreed number of hours worked. These variables can be used to

calculate the log hourly basis wage, the wage without any bonuses, and the basis yfte. This definition of wage is referred to as the basic wage in this report, and this variable is also included in the basic statistics in Appendix D. Then, using the yfte, only the employee relationship is included in which the most hours have been worked. Also, only individuals who have at least worked half a yfte, corresponding to 860 hours, are included in the analysis.

Figure 4.7 shows the Oaxaca-Blinder wage gap of this basic wage definition, also in relation to the original wage definition, which is referred to as extra wage. It shows fairly equal values for the wage gaps. The most notable difference is in the unexplained wage gap development between 2013 and 2018, where the unexplained wage gap for the basic wage definition is less volatile. This can perhaps be explained by the fact that the basic wages have less spreading. Nevertheless, the robustness check does not indicate non-robust results for the definition of wages applied within the analysis.



(a) Total wage gap splitted by explained and unexplained wage gap for a basic definition of wages



(b) Unexplained wage gap: original vs. robustness check

[1] The basic definition of wage concerns the contractually agreed hourly wage without any variable payments;
[2] The original definition of wage concerns the total hourly wage with any variable payments.

Figure 4.7: Robustness check: Basic definition of wages

4.3.2. Narrow definition of the public sector

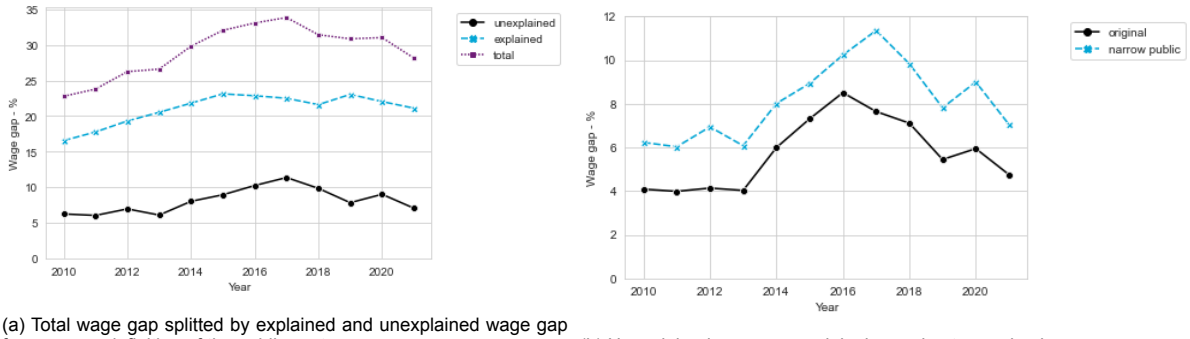
Within the analysis, a broad definition of the public sector is applied. This public sector includes sector-specific jobs, including teachers, healthcare workers, defence and police, and judiciary. As discussed, this study takes an economic approach, focusing on comparing people from both sectors. It is also possible to adopt a political approach, focusing on the public sector's labour market (Biesenbeek et al., 2019). This political approach focuses on a narrow definition of the public sector, looking at public administration jobs and excluding the following sector-specific jobs: education, defence, police and judiciary. The definition of the private sector remains the same. This robustness check uses the narrow definition of the public sector in response to two discussed points of attention: "sector-specific jobs" and "definition of the public sector".

The dataset included a variable that reveals the sector of the employer. Using this sector, one can limit public sector employees to only those employees that work at the national decentral government, excluding any other public sector jobs. Then the same Oaxaca-Blinder decomposition can be performed.

Figure 4.8 shows the Oaxaca-Blinder wage gap of this narrow public sector definition. The wage gap for the narrow definition is slightly higher than for the broad definition as used in the analysis but otherwise shows the same development. This higher unexplained wage gap is of course explained by the differences in composition between the narrow and broad definitions. However, the choice for the broad definition is deliberate and the differences in composition are part of the story and the evaluation. Hence, there is no reason to doubt the robustness of the results within the analysis based on the definition of the public sector.

4.3.3. Exclusion of yfte weights

Within the analysis, a weighting factor called yfte is applied. This is to correct for the number of hours someone has worked in a year on the one hand, and, on the other hand, to apply a weighting factor to prevent employees with multiple simultaneous jobs from being included twice in the regression model, as a result of which their human capital characteristics are wrongly weighted more heavily in the re-



(a) Total wage gap splitted by explained and unexplained wage gap for a narrow definition of the public sector

(b) Unexplained wage gap: original vs. robustness check

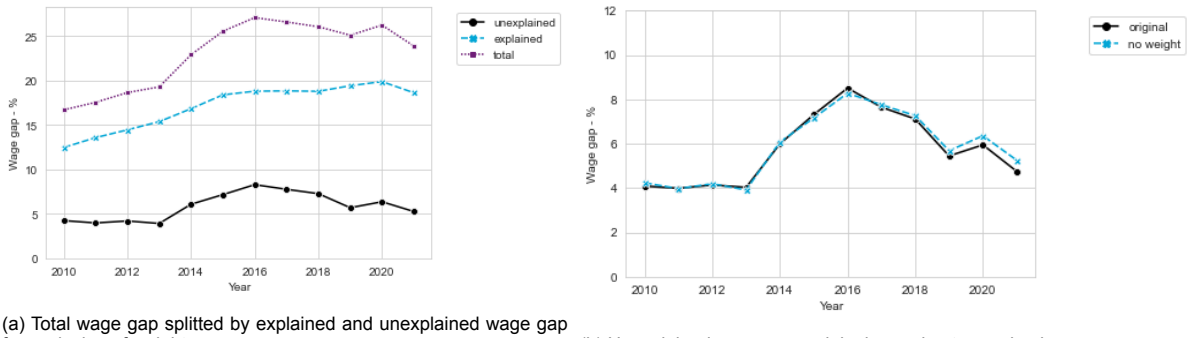
[1] The narrow definition of the public sector concerns only the national decentral government, including provinces and municipalities;
[2] The original definition of the public sector concerns all public servants, also including education, defence, police and judiciary.

Figure 4.8: Robustness check: Narrow definition of the public sector

gression. However, the choice can also be made to weigh everyone equally and only look at the job in which a person has worked the most hours - dropping the weight, only including the main occupation of an individual. The WLS regression, as specified in Section 3.4, then becomes a normal OLS regression again. This robustness check performs a mean decomposition dropping the weights and considering the main occupation of an individual only, in response to the discussed point of attention: ”upcoming trend: part-time workers”.

To make this possible, it is first necessary to filter on only the main occupation of each individual in the original dataset. The yfte is used for this. In addition, only individuals are included who have a yfte of more than 0.5, minimally 860 hours in a year - as discussed in Section 3.3.1 to only include individuals that have been sufficiently active in the labour market. As a final step, each individual's weight is equalised to one, essentially dropping the weights of the individuals and making it a normal OLS regression (Wooldridge, 2015).

Figure 4.9 shows the Oaxaca-Blinder wage gap of the exclusion of weights. It shows very limited differences with the analysis with the use of weights, something that on the one hand confirms the robustness and on the other hand perhaps shows that the addition of weights in the analysis produces more work than improved insights. However, also from an international perspective, this can also change per country and over time. Excluding weights is therefore not necessarily the right choice. In that case, a robustness check in the other direction, with the addition of weights, would be a valuable addition. Still, it can be concluded that the robustness check does not indicate non-robust results for the weights applied within the analysis.



(a) Total wage gap splitted by explained and unexplained wage gap for exclusion of weights

(b) Unexplained wage gap: original vs. robustness check

[1] The exclusion of weights concerns a sample with only the individuals who worked more than 860 hours in the relevant year, for this sample an unweighted OLS regression is applied within the Oaxaca-Blinder decomposition;
[2] The original analysis applied weighted OLS regression within the Oaxaca-Blinder decomposition, weights based on the number of hours worked in the year by the individual (yfte)

Figure 4.9: Robustness check: Unweighted OLS regression

4.4. Concluding notes: Answering the second sub-question

The analysis of public-private wage differences provides the insights needed to answer the second sub-question: ”To what extent do public and private sector wages differ for the period 2010 to 2021?”.

There are substantial differences in wages between the public and private sectors. On average, public sector employees earn a higher wage than private sector employees, as is shown by the basic statistics and raw wage trends. However, these statistics also show major differences in composition between the two sectors. There are clear differences in the averages in education level, education field, contract duration and gender.

The mean Oaxaca-Blinder decomposition shows that the wage gap between the public and private sectors is largely explained by human capital characteristics, the explained wage gap. The average wage is reasonably comparable, as is to be expected from the Dutch public wage policy with a competitive approach. Though, there is an unexplained gap of more than 5% for 2021. Also, there are big changes visible over the years with a significant rise in the unexplained wage gap during 2015 and 2016.

Looking at the Oaxaca-Blinder decomposition beyond the mean, analysing subgroups, age or income distributions, it can be seen there exists a much greater unexplained wage gap. Substantial differences in wages exist between the public and private sectors that cannot be explained by the human capital characteristics for these subgroups. As such, it is concluded that wages of individuals in the public sector are not comparable to wages in the private sector - groups are either ”overpaid” or ”underpaid”. Belman et al. (2004) statement stands, ”If one half of the wage distribution gain a public wage premium, while the other of the distribution receive a public wage penalty - the average differential will be close to zero, suggesting comparability when, in truth, no workers are being paid comparably”. This is exactly what the data shows and is against the expectations of the Dutch public wage policy, which mainly aims for competitive wage-setting.

Lastly, it is important to pay brief attention to the quality of the analysis. The weighted OLS regressions, and the exclusion of multicollinearity issues, show that the regression model applied within the Oaxaca-Blinder decomposition yields reliable interpretable coefficients. The robustness analysis shows that the analysis is robust for several methodological choices made. This speaks in favour of the quality of the analysis. However, the question can be asked whether the application of weights is worthwhile. It takes effort and time to adapt the method to weighted regressions, while the outcomes are virtually identical.

In the next chapter, the relation between these found wage gaps and sectoral mobility is examined. This is to gain insight into whether wage differences can be a possible reason for labour shortages. To get a better understanding of this, there is an application for two labour groups with severe labour shortages: healthcare and ICT personnel.

5

Sectoral Job Mobility Analysis

This chapter presents the results of the sectoral job mobility analysis, answering the third sub-question: ”To what extent can the public-private wage differentials explain labour market shortages?”. The goal is to investigate whether a relationship exists between the estimated wage gap and sectoral shifts towards or from the public sector. Section 5.1 performs the analysis for the whole public sector and Section 5.2 applies this analysis to two professional groups with a shortage: healthcare workers and ICT personnel.

5.1. Sectoral job mobility analysis

This section exposes a possible relationship between wage differentials and the number of sectoral shifters to or from the public sector, applying the ”back-of-the-envelope” calculation from Section 3.2. This section first provides basic statistics of sectoral shifters, followed by an examination of correlations.

Table 5.1 summarises the statistics that describe the characteristics of ”sectoral shifters”, people that have moved from the public sector to the private sector (public leavers), and vice versa (public joiners). For the sake of completeness, they are compared with public stayers, the total public sector. All statistics are available in Appendix E.

Table 5.1 reveals that on average, wages of public stayers are higher than those of joiners and leavers. People entering the public sector are younger on average and are most often offered fixed-term (definite) contracts. This may result in a lower starting wage. We also see differences between education and healthcare backgrounds, with relatively few people with an education background shifting sectors, while more healthcare workers do so. This is because healthcare is arranged both publicly and privately, while education is primarily provided by the public sector in the Netherlands.

The relationship between the estimated wage gap and the number of shifters is investigated using Pearson correlations, the results of which are shown below. Figure 5.1 presents the correlation between the sectoral shift balance, both measured as the total number of individuals and the total amount of FTE, and the Oaxaca-Blinder wage gap estimates, including the total, the explained, and the unexplained wage gap. The correlations show a strong relationship between any of the wage gaps and the shift balances - confirming the suspicion of a relationship. For instance, the correlation between the total wage gap and the shift balance is equal to 0.77 and 0.76 for the number of individuals and amount of FTE respectively, which indicates a very strong relationship. Since the difference between FTE and the number of people is limited, we will refer to the correlation employing the FTE in the remainder of this report. What is striking about the correlations is that the relationship between the explained wage gap and the shift balance is stronger than for the unexplained wage gap. While the explained wage gap exceeds the total wage gap with a correlation value of 0.83, the unexplained wage gap remains at ”only” 0.53 - a striking finding that feels counter-intuitive. As not much is known about the exact relationship, this finding may have several causes and can be guessed with suggestive reasoning. It is, for instance, possible that information asymmetry occurs. Employees know better what a fair wage is for them based on the observed human capital characteristics and are more guided by this. This could be an explanation for why the explained wage gap has a higher correlation with the shift balance, but this remains suggestive. More research is needed to provide clarity on this.

Variable	Public joiner	Public leaver	Public stayer
Dependent outcome variable			
Hourly wage	25.06 (9.26)	28.73 (23.94)	29.29 (10.51)
Explanatory variables			
Age	37.55 (10.75)	39.20 (10.76)	42.74 (11.08)
Gender (male)	44.53%	45.66%	45.72%
Origin			
Native	79.25%	80.87%	82.95%
Immigrant, first generation	7.85%	7.96%	6.89%
Immigrant, second generation	12.90%	11.18%	10.17%
Education Level			
Primary & secondary	9.87%	8.78%	10.92%
Tertiary 1	56.65%	48.36%	53.95%
Tertiary 2	33.48%	42.86%	35.13%
Education field			
Generic programmes	5.53%	4.96%	6.55%
Education	16.98%	16.98%	26.08%
Health and welfare	16.56%	21.26%	11.42%
ICT	2.93%	2.76%	2.70%
Controlling variables			
Full-time	58.38%	53.12%	59.56%
Contract duration (Infinite)	31.92%	55.85%	81.13%
Counts			
Number of individuals	80.3	38.9	$0.81*10^3$
number of FTE	75.7	31.3	$0.74*10^3$

[1] The table has continuous, categorical and count variables, including respectively weighted means with standard deviations in parentheses, percentages indicating the occurrence of a particular value, or the total count in thousands;
[2] The samples consist of all employees who have joined the public sector from the private sector in 2021 (public joiner), all employees who have left the public sector to the private sector in 2021 (public leaver), or all employees in the public sector in 2021 (public stayer).

Table 5.1: Summary statistics of the public sector and shifters for 2021

[1] The heatmap concerns the correlations between the wage gaps and the shift balances;
[2] The gaps concern the three-folder Oaxaca-Blinder decomposition of the mean, showing the unexplained, the explained, and the total wage gap;
[3] The shift balances concern the number of people or FTE that have joined the public sector from the private sector, minus the number of people or FTE that have left the public sector to the private sector.

Figure 5.1: Correlation heatmap between wage gap estimates and sectoral shift balances

The above analysis indicates a relationship between wage differentials and sectoral shifts. But it can still be related to a limited extent to specific shortages that the Dutch public sector is currently facing. To gain more insight into specific shortages, we zoom in on professional groups with shortages below.

5.2. An application to occupation shortages

In this section, an application is made to healthcare and ICT personnel as these occupations have been detected as extremely tight and consequential in the introduction of Chapter 1. These occupations are zoomed in by looking at the educational background of individuals. As found above, healthcare occupations have some substitution options in the private sector, but this is even more so for ICT personnel, who can be of value to almost any company in any sector and are therefore extremely mobile. To identify differences in mobility, the sectoral balance is expressed in percentages, the amount of FTE shifted compared to the total amount of FTE with the same occupation or educational background in the public sector. To keep the results concise, only the amount of FTE shifted is considered.

Table 5.2 presents the estimated wage gaps and the percentage shift balance for the healthcare and ICT educational fields. The shift balance is positive for both education fields for all years, which means that structurally more people move from the private sector to the public sector than the other way around. Though, there are big differences between the two education fields. While people with a healthcare background receive a substantial public premium of over 8%, people with an ICT background receive a public penalty of 2%. The effect of the compensation measures in 2015 and 2016 can also be observed here. It is striking that in the years after 2016, the unexplained wage gap for ICT personnel decreased structurally and therefore became negative, while the unexplained wage gap for healthcare personnel remained constant. This may be due to the large media attention for shortages in healthcare combined with the high workload and which led to extra financial compensation (NOS, 2021a). These wage gap differences for subgroups have been discussed in Chapter 4, but are thus observed again here. Also, as expected the percentual shift between both education fields is different, with people with an ICT background being more mobile due to their ability to work in almost any sector.

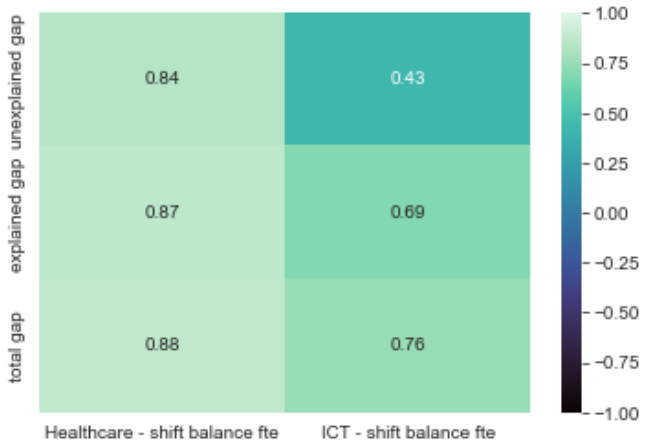
The wage gaps and sectoral shift balances seem to be related. During the period of 2010-2013, with low wage premia, the influx of public employees is limited, while the influx increases sharply in the years in which the compensation policy has been applied. However, this relationship can better be estimated with correlations.

	Healthcare				**ICT**			
	Wage gap			**Shift**	**Wage gap**			**Shift**
Year	Unexpl.	Expl.	Total	Balance	Unexpl.	Expl.	Total	Balance
2010	4.89%	10.10%	14.99%	0.21%	-1.11%	5.55%	4.44%	5.36%
2011	3.75%	10.75%	14.50%	0.20%	-1.27%	6.22%	4.95%	1.43%
2012	3.69%	11.51%	15.21%	0.23%	-1.51%	7.16%	5.65%	1.76%
2013	3.79%	11.82%	15.61%	0.17%	-2.00%	7.68%	5.68%	0.84%
2014	6.60%	13.40%	20.00%	0.73%	0.44%	8.86%	9.06%	5.56%
2015	7.33%	13.92%	21.24%	0.36%	1.84%	10.25%	12.10%	5.52%
2016	8.71%	14.28%	22.99%	0.46%	3.69%	10.37%	14.07%	6.31%
2017	8.50%	14.27%	22.77%	0.64%	2.71%	9.02%	11.74%	7.63%
2018	7.84%	14.38%	22.22%	0.59%	1.43%	8.85%	10.28%	7.22%
2019	8.56%	16.55%	25.12%	0.74%	-1.26%	12.48%	11.22%	7.84%
2020	8.73%	16.13%	24.86%	0.80%	-0.52%	12.54%	12.02%	7.97%
2021	8.45%	15.19%	23.64%	0.80%	-2.19%	11.94%	9.74%	6.79%

[1] The table concerns the values of the wage gaps and the shift balances of two education fields: Healthcare and ICT;
[2] The gaps concern the three-folded Oaxaca-Blinder decomposition of the mean for the two specific education fields, showing the unexplained (Unexpl.), the explained (Expl.), and the total wage gap;
[3] The shift balance concern the number of FTE for the two specific education fields that have joined the public sector from the private sector, minus the number of FTE that have left the public sector to the private sector.

Table 5.2: Wage gap estimates and shift balance for the Healthcare and ICT education fields

Figure 5.2 presents these correlations, showing a strong correlation for both education fields, but a greater correlation of 0.88 for healthcare workers. This may go against expectations, as healthcare workers are expected to be less mobile, and cannot be simply explained based on the analysis conducted. But also for the ICT occupation, there is a strong correlation with the total wage gap of 0.76, although the relationship with the unexplained wage gap is weaker. This cannot be explained directly too and, again, advocates for more research into the relationship.



[1] The heatmap concerns the correlations between the wage gaps and the shift balances of two specific education fields: Healthcare and ICT;
[2] The gaps concern the three-folded Oaxaca-Blinder decomposition of the mean for the two specific education fields, showing the unexplained, the explained, and the total wage gap;
[3] The shift balance concern the number of FTE that have joined the public sector from the private sector, minus the number of FTE that have left the public sector to the private sector.

Figure 5.2: Correlation heatmap between wage gap estimates and sectoral shift balance for the Healthcare and ICT education field

5.3. Concluding notes: Answering the third sub-question

The sectoral mobility analysis provides the insights needed to answer the third sub-question: ”To what extent can the public-private wage differentials explain labour market shortages?”.

There is a strong relationship between the estimated wage gaps and the sectoral shift balances, the number of people that have joined the public sector from the private sector minus the number of people that have left the public sector to the private sector. The high correlations confirm the suspicion that there does indeed seem to be a link between public-private pay differentials and the ability to attract workers in the public sector, which can lead to shortages if wage levels in the public sector are considered insufficient. This is shown in the analysis of the entire public sector, as well as in the application to two specific education fields. This implies the possibility of influencing the wage gap to attract personnel to a public sector where there is a shortage.

Though, this concerns a ”back-of-the-envelope” calculation where other relevant variables are not included and the ceteris paribus condition is assumed. This is a very strong assumption and therefore the results should be interpreted with great caution. This suspicion is amplified by the sometimes inexplicable results. This lack of clarity in some of the results emphasises all the more the urge for thorough analysis, incorporating other relevant factors that influence sectoral job mobility.

6

Discussion

This thesis evaluates the Dutch reference model, the main instrument for the government's competitive public wage policy, during the period of 2010 to 2021 through quantitative empirical analysis of wage differentials between public and private sector employees. Subsequently, for these wage differences, the impact on sectoral job mobility, the influx of employees in the public sector, is examined. This chapter aims to analyse the meaning and identify the importance of the results, and relate them to the Dutch public wage policy, as such discussing the results on the basis of three sections: 1) interpretation of the findings, 2) relevance of the study, and 3) limitations and suggestions for further research.

6.1. Interpretation of the findings

The results indicate substantial differences between public and private sector wages, concluding that wages in the public sector are not comparable - at least not for specific human capital characteristics. For the weighted average, most of the wage gap is explained by differences in human capital characteristics - the "adjusted" wage gap is only about 4%. However, looking at subgroups, with breakdowns by gender, age, education level and field, and wage distribution, it can be concluded that public wages are not comparable for these specific personal human capital characteristics. One part receives a public premium, while another part receives a public penalty. With this, the government, in fact, does not offer comparable wages for any of its employees and which goes against the intended policy of competitive wage-setting. The reference model is only competitive for the average public servant but is too generic to offer comparable wages for individual public servants.

The implementation of compensation policies for civil servants, a policy deviation leading to higher wage development in the public sector compared to the private sector, drastically worsens competitiveness, while austerity measures have little impact. The adjusted wage gap remained stable between 2010 and 2014 despite a wage freeze in the public sector due to budgetary constraints following the aftermath of the crises of 2008 and 2010. But the adjusted wage gap more than doubled between 2014 and 2016 because of compensation schemes, allowing public wages to rise more than private wages. This compensation policy, jokingly enough, was implemented by politicians to restore competitiveness, compensating civil servants for the lower wage development due to the wage freeze in the preceding years. However, it has had the opposite effect and the competitiveness of public wages has seriously deteriorated as a result.

Strong relationships exist between wage gaps and the number of people moving between the public and private sectors, concluding that wage levels are an important driver for sectoral job mobility. Under acceptance of strong assumptions with regard to the ceteris paribus conditions, there exist high correlations between the estimated wage gaps and the number of people moving between the public and private sectors. This strong relationship also exists for individuals with a healthcare or ICT background, so a change in the competitiveness of the public wages for these occupations has an impact on the ability to attract qualified personnel. Higher public wages for these occupations can therefore provide a solution for the shortages of both professions in the public sector. The public wage policy, and correct implementation of the reference model, therefore play an important role in combating shortages in public sectors.

6.2. Relevance of the study

In this section, the relevance, both policy and scientific relevance, of the research is discussed to put the findings into context.

Policy relevance

This study has significant policy implications, as it provides an evaluation of the Dutch reference model, the main instrument of the Dutch public wage policy, and highlights potential issues with the policy's effectiveness. This research, as the first quantitative evaluation of this reference model, is looking for evidence that the Dutch public wage policy is working effectively - one of the two forms of policy evaluation described by Sanderson (2002). The reference model is the backbone of the Dutch public wage policy and is based on a competitive approach. However, the results find incomparable wages for public sector employees in relation to private sector employees, suggesting non-competitive wage-setting. One conclusion may be that the Dutch public wage policy is therefore ineffective, but this assumes that the government aims to be fully competitive, even for each subgroup. An assumption that may not be accurate. The government could strive to be a "good" employer, driven by egalitarian motives. Although equalising pay between men and women in the public sector appears to be a just policy, it results in a wider public-private wage gap - women are overpaid compared to the private sector, while men are underpaid. Through public wage policy, the government can support marginalised groups in the labour market and incentivize the private sector to do the same. In instances where there are significant labour shortages, such as the current shortfall of ICT personnel, the government may adopt a different approach, moving away from either competitive or egalitarian motives, to safeguard their primary task: providing public services to Dutch society. Only the government is not so outspoken in its policy. It remains uncertain whether the government has made such considerations or if it unconsciously adopted a broad approach to its reference model. This topic is unaddressed in evaluations, leaving it confirmed nor refuted.

This research also sheds light on the effectiveness of the policy deviation possibility within the reference model. The reference model offers deviation possibilities on political grounds, allowing politicians to chart a different wage development path for public wages than the baseline that follows average private sector wage development. This was done several times in the period from 2010 to 2021, from 2010 to 2014 a wage freeze was implemented due to budgetary constraints and a compensation policy was subsequently implemented in 2015 and 2016. The wage freeze has not led to a change in wage comparability. In the private sector, companies are just as affected by budgetary constraints as a result of the economic and Euro crises (NOS, 2014). The possibility of a wage freeze due to budgetary constraints does not reduce the competitiveness of the public wage policy and is therefore considered an effective measure. However, the compensation policy of 2015 and 2016 serves as an example of how political pressure for wage increases reduces the comparability of public wages in relation to private wages, reducing the competitiveness and thus the effectiveness of the public wage policy. Similar concerns were previously addressed in a qualitative evaluation, which called for the abolishment of the policy-based possibility of deviation from competitive wage-setting (the standard outcome of the reference model) (Uijlenbroek et al., 2015). This research confirms this issue and argues for the abolition of policy-based deviations and compensation policies. However, budgetary restrictions cannot be ruled out and do not necessarily lead to reduced competitiveness.

Scientific relevance

This study is a notable contribution to the field of wage gap research as it employs rich administrative data and a novel adaptation to widely-known methods to provide an updated analysis of the Dutch public-private wage gap, taking into account the Dutch labour market characteristics. While the application of the Oaxaca-Blinder decomposition is a safe bet, the usage of administrative microdata and the application of quantile- and weighted regressions are progressive. As data collection and analysis methods become more sophisticated, the use of microdata is increasing, allowing researchers to analyse entire populations rather than relying on small samples. Administrative data is considered a major asset in econometric research due to its reliability and offers the enhanced capability of data-driven policy evaluation (van Veenstra et al., 2017; Wooldridge, 2015). The outcomes of the wage gap estimates are in line with most recent studies, both internationally and for the Netherlands (e.g. Biesenbeek et al., 2019) - indicating a public wage premium, but wage compression in the public sector when focusing on subgroups or the wage distribution. This study once again confirms such observations. With regard

to the Netherlands, only van der Werff et al. (2017) applied quantile regression methods, with 2016 as the most recent measurement year and with a focus on only the central government and provinces - this study is both an update and extension. Such applications of weighted regressions have not yet been encountered internationally, but can certainly follow in the near future, as part-time work is on the rise in other countries too. Though the addition of weights in the analysis has virtually no effect on the results, this does not exclude the usefulness of the implementation of weights. It is possible that this effect will play a role in the Netherlands in the future, or that this effect does play a role in other countries.

Furthermore, this research is significant for bridging the gap between wage gap research and other scientific and policy domains. Despite identifying opportunities for applying wage gap results in other areas, such as sector mobility, Public Service Motivation (PSM) research, and policy issues and evaluation, this connection has rarely been made. Too often, policy implications of public-private wage gaps are assumed without any analysis (e.g. Bonaccolto-Töpfer et al., 2022). An exception to this is Michael et al. (2020), who examined the impact of budget restrictions on the public-private wage gap and discovered that the wage gap has widened for the Netherlands, despite the unjustified omission of wage freezes and compensation policies in the analysis. The connection between the public-private wage gap and other research domains, particularly in PSM research, has also been limited, with only a few instances. This study demonstrates that it is possible to assess policy implications, even though the analysis itself is limited. The results of this study are consistent with PSM research, which indicates that wages play a role. However, PSM researchers also suggest that there may be other, possibly more critical, motivations for working in the public sector (Taylor et al., 2011). Nevertheless, due to the study's scope, these motivations were not included in the "back-of-the-envelope" analysis.

6.3. Limitations of the study

Finally, the limitations of the research are mentioned together with starting points for future research. Here too, the policy aspect and the scientific aspect are considered, which makes a direct distinction between possible starting points for either policymakers or researchers.

Policy limitations

Firstly, the study finds that the Dutch reference model results in incomparable wages, leading to a non-competitive public wage policy. However, as discussed, it is unclear what the precise intention of the Dutch government is for its public wage policy. It remains a question of whether the government aims to achieve comparable wages for every individual civil servant or just the average civil servant. If the government intentionally uses a generic approach to the reference model to be competitive only for the average civil servant, then the current public wage policy may be effective. However, the government is not pronounced; this question has not been answered to date. Therefore, it is premature to conclude that the current public wage policy is ineffective.

This issue is political and requires clarification before a full evaluation of the effectiveness of the current public wage policy is possible. It is therefore recommended to conduct more research into this political issue. This concerns, on the one hand, more research into the rationale behind the public wage policy, which can provide a conclusion to the evaluation of policy effectiveness, the first form of policy evaluation (Sanderson, 2002). On the other hand, more research into the associated technical operation of the reference model and possible policy options is desired. This relates to the second form of policy evaluation, promoting the improvement of the current policy and looking for policy options to increase effectiveness. If the government wants to be fully competitive, it should look at how this can be achieved in the current reference model. In this regard, the possibility of policy deviation should also be critically examined. This aspect of the reference model can provide a solution to better respond to impending shortages, but the incorrect application of this "policy button" shows that the competitiveness of the public sector decreases drastically.

Secondly, only limited conclusions can be drawn from the sectoral mobility analysis and the possible cause of labour shortages. The scientific limitations of this analysis will be discussed below, but for the policy limitations, it is relevant to mention that now only the role of wages has been considered in a worker's choice for either the public or private sector, while Public Service Motivation and intrinsic motives also play an important role.

So, in addition to setting comparable wages in the public sector, it is therefore also important to make working in the public sector attractive in other ways. Further research into how to make the

public sector more attractive, apart from raising wages, certainly serves as a possible solution. Another possible solution, although not directly within the scope of this study, is to make the public sector more productive. If imminent shortages arise, the question should not only be how to attract more people to tackle the shortages but also how to tackle the shortages more efficiently with the limited number of people available. This approach may fall slightly outside the scope of the analyses performed in this study, but they can provide a solution for impending shortages and are therefore also of great interest for further research.

Thirdly, this study only looks at salaried employees in the public and private sectors and, with it, disregards a relevant group that also belongs to the labour market. The group that is not included in the analysis are the self-employed individuals. This group, with a population of over one million individuals, forms an important part of the Dutch labour market, but cannot be included in a fair comparison of wage differences due to their widely differing pay structure, job security, and pension accrual. However, the government may also aim to be competitive with the self-employed, since this group can also offer a possible solution to shortages. Self-employed individuals have made the conscious choice not to work for an employer and often the financial aspect plays a role in this choice. For instance, within healthcare, there is a noticeable shift from paid employment towards self-employment (NOS, 2023a).

Focusing on measuring wage differentials including self-employed individuals is thus an extremely relevant direction for future research. Investigating how public wages differ in comparison to this group, and whether this could also be a possible source of and solution to labour shortages, is considered a useful exercise. Scientific researchers have shown that there are methods to include self-employed individuals in wage gap research (e.g. Christofides and Pashardes, 2002). Future research should focus primarily on the ability to compare the hourly wages correctly, since the current wage structure, job security and pension accrual are so different that a good comparison is not possible. This suggestion for future research has already been taken up by the Ministry of Finance, where plans are being made to analyse the group of self-employed people and their wages.

Scientific limitations

First, the use of administrative data provides enormously rich and reliable data but has also led to problems in data preparation and representativeness. A lower quality of the education dataset (Hoogsteopltab), missing crucial education variables for the years 2010 to 2012 and limited observations due to lower coverage, led to a serious decrease in sample size. For 2010, the year with the largest loss, the sample size has shrunk to half the target population. Even though the current analysis still concerns a very large sample size and the representativeness of the sample was briefly examined by investigating the difference in the wage distribution, this is an important limitation of the current study. This is because there was no room within this study to properly analyse this excluded group for its consequences on representativeness. The big problem is that you cannot look at the variables that are missing, as this is the reason why this problem occurred in the first place. It is possible that, due to these problems, particular groups are excluded from the analysis and that the results of the analyses are therefore not representative of the entire Dutch labour market. The largest group is excluded because no education data is available. It could therefore be that this excluded group dominates in a certain level or field of education. However, this cannot be checked as these variables are missing. This has serious consequences for the representativeness of the sample.

Further research into the impact of these issues can provide more clarity about the representativeness of the sample. This is also strongly linked to the quality of the source of the datasets; SSD datasets of *Statistics Netherlands*. As pointed out by Bakker et al. (2014), the quality of the SSD dataset is difficult to test. Investigating why the coverage ratio and consistency in the variables are low for the education dataset, and what consequences this has for the representativeness in this study, are useful exercises. Regarding this research into the wage gap, it can increase the representativeness and thus the relevance of the research. For *Statistics Netherlands*, it can provide more insight into the quality of the SSD datasets.

Second, the choice for the Oaxaca-Blinder decomposition is a safe choice, but also a choice with limitations. This method is prone to omitted variable bias. If a relevant human capital variable or controlling variable is not included in the model specification, the extent of the explained and unexplained effect is either underestimated or overestimated. Many variables were deliberately included, Biesenbeek et al. (2019) included comparable variables in their analysis and considered the risk of omitted variable bias minimal. However, including other relevant variables, among which specific occupation

and relevant experience variables, can reduce the omitted variable bias. Another method could also have reduced this problem. With the data from Statistics Netherlands, this study obtained administrative panel data. With proper use of another method, time-constant unobserved heterogeneity can be controlled for and omitted variable bias can be reduced. A new group of researchers, therefore, propose a fixed-effects approach to the well-known Oaxaca-Blinder decomposition and quantile decomposition (e.g. Bonaccolto-Töpfer et al., 2022; Castagnetti et al., 2019). However, such a progressive method was not chosen deliberately, as these methods yield less intuitive results and are not as tried-and-tested as the Oaxaca-Blinder decomposition using standard linear regression. Also, for these newer methods, documentation on the exact operation and how to apply the method is limited.

As an avenue for future research, it is therefore certainly encouraged to apply other methods to these fine-grained panel data. Methods that lend themselves to panel data analysis and the results of which can then be compared with the results of this study. This is the reason so many different methods have appeared in the first place, and perhaps further discovering this new method will not help. But to eventually become a tried-and-tested method like the Oaxaca-Blinder decomposition and the quantile decomposition, such methods must first be investigated. Now that more and more administrative panel data are becoming available to researchers, the application of new methods is only a matter of time. Investigating possible better alternatives can only expand scientific knowledge.

Third, the application of the sector mobility analysis, the analysis of the impact of the wage gap on the number of people moving to and from the public sector, has serious limitations. As mentioned, other motives for switching sectors must be included for a thorough analysis, something which has not been done due to the difficulty of measuring these motives, the limited data availability and the goal and scope of this study. PSM and intrinsic motivations are important reasons for choosing the public sector (Taylor et al., 2011). A reliable causal relationship can only be established if variables for these motivations are controlled for. In this study, the ceteris paribus condition has been assumed, a strong assumption that weakens the power of the analysis and that entails a serious limitation. However, the initial aim of this sector mobility analysis was to show whether a relationship could exist and to show that wage gap research can be used for other relevant policy and scientific topics.

With this sector mobility analysis, the goal was also to encourage more research into the relationship between wage differences and sectoral job mobility - an interesting topic which, given the strong relationships found in this study, is certainly a relevant point for future research. Such specific applications are already being demanded from the PSM domain as to the disaggregation and unbundling of the public service motivation construct (e.g. J. Perry et al., 2015). The further application of the wage differences, including other PSM motives in the analysis, would be a direct answer to this call.

Fourth, there are improvements to be made in the econometric analysis. As a newcomer to econometric analysis, it can be said that there are many nuances associated with performing econometric analysis correctly. There are undoubtedly improvements to be made in the regressions applied within this study. For example, adjustments are made in the specification of the regression model to counteract multicollinearity. In this, among other things, age and age^2 are centred, something that is not carried out entirely according to econometric standards. The age is first centred, and then the age is squared. Although it resolves the multicollinearity, it has undesirable effects on the interpretation of the age^2 variable. Fortunately, this has no consequences for further analysis, as the interpretation of the age^2 variable is not important for this study. It, therefore, has no impact on the results, but if there was room to redo the research, it is advisable to take more space for the correct specification of the econometric method.

7

Conclusion

This chapter brings a conclusion to this research. In doing so, it provides an answer to the main research question and sub-questions, reflects on the relevance, makes concrete recommendations to the ministry, and provides avenues for future research.

7.1. Answering the research questions

Answers are given to the three sub-questions that jointly provide the information needed to answer the main research question of this research. The first sub-question is answered through a review of relevant literature in Chapter 2, and the second and third sub-questions are answered through econometric analysis performed in respectively Chapter 4 and Chapter 5.

> **SQ1:** What are the rationales of the Dutch government for wage differentiation between public and private wages?

The Dutch government intends to provide comparable public wages in relation to wages in the private sector, advocating a competitive public wage policy; a policy in which wages for civil servants are comparable, neither too low nor too high, to what these persons could earn in the private sector. Over the past decades, the government has made a conscious effort to bridge the gap between the public and private sectors through the normalisation of public sector wage agreements and the implementation of the reference model. This reference model, the model used to determine the annual budget for public wage development, is directly linked to private wage development and serves as a prime instrument of the Dutch government's competitive stance on its public wage policy. The reference model does not provide possibilities to differentiate wage development for specific occupations. Instead, wage development is agreed upon within the collective labour agreement negotiations.

Nonetheless, there are reasons why the government may want to deviate from this competitive approach, reasons that the government deployed several times between 2010 and 2021. The main reason that has been deployed is budgetary restrictions. During a crisis, when government budgets are limited, it is possible to stray from the established competitive path and temporarily offer lower wages. The reference model offers the possibility for policy deviation, creating the possibility to deviate from the competitive wage development path on the basis of political grounds. Additionally, reasons for deviating from full competitiveness include the desire for egalitarianism, where the government acts as a ”good” employer, offering relatively high wages to marginalised groups in order to combat wage discrimination; the difference in wages due to the difference in a characteristic such as a gender, despite equal relevant knowledge, experience and capacities. Egalitarian considerations should be included in the basis of the reference model; what characteristics do and do not determine the level of wages.

> **SQ2:** To what extent do public and private sector wages differ for the period 2010 to 2021?

Between 2010 and 2021, there was a great difference in wage levels between the public and private sectors. Specifically, in 2021, the weighted average hourly wage in the public sector was 24% higher. 3/4th of this wage gap can be explained by the difference in human capital characteristics; differences

in the characteristics of employees in the sectors. The remaining 1/4th, equivalent to more than 4% wage difference, is attributed to the ”adjusted” wage gap; the wage difference that cannot be explained by differences in human capital characteristics of the employees between the sectors and which represents a discrepancy in wage structure imposed by the Dutch government. This adjusted wage gap represents the unexplained wage difference and indicates whether public wages are comparable with private wages and thus whether public wages are in reality competitive. When examining specific subgroups, the adjusted wage gap diverges greatly. For instance, lower-educated individuals receive a public premium of almost 20% while higher-educated individuals in the public sector receive a 5% lower wage in comparison to their private sector counterparts. When the adjusted wage gap is analysed and broken down on other personal characteristics, the same disparity exists. This means that, when considering specific individuals, a large wage difference typically exists, which could be either positive or negative.

Over the years, this adjusted wage gap has fluctuated considerably, with the largest adjusted wage gap occurring between 2015 and 2017. In 2010, the average adjusted wage gap was around 4%, but it more than doubled to over 8.5% in 2016. It gradually fell back to 5% in the following years. The total wage gap increased from 17% to 24% between 2010 and 2021. So, the increase in the total wage gap can mostly be explained by the rise in the explained wage gap between 2010 and 2021. However, the strong increase in the adjusted wage gap between 2010 and 2016 is the most remarkable finding and is certainly important for the evaluation of the reference model.

> **SQ3:** To what extent can the public-private wage differentials explain labour market shortages?

Initial analyses suggest a strong association between public-private wage differentials and sectoral job mobility, indicating that wage gaps could contribute to labour shortages. Correlations well-exceed 0.5, indicating a strong positive relationship. However, it is important to note that this analysis assumes a ceteris paribus condition, which assumes all other relevant variables remain constant. The Public Service Motivation (PSM) literature, the intrinsic motivation to work in the public sector, shows that other job conditions and intrinsic motivations also play a significant role in sectoral job-switching decisions. Despite this assumption, the strong correlation suggests a relationship between wage differentials and sectoral job mobility.

The same conclusion applies to healthcare and ICT personnel, two occupations that face labour shortages in the public sector in the Netherlands. Correlations exceeding 0.8 have been found in these fields as well. If public sector wages experience greater growth than private sector wages, it could attract more individuals to the public sector. Conversely, lower wages could influence the public sector’s ability to find qualified personnel to address these shortages. The consequences of these shortages may prevent the Dutch government from providing its public services properly, with far-reaching consequences for society. Competitive wage-setting through the reference model and effective public wage policy, therefore, play an important role in this.

These findings provide all the necessary knowledge to evaluate the reference model and the Dutch public wage policy, providing an answer to the main research question that is central to this study:

> How does the Dutch public wage policy translate into public-private wage differentials and sectoral shifts?

The competitive approach of Dutch public wage policy translates into substantial public-private wage differentials and influences the number of people moving to and from the public sector to the private sector, leading to non-competitive wage-setting and contributing to labour shortages. The large wage differentials for subgroups show that the reference model is too generic in nature and is only competitive for the average public servant. In this model, everyone covered by the same collective labour agreement receives the same wage development, unlike in the private sector, where there is more differentiation. This results in great differences in public-private wage gaps between subgroups. Due to this generic application of the reference model, the lower educated structurally receive a higher wage development and the higher educated receive a lower wage development, creating structural, non-competitive wages. The policy prioritises competitiveness for the average employee and fails to be competitive on individual human capital characteristics. As a result, the Dutch public wage policy offers, in fact, non-competitive wages for all public servants.

However, there is ignorance as to whether this generic approach is implemented deliberately. Egalitarian motives are described as legitimate reasons in the literature but are not described in any documentation available on the reference model. Government documentation, including reports from agencies such as the Netherlands Central Planning Bureau (CPB), suggests that the government primarily aims to be competitive rather than prioritise egalitarianism (CPB, 2016b). There is no government documentation that describes such egalitarian motives. The government should have such motives. The public wage policy offers an excellent opportunity to combat the described wage discrimination, for example by valuing men and women equally with a comparable wage. In this way, the government positions itself as a ”good” employer and sets an example for the private sector.

Moreover, the public wage policy lacks provisions to address local labour shortages despite public-private wage differences potentially causing shortages. If these structural wage disparities persist, attracting sufficiently qualified personnel to the public sector will become increasingly difficult. The reference model currently does not allow for a targeted response to specific labour shortages. While there are individual components in the existing legal framework, they focus mainly on the performance of current employees, rather than recruiting new labour. Efficiently tackling labour shortages is thus not possible in the current public wage policy. The government agencies acknowledge the risks but fail to address the issue. Other options, in addition to high wages, to make the public sector attractive can also serve as a solution. After all, the PSM motives are mentioned as an important motivation for people, so tapping into intrinsic motivations and improving, for instance, personal development opportunities can also offer a solution.

Furthermore, the compensation policy implemented in 2015 and 2016 led to a decline in the competitiveness of the Dutch public wage policy. The adjusted wage gap doubled within two years, indicating that such compensation policies are detrimental to the competitiveness of public wages. From a competitive point of view, it is therefore strongly discouraged to implement such compensation policies despite the strong political pressure that forces such policies. This study confirms this suspicion from previous research (Uijlenbroek et al., 2015). This study also shows that budgetary restrictions have no negative impact on the competitiveness of public wages, the adjusted wage gap remained unchanged. It is argued that private companies were just as affected by the global economic crisis of 2008 and the Eurocrisis of 2009 and 2010 and that they had budget restrictions just as well. This study, therefore, argues for the abolition of policy deviation for compensation policies, while advocating for retaining the ability to apply budget constraints.

7.2. Relevance and contributions

Several research problems, which closely align with the scientific and societal relevance, are identified in the introduction of Chapter 1. By reflecting on the research problems, the relevance and contributions of this research are addressed.

Policy aspect: There has not been a quantitative evaluation of the Dutch reference model

This study provides the first quantitative evaluation of the Dutch reference model, highlighting the need for such an assessment due to the limited documentation available on the Dutch public wage policy. Despite the competitive approach of the policy, the observed data and wage disparity analysis show non-competitive wage-setting of public wages for subgroups. The findings of this study raise the political question about whether public wages should competitive only for the average public servant, or for every public servant. While there may be legitimate egalitarian reasons to be competitive for only the average, the lack of government documentation on this topic leaves the rationale unclear. The analysis shows that the reference model is not competitive for individuals and may lead to occupational shortages, highlighting the need for a political decision on how to address these issues.

Given the potential consequences of wage disparities on labour shortages, it is essential to pay more attention to effective public wage policy. The government’s core task is to be able to provide good public services and the inability to attract qualified personnel and provide the desired services, such as healthcare, implies ineffectiveness. A shortage of ICT personnel has far-reaching consequences. At the moment, these are overdue ICT systems, which means that no tax changes can be implemented. But this can get really out of hand if, for example, the ICT systems no longer function due to a major malfunction.

However, more effort is needed to complete an evaluation of the Dutch public wage policy. The next step in evaluating the policy would be to consider concrete policy interventions, following the two forms

of evaluation identified by Sanderson (2002). The follow-up depends on the answer to the as-of-yet unanswered question: ”How competitive do we really want to be?”. If the decision is to pursue a fully competitive approach, the reference model should be reviewed to identify interventions to make wages comparable for subgroups. Alternatively, if the decision is to implement egalitarian reasons, then it should be examined for which subgroups it wants to adopt egalitarian reasons and other strategies to address occupational shortages must be explored. Ultimately, the answer to the question of how competitive the policy should be will shape the next steps in evaluating and improving the policy.

> **Scientific aspect:** Little attention is paid to the measurement of public-private wage differences in the Netherlands

This study employs a comprehensive dataset and measurement techniques to investigate the public-private wage gap. The study outlines several methods and challenges associated with measuring the adjusted wage gap. While the Oaxaca-Blinder decomposition method is not new, the adjustments made in this study, including the use of administrative data and the extension to the quantile decomposition, represent progress in the field. The study describes the data used and the adjustments made to the standard Oaxaca-Blinder method in detail, including the preparation of microdata from *Statistics Netherlands* and the application of weights to individuals for the number of hours worked in a year. The robustness analysis confirms the validity of the choices and adjustments made.

Methodologically, this study is significant as it offers tools for future research both in the Netherlands and internationally. The research demonstrates that it is not always necessary to limit the analysis to full-time employees, nor to rely solely on survey data. The growth of part-time work in the labour market makes such descriptions and applications of weights to individuals increasingly relevant, also internationally. This research, with its detailed methodology and choices, provides researchers with the tools required to make similar adjustments.

> **Combined aspect:** Scientific research on public-private wage differences is to a limited extent related to public wage policy

This research shows that gender pay gap estimates can be used to evaluate policy and to increase knowledge in other scientific domains. The study uses wage gap estimates to study the role of wages in sector selection. Also, the estimates of the public-private wage gap are used to evaluate the reference model quantitatively. This study highlights that such scientific studies can have a significant impact on other domains, an aspect that is not applied enough within current wage gap research. Wage gap research sits in an ivory tower, providing relevant research outcomes but giving too few policy implications.

This study aims to encourage other wage gap researchers to step off this ivory tower and provide policy implications based on the wage gap estimates found. For instance, public-private wage gap research can provide insights into various social discrimination issues related to the labour market. Such research can support evidence-based policy-making, ultimately leading to improved policy outcomes (van Veenstra et al., 2017).

7.3. Recommendations for the Ministry of Finance

The research findings provide concrete recommendations that can be given to the Ministry of Finance or the Dutch government. These recommendations are closely linked to the conclusion and relevance of the study and primarily aim to accomplish two things. First, to complete the evaluation of the reference model, and second, to achieve the government’s primary goal for the Dutch public wage policy to attract enough qualified labour to provide essential services to society.

- Ask oneself how competitive the Dutch public wages should be. This politically oriented question underlies the determination of how effective the current public wage policy is. Answering this question is crucial to be able to evaluate and improve the current policy. If one really wants to be fully competitive, then the current public wage policy is not effective and the reference model needs to be scrutinised closely. If the government wants to implement egalitarian motives, then it should be examined how this can be achieved with the reference model.
- Ask oneself what role possible labour shortages play in determining public wage developments. This question was already stated by former minister Remkes (2007), noting that the government

should present itself as an attractive employer - an attractive wage is certainly part of this (Ministry of the Interior and Kingdom Relations, 2017). The current reference model, however, offers no possibilities for solving specific shortages with higher wages. It should be examined whether and how this is possible.

- Reconsider the possibility of policy deviations within the reference model. The compensation policy of 2015 and 2016 has been found to have a strong negative effect on the competitiveness of public wages. Wage freezes due to budget restrictions, on the other hand, do not hurt the competitiveness of public wages. It is debatable whether such possibilities for compensation policy are actually desirable. If the government wants to focus on competitiveness, then the answer is: no, a compensation policy is not desirable. However, the wage freeze can be a useful policy option that fits within the goal of a competitive public wage policy.

- Investigate policy options to make the Dutch public wage policy and the reference model more competitive. If the public wage policy has to be implemented competitively, then the next step in the evaluation is to investigate how to achieve this. This refers to the second form of policy evaluation of Sanderson (2002), in which policy interventions are tested for effectiveness. For example, further differentiation of wage developments can be sought, or more room can be made in the individual or occupation-specific component to combat specific shortages.

- Investigate the possibilities to make working in the public sector more attractive. This is closely related to the important role of PSM motives to work in the public sector. This theme has recently come up several times in the Dutch news and for which Hazekamp (2023), director of the CPB, made an appeal two weeks ago. Working in the government is often seen as a working environment with fewer growth opportunities and improving such working conditions may provide an effective solution to make the public sector more attractive to potential employees.

- Investigate other options, mainly productivity growth, to address labour shortages. In addition to having more people working in the public sector, working more productively is considered a sustainable solution for shortages. The productivity growth in the Dutch public sector is lagging behind the private sector dramatically (Sociaal-Economische Raad, 2023). Possibilities for improvement are identified by the The Work Regulation Committee (2020), which was set up to outline the future of the labour market. With regard to the reference model, it is possible to examine how wage growth could better match productivity growth. International research shows that productivity and the age of employees are less closely related than at which wage growth over age is currently set (CPB, 2016b). The OECD (2015) has also advised on this for Denmark, economically speaking a comparable country.

7.4. Avenues for future research

Based on the research conducted, also multiple avenues for future scientific research can be provided. These mainly deal with limitations in the current research, and the possibilities that aspects of the current research offer to other researchers, but what, for example, is outside the scope of this research.

- Investigate the representativeness of the sample that is applied in this study. The dataset excludes half of the desired population due to missing observations, which introduces a significant limitation. Proper analysis of the impact of this exclusion on the representativeness of the sample lies outside the scope of this study and is thus a valuable point for future research. This also offers an opportunity to conduct research into the quality of the administrative datasets (SSD) of *Statistics Netherlands*, something that is also desired according to Bakker et al. (2014).

- Investigate wage differences with other methods, preferably panel-data methods, on the administrative data. The rich dataset makes it possible to follow the same people over a longer period of time in their work careers. This opens up a world of possibilities for applying other methods to estimate the wage gap. While tried-and-tested methods have been chosen in this research, panel-data methods, such as new progressive methods with a fixed effects approach, can be of excellent added value for wage gap research (Bonaccolto-Töpfer et al., 2022). This could perhaps better respond to current measurement issues.

- Investigate the impact of wage differentials on sectoral job mobility, relative to other motives. Currently, the influence of wage differentials on sectoral job mobility has been investigated without controlling for relevant Public Service Motivations (PSM) and intrinsic motives. The relationship found in this study shows that it is more than worth investigating the role of wages in sector selection, in combination with other relevant PSM motives, further. The demand for such research is also underlined by the PSM domain (e.g. J. Perry et al., 2015; Taylor et al., 2011).
- Investigate the opportunities to apply other definitions for wages to investigate public-private wage differentials. This study uses hourly wages that include bonuses and overtime hours. However, it does not take into account, for example, pensions, while pension accrual can differ greatly between the public and private sectors. Lower earners in the public sector accrue a pension much more often than in the private sector (DNB, 2022). At the moment, it is still difficult to correctly include pension accrual in the wages. However, progress is being made in the field; Gomes and Wellschmied (2020), for example, provide a good attempt to include pensions and other ”lifetime” earnings.
- Investigate the possibilities to identify the self-employed workforce and investigate ways to representatively compare their wages to salaried individuals. This study only examines public and private sector employees. However, with over a million individuals, a significant proportion of the Dutch working population is self-employed. It is difficult to properly compare the wages of this self-employed workforce with the wages of salaried employees, as they do not have the same wage structure as salaried employees. For example, they have to arrange their own insurance and build up their own pension. It is also more difficult to determine how much they earn, how many hours they work and therefore how much they actually earn per hour. Investigating how the hourly wages of these self-employed compare to employees in the public and private sectors can further aid wage gap research and job mobility research. Some research has been carried out in this area, demonstrating the possibilities (Christofides and Pashardes, 2002). However, this is still a highly underexposed subject.

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A

Literature review process

To structurize the literature review process, a search strategy, in combination with good documentation, is required. To this end, the framework presented by Kable et al. (2012), is followed in rough lines, including databases, search terms and restrictions. The search strategy is presented in Table A.1. In the search strategy, synonyms and acronyms are used to find articles.

The search strategy led to the search process shown in Table A.2. In the search process, snowballing is included within the numbers. Also, non-scientific articles and reports have been included for Section 2.3, as reports form the main source of information for this topic. Articles are primarily selected for reading or inclusion, after of course the relevance to the topic to be described, based on the prominence of the article (number of citations), the country to which the article refers (developed countries), and the year from which the article comes (recentness). Articles from other sections are also cited several times to make links between the different topics, these are indicated by the number under ”others”.

Section and topic	Boolean search terms	Focus	Databases
2.1: Wage determination theories	Wage **OR** Pay, **AND** determination, **AND**, Macroeconomic, **AND** Theory	Theory Prominence (initiator)	Scopus Google Scholar
2.2.1: Reasons for wage disparity	Reason **OR** Explanation, **AND** Wage **OR** Pay, **AND** Public **OR** Government **OR** Political, **AND** Constraint **OR** Cause	-	Scopus Google Scholar
2.2.2: Observed public-private wage differences	Public-private **OR** Federal, **AND** Wage **OR** Pay, **AND** Gap **OR** Premium	Western countries >2000	Scopus Google Scholar
2.2.3: Reasons to work in the public sector	Public-private **OR** Federal, **AND** selection **OR** Choice, **AND** motivation **OR** Motives, **AND** Wages **OR** Pay	Western countries >2000	Scopus Google Scholar
2.3: Dutch public wage policy	Wages **OR** Pay, **AND** Policy, **AND** Government, **AND** Netherlands **OR** dutch	>1980 Netherlands Government	Scopus Google Scholar Non scientific sources

Table A.1: Search strategy

Section	Found	Analysed	Included	Others
2.1	207	24	6	10
2.2.1	228	21	9	5
2.2.2	483	75	44	4
2.2.3	261	31	18	6
2.3	72	38	20	5

Table A.2: Literature review process

B

Detailed construction of the Oaxaca-Blinder decomposition

This appendix provides additional information and intermediate steps for the Oaxaca-Blinder methods applied in this study. As Wooldridge (2015) described, it is important to increase the reproducibility of the research. This appendix is an attempt to do just that. It has the same structure as in the main report.

Decomposition at the mean

The original Oaxaca-Blinder decomposition equation, with the difference in the average (logarithmic) wages between the public and private sector, is represented by:

$$Gap = \ln \bar{W}_P - \ln \bar{W}_M = (\bar{X}_P - \bar{X}_M)\beta_P + \bar{X}_M(\beta_P - \beta_M) \tag{B.1}$$

This Oaxaca-Blinder decomposition compares the mean log wage of two groups, in this case, the public (P) and private (M) sectors, to determine the wage gap, and uses separate regression models for the public and private sectors to account for variability in human capital characteristics between both sectors (Oaxaca, 1973). The total wage gap is divided into two parts: the explained differences in human capital characteristics and the unexplained differences in pay structure between the public and private sector (Michael et al., 2020). While the division into explained and unexplained parts may seem straightforward, understanding Equation B.1 requires a deeper explanation, which is provided below.

The idea of Oaxaca (1973) stems from the notion of a discrimination coefficient, a factor that reflects the extent to which wages differ between two groups, and which cannot be explained by differences in human capital characteristics. This discrimination term concerns the unexplained wage gap. To formalise this discrimination coefficient, one first needs to define the total wage gap (G), defined simply as:

$$G = \frac{W_P - W_M}{W_M} = (W_P/W_M) - 1 \tag{B.2}$$

Formulating the percentual wage gap as the difference between the public and private sector wages by $W_P - W_M$ and dividing it by the private sector wage W_M. In the same way, one could construct the equation if there were no discrimination between wages in the public and private sectors, reflecting wage differentials purely based on human capital characteristics differences. This characteristics gap (CG) is given by:

$$CG = (W_P^0/W_M^0) - 1 \tag{B.3}$$

In which W_P^0/W_M^0 represents the public-private wage ratio in the absence of discrimination, hence the superscript. Using both the total wage gap and the characteristics gap, one could construct the discriminatory gap (DG) as the proportionate difference between $G + 1$ and $CG + 1$ by:

$$DG = \frac{G - CG}{CG} = \frac{(W_P/W_M) - (W_P^0/W_M^0)}{(W_P^0/W_M^0)} \tag{B.4}$$

Which, using basic log transformation, can be rewritten as:

$$\ln(DG+1) = \ln(G+1) - \ln(CG+1) = \ln(W_P/W_M) - \ln(W_P^0/W_M^0) \tag{B.5}$$

This is a function to approximate the discriminatory gap. Again, this discriminatory gap concerns the unexplained wage gap as described earlier. If in possession of data, W_P and W_M are known, however, W_P^0 and W_M^0 are not known and can only be estimated.

For this estimate, the now well-known Mincerian equation is applied using a linear regression model. Most often, ordinary least squares (OLS) regressions are used to provide estimates of a wage equation for a given group. Within this research, to account for part-time workers and simultaneous jobs, weighted least squares (WLS) regressions are used. However, this adaptation is not important for the explanation of the Blinder-Oaxaca method, which is why the explanation continues with a standard Mincerian equation. The wage equation to be estimated separately for each sector has the semi-log functional form:

$$\ln W_i = X_i\beta + \epsilon_i \quad \text{, where: } X_i = [1, x_1, x_2, ..., x_n] \tag{B.6}$$

Where $\ln W_i$, is explained by the human capital characteristics X_i if individual i, the corresponding vector with coefficients, β, and the individual error term ϵ_i. Such a semi-log function is often referred to as a log-level model, a model with log(y) as the dependent variable and X as the independent variable (Wooldridge, 2015). The main reason for using $\ln W_i$ in linear regression is to impose a constant percentage effect of β on wages. In the light of this Oaxaca-Blinder decomposition, this log-level model enables the interpretation of $\ln(W_P) - \ln(W_M)$, the total wage differential of Equation B.1, as percentual difference (Wooldridge, 2015) - intuitively an attractive interpretation.

Then, as for fitting the regression on a group, the least squares properties $E(\beta) = \widehat{\beta}$ and $E(\epsilon) = 0$ apply, holding $\ln \bar{W}_S = \bar{X}_S\widehat{\beta_S}$ for the estimated weighted mean log hourly wages of a to be specified sector S. Since two separate regression models are estimated, one for the public (P) and one for the private (M) sector, This can be applied as: $\ln \bar{W}_P = \bar{X}_P\widehat{\beta_P}$, and: $\ln \bar{W}_M = \bar{X}_M\widehat{\beta_M}$.

The total wage gap (G) Equation B.2 can be rewritten, again using log transformation, as: $\ln(G+1) = \ln(W_P) - \ln(W_M)$. This way, one can obtain an estimate for the log gross hourly wage differential by:

$$\ln(G+1) = \ln(W_P) - \ln(W_M) = \bar{X_P}\widehat{\beta_P} - \bar{X_M}\widehat{\beta_M} \tag{B.7}$$

Then, Oaxaca (1973) defines two terms: $\Delta\bar{X} = \bar{X_P} - \bar{X_M}$ and $\Delta\widehat{\beta} = \widehat{\beta_P} - \widehat{\beta_M}$. Using these terms, Equation B.7 can be rewritten as:

$$\begin{aligned}
\ln(G+1) &= \bar{X_P}\widehat{\beta_P} - \bar{X_M}\widehat{\beta_M} \\
&= (\bar{X_M} + \Delta\bar{X})\hat{\beta_P} - \bar{X_M}\widehat{\beta_M} \\
&= \bar{X_M}\widehat{\beta_P} + \Delta\bar{X}\widehat{\beta_P} - \bar{X_M}\widehat{\beta_M} \\
&= \Delta\bar{X}\widehat{\beta_P} + \bar{X_M}(\widehat{\beta_P} - \widehat{\beta_M}) \\
\ln(G+1) &= \Delta\bar{X}\widehat{\beta_P} + \bar{X_M}\Delta\widehat{\beta} = (\bar{X_P} - \bar{X_M})\beta_P + \bar{X_M}(\beta_P - \beta_M)
\end{aligned} \tag{B.8}$$

Which represents the starting Equation B.1. Based on Equation B.5 and the human capital principle that equal people should receive equal wages, regardless of whether they work in the public or private sector, it can be shown that the parts of Equation B.8 represent the individual estimated components, the unexplained wage gap and the explained wage gap respectively, as:

$$\ln\widehat{(W_P^0/W_M^0)} = \Delta\bar{X}\widehat{\beta_P} = (\bar{X_P} - \bar{X_M})\widehat{\beta_P} \tag{B.9}$$

$$\ln\widehat{(DG+1)} = \bar{X_M}\Delta\widehat{\beta} = \bar{X_M}(\widehat{\beta_P} - \widehat{\beta_M}) \tag{B.10}$$

Equation B.8 suffers the widely-known ”index number problem” (Oaxaca, 1973). This problem will not be explained in detail, but in short, it means that the choice of the reference group may affect the ratio of explained to unexplained portions of the gap. The explained part (first part, Equation B.9) depends on β_P and the unexplained part (second part, Equation B.10) depends on $\bar{X_M}$ (Sen, 2014).

Several variants have been devised on this original Oaxaca-Blinder decomposition formula, one of which will be applied in this study. Regarding this variant, researchers propose adding a pooled regression (e.g. Christofides and Michael, 2013) - avoiding this arbitrary dependence and deriving a

"non-discriminatory" structure. Oaxaca and Ransom (1994) devised a three-part wage gap formula, with the addition of a non-discriminatory term N by adding a pooled regression. A pooled regression involves estimating the same regression model, but not specifically for one of the two sectors, but for both sectors together. This means that no distinction is made between the differences in the wage structure, hence the non-discriminatory term. Using a pooled regression, this arbitrary dependence can be abandoned, as can be seen by the formula that will be applied in this research:

$$\begin{aligned} \ln \bar{W}_P - \ln \bar{W}_M &= (\bar{X}_P - \bar{X}_M)\beta_N + \bar{X}_P(\beta_P - \beta_N) + \bar{X}_M(\beta_N - \beta_M) \\ &= (\bar{X}_P - \bar{X}_M)\beta_N + \bar{X}_P(\beta_P - \beta_N) - \bar{X}_M(\beta_M - \beta_N) \end{aligned} \tag{B.11}$$

This formula is often referred to as the three-folded, consisting of three parts: the explained wage gap, $(\bar{X}_P - \bar{X}_M)\beta_N$, the unexplained public sector advantage, $\bar{X}_P(\beta_P - \beta_N)$, and the unexplained advantage of the private sector, $\bar{X}_M(\beta_M - \beta_N)$. Now, it is the combination of the second and third part that represents the total unexplained wage differential presented as a component in Equation B.10 - the public sector advantage, minus the private sector advantage.

The general literature uses the unexplained private disadvantage, $\bar{X}_M(\beta_N - \beta_M)$, instead of the unexplained private advantage shown above. This study prefers to use the private advantage over the private disadvantage, as this private disadvantage requires caution in interpretation (Michael et al., 2020). the unexplained private advantage seems more easily interpretable. This improved interpretability will certainly come into play when the wages turn in favour of the private sector - which may be the case within this research.

Here, for understanding too, it is wise to dive a little deeper into the formula - though not entering the same level of detail as before, since the steps to arrive at Equation B.11 show great similarities. Instead, a figure should provide more understanding of the formula to be used. But first, it is good to briefly show how the gross wage gap can be divided into the three parts mentioned above. For this, the first step is to rewrite the discriminatory gap (DG), which is familiar from Equation B.5, as:

$$\begin{aligned} \ln(D+1) &= \ln(W_P/W_M) - \ln(W_P^0/W_M^0) \\ &= \ln(W_P/W_P^0) - \ln(W_M/W_M^0) \\ &= \ln(\delta_P + 1) - \ln(\delta_M + 1) \end{aligned} \tag{B.12}$$

Where $\delta_P = (W_P/W_P^0) - 1$ represents the differential between current public sector wages and the wages that public sector employees would have received in the absence of discrimination term. Similarly, $\delta_M = (W_M/W_M^0) - 1$ is the differential between current private sector wages and the wages that private sector employees would have received in the absence of a discrimination term. Implementing this breakdown into the formula for the gross wage gap (G), as of Equation B.7, one obtains:

$$\ln(G+1) = \ln(\delta_P + 1) - \ln(\delta_M + 1) + \ln(CG + 1) \tag{B.13}$$

With the same application as Equations B.6 to B.10, one arrives at the three-folded Blinder-Oaxaca decomposition of the weighted mean, as devised by Oaxaca and Ransom (1994), via the equation:

$$\ln \bar{W}_P - \ln \bar{W}_M = (\bar{X}_P - \bar{X}_M)\beta_N + \bar{X}_P(\beta_P - \beta_N) - \bar{X}_M(\beta_M - \beta_N) \tag{B.14}$$

This three-folded public-private wage gap equation will serve as the foundation for the mean decomposition analysis.

Python has a package for implementing the Oaxaca-Blinder decomposition [1]. However, it has a few limitations, such as not allowing WLS regression in place of OLS regression and providing only the default two-fold decomposition instead of the three-fold decomposition preferred in this study. To address these limitations, the source code from this package is utilised to develop specific functions that meet to our approach's requirements.

[1] Refers to the *Statsmodels* package containing the *OaxacaBlinder* class, for which code descriptions are given in the user guide (Perktold et al., 2022)

Quantile decomposition using a counterfactual approach

To obtain a more detailed analysis of the wage gap beyond the mean, different methods have been proposed such as quantile regressions and inverse propensity weighting. In addition to focusing on subgroups, such as only highly educated individuals, these methods can provide a picture of the distribution over an entire distribution. Fortin et al. (2011) presents an overview of different decomposition methods beyond the mean and discusses limitations - This section will therefore not go into more detail on these methods. This study uses the approach proposed by Chernozhukov et al. (2013) which employs linear regressions for specified quantiles and estimates the marginal density function of wages using "counterfactual" distributions. This method is focused on the wage distribution of employees in the private and public sectors, and how it would change if they switched sectors. Depending on the type of counterfactual interest, different follow-up strategies can be implemented. In this study, the interest concerns the overall change, and for simplicity, more detailed decomposition methods are not used.

The counterfactual approach of any functional decomposition, as proposed by Chernozhukov et al. (2013), can be captured as:

$$F_{W(P|P)} - F_{W(M|M)} = [F_{W(P|P)} - F_{W(M|P)}] + [F_{W(M|P)} - F_{W(M|M)}] \tag{B.15}$$

Where, in the spirit of Oaxaca (1973), the left-hand side represents the total wage differential, the first term on the right-hand side is due to differences in the wage structure (the unexplained gap) and the second term is a composition effect due to differences in characteristics (the explained gap). Equation B.15 consists of three distinctive elements: 1) the observed distribution function of public (P) sector employees $F_{W(P/P)}$, 2) the observed distribution function of private (M) sector employees $F_{W(M/M)}$, and 3) the unobserved counterfactual distribution function of private sector workers had they faced the public sector's wage schedule $F_{W(M/P)}$. Estimating this counterfactual distribution, and implementing this distribution along the wage distribution in Equation B.15, forms the basis of the counterfactual approach.

However, this is a generic description of the counterfactual approach, and the above formula, as with the standard Oaxaca blinder formula, does not yet provide the intuitive interpretation desired. In simple terms, our objective is to estimate the hypothetical wage distribution of the private sector based on the covariates of the public sector. Although we cannot observe this hypothetical distribution directly, we can estimate the conditional distribution of W_M given the covariates X_P for the public sector.

The estimation of an unobserved counterfactual distribution is obtained by the plug-in rule, which is a method for estimating the counterfactual distribution based on estimated conditional distributions (Chernozhukov et al., 2013). The plug-in rule involves substituting the estimated conditional distributions into a formula for the counterfactual distribution, effectively "plugging in" the estimates. The counterfactual distribution and quantile functions are formed by combining the conditional distribution of the private sector with the covariate distribution of the public sector, namely:

$$\begin{aligned} F_{W(M|P)}(w) &:= \int_{X_P} F_{W_M|X_M}(w|x) dF_{X_P}(x) \\ Q_{W(M|P)}(\theta) &:= F_W^{\leftarrow}(M|P)(\theta) \end{aligned} \tag{B.16}$$

$F_W^{\leftarrow}(M|P)$ is the left-inverse function of $F_{W(M|P)}$; $Q_{W(M|P)}$ is the quantile function for quantile θ. To complete the quantile decomposition and the counterfactual exercise, one needs to estimate the conditional wage distribution based on the relevant human capital variables X. The estimation functions of Equation B.16 is given by:

$$\begin{aligned} \widehat{F}_{W(M|P)}(w) &:= \int_{X_P} \widehat{F}_{W_M|X_M}(w|X) d\widehat{F}_{X_P}(x) \\ \widehat{Q}_{W(M|P)}(\theta) &:= \widehat{F}^{\leftarrow}_{W(M|P)}(\theta) \end{aligned} \tag{B.17}$$

Which consists of two components: 1) the conditional quantile distribution function $\hat{F}_{W(M|X)}(w|x)$, and 2) the empirical covariate distribution function $\widehat{F}_{X_P}(x)$. Assuming that we have samples of individuals: $(W_{Pi}, X_{Pi}) : i = 1, 2, ..., n_k$; one estimates the covariate distribution $\widehat{F}_{X_P}(x)$ using the empirical distribution function:

$$\widehat{F}_{X_P}(x) = n_k^{-1} \sum_{i=1}^{n_k} 1\{X_{Pi} \leq x\} \tag{B.18}$$

The conditional quantile distribution function must also be estimated. For this, various modelling choices are described by Chernozhukov et al. (2013). Within this study, the most regular method is used, namely quantile regression. This method was introduced by Koenker et al. (1978), described by other researchers (e.g. Machado et al., 2005), and applied by default when this counterfactual approach would be performed in *R* (Chen et al., 2016). To estimate the conditional quantile distribution, Chernozhukov et al. (2013) proposes the form:

$$\hat{F}_{W(M|X)}(w|x) = \epsilon + \int_{\varepsilon}^{1-\varepsilon} 1\{x'\hat{\beta}(\theta) \leq y\}d\theta \tag{B.19}$$

Giving the formula for the coefficient estimates of the quantile regression - ϵ represents the trimming parameter, a small constant that avoids estimation of tail quantiles; $\hat{\beta}(\theta)$ is the Koenker et al. (1978) quantile regression estimator of the θth quantile. It is obtained by minimising the sum of weighted absolute deviations between the response variable and the predicted values, where the weights are a function of the quantile level θ and the trimming parameter ϵ. This quantile regression estimator is given by:

$$\hat{\beta}(\theta) = \arg\min_{b \in \mathbb{R}_x^d} \sum_{i=1}^{n} \big[\theta - 1\{Y_i \leq X_i'b\}\big] + \big[Y_i - X_i'b\big] \tag{B.20}$$

Which basically is a minimisation problem. This method should only be used with continuous dependent variables, which is the case in my research with log hourly wages (Chen et al., 2016). This need to be the case as the left inverse of Equation B.17 requires a monotonically increasing function.

This theory provides all necessary functions and procedures to find out all the elements in Equation B.15 specified for quantile decomposition. Ultimately, and in accordance with Chernozhukov et al. (2013), this leads to four steps to arrive at the quantile decomposition of the public-private wage gap. The first step is to obtain estimates of $\widehat{F}X_P$, the empirical covariate distributions of the public sector. Second, one obtains estimates of $\widehat{F}_{W(M|P)}$ of the counterfactual distribution using formulas B.19 and B.20 for quantile regression. The third step is to obtain estimates of the counterfactual distributions, quantiles, and other functionals via Equation B.17. Finally, one measures the Oaxaca (1973) spirited wage gap for each quantile by implementing all obtained estimates into Equation B.15.

There is a package on this methodology, defined by Chernozhukov et al. (2013) themselves, available in *R*. Unfortunately, this package is not available for Python. However, with *R* experience, the steps are applied in a similar way in Python.

C

Details of data preparation

This appendix describes the data preparation, in the report under section 3.3.3, in more detail. It has the same structure as the report, but more space is allocated to describe the steps and outcomes.

Individual datasets

The first step involves analysing the individual datasets. However, because it concerns enormously large datasets, and we know that we ultimately have to filter on only the Personal IDs, the persons who are in the Spolisbus datasets; it is wise to first filter for each dataset on only the IDs that occur in the Spolisbus for each year. These are the only individuals that are of interest, as the Spolisbus file contains all individuals that are active in the labour market (work in either the public or private sector). This has two direct advantages: it saves processing time in the further course, and it provides better insights when making choices about missing values or missing variables for the individual datasets. Table C.1 shows the number of IDs to be discarded through this step, for what, in my conscience, it needs no explanation of how large a reduction in data is achieved. The Betab dataset is not included, as it does not contain personal IDs and is not large on data usage, making this step unnecessary for this file. The second point may require some explanation. There are a few moments in data preparation when it is unavoidable to drop IDs, for example, due to missing values. There are several choices to be made, often depending on the amount of data loss. To properly determine this data loss, it is wise to only consider the IDs that will actually be included in the final analysis - And not those who would be excluded from the analysis anyway, because these persons do not belong to the working population and are thus not included in the Spolisbus dataset. Table C.1 shows the results of the exercise.

Spolisbus

In order to prepare the Spolisbus file, data containing all periodic payrolls of all Dutch employees, a number of steps are required. This starts with loading the file, which in principle has more than 199 million rows and more than 90 columns - making the file too large to load in its entirety. After a short analysis of the individual rows, which shows that a single person records more than ten rows, a choice is made to load this file efficiently and in its entirety.

This efficient loading starts with selecting only the required columns for the analysis. The required columns are limited to their personal anonymous IDs, information about the number of hours worked and the wages obtained for this (both the basic wage and the total gross wage, via bonuses), the company IDs, the sector, the collective labour agreement, and the type of employment and contract. A total of sixteen columns are included in the analysis, including the Personal IDs and the Company IDs.

It is also necessary to limit the number of rows. This is done immediately upon loading the file by grouping by both personal IDs and company IDs. It results in 1 row per person per company it worked for during that year. Functions are applied to arrive at a correct value for the other columns (summing monthly wages and hours, for example). Because of this exercise, it is still possible to distinguish people who have changed employers, and perhaps sectors, and it is possible to see whether people have several jobs at the same time.

Dataset	Spolisbus	Gbapersoontab		Hoogsteopltab		Onderwijstab	
Year	1	1	2	1	2	1	2
2010	8.525	20.049	11.799	9.051	4.446	2.278	940
2011	8.585	20.344	12.052	9.382	4.559	2.259	939
2012	8.504	20.634	12.407	9.710	4.723	2.249	980
2013	8.406	20.966	12.830	10.518	5.065	2.258	1.022
2014	8.379	21.367	13.250	10.735	5.210	2.237	1.027
2015	8.456	21.679	13.500	10.944	5.278	3.762	2.551
2016	8.588	22.022	13.734	11.226	5.331	3.759	2.509
2017	8.805	22.472	14.004	11.483	5.332	3.763	2.461
2018	9.056	24.951	15.905	11.724	5.327	3.784	2.412
2019	9.233	25.489	16.374	11.965	5.369	3.789	2.378
2020	9.145	25.919	16.935	12.189	5.541	3.812	2.429
2021	9.328	26.463	17.149	12.383	5.549	3.763	2.356

[1] The numbers concern the number of (unique) individuals in the datasets (1) originally, and (2) discarded by limiting to Spolisbus individuals only;
[2] The numbers are in millions, 2.356 is therefore 2.356 million.

Table C.1: Results of limiting all datasets to only individuals active in the labour market

Then, it is time to perform the needed preparations for the spolisbus file. To this end, several steps have been taken. First, the dataset is checked on empty values, but fortunately, this was not the case. Then variables are created that will be needed for the analysis. This concerns the hourly wages and natural logarithms of the hourly wages, both for the basic wage and the gross wage. This also concerns the definition of the public sector, by means of a public sector dummy variable. The part-time factor is calculated, so that a weighting can be applied as a full-time equivalent in the analysis. Furthermore, some variables need to change their shape, for example, sector codes are first strings and are converted into numerical numbers. See table C.2 for an overview of all included variables and a brief description of all variables used.

Gbapersoontab

To the Gbapersoontab file, the file containing all personal information on all Dutch residents and non-residents, very few adaptations need to be done. In view of the high privacy sensitivity and the size of this file, only the really necessary columns are loaded. This concerns gender, country of origin, generation (native Dutch or first or second-generation immigrant) and year of birth.

First, missing values within the file was checked again, but that is not the case in this file either. After that, only one new variable needs to be created. This concerns age, which is easy to calculate from the year of birth. However, the simplification is made that someone has the same age over the entire year - No differentiation is made here. An overview of included variables is given in table C.3.

Variable	Explanation	Values
Gender	Race of the employee	Categorical: 1. Female 2. Male
Origin	Generation ancestry	Categorical: 1. Native 2. Immigrant, first generation 3. Immigrant, second generation
Age	Age of the employee	Continuous: 23 →64

Table C.3: Overview of all included variables of Gbapersoontab dataset

Hoogsteopltab

As opposed to the Gbapersoontab file, the preparation of Hoogsteopltab file, which contains the edu-

Variable	Explanation	Values
Log hourly wage basis	Hourly wage without extras and overtime	Continuous: 0 →∞
Log hourly wage total	Hourly wage with extras and overtime	Continuous: 0 →∞
Total days	Number of calendar days the job exists	Continuous: 0 →365
Sort job	Type of profession or position performed	Categorical: 1. Manager 2. Temporary/On-call worker 3. Regular
Contract duration	Type of contract of an employee	Categorical: 1. Definite 2. Indefinite
Full-time class	Classified weekly working hours	Categorical: 1. <12 2. 12-<20 3. 20-<25 4. 25-<30 5. 30-<35 6. 35+
Public dummy	Sector of employer	Categorical: 1. Private 2. Public
Full-time equivalent	Fraction of yearly full-time hours	Continuous: 0 →∞

Table C.2: Overview of all included variables of Spolisbus dataset

cational field and level of almost all Dutch people, requires more work and thinking. Also, of course, only the necessary variables are loaded here - this concerns the study background, both according to the new classification and the old classification and the highest level of education achieved.

As a starter, there are two problems to be solved. First, the years 2010 to 2018 do not have a structured education direction - The education direction is classified in the new classification called 'SOI 2021' and in accordance with the ISCED-F 2013. It does have unstructured study background, defined through by the old classification, but it contains little consistency in the notation. Consistency must be achieved over all years for further analysis. The second problem is that from 2010 to 2012, the dataset does not have the highest level of education achieved. However, this is crucial for further analysis, since several sources indicate that wage development strongly depends on the level of education (CPB, 2011).

The first problem appears to be persistent as it concerns most years - A number of steps are required to gather a structured education variable from an unstructured education variable. This problem arose in the first place, as there have been adjustments to the data collected by Statistics Netherlands during this period. New guidelines (SOI2021) have been set for education direction, to better align with international classifications (ISCED-F 2013) - Resulting in different variables in the data over the years with different classifications (CBS, 2021c; UNESCO, 2014). The choice on how to deal with this information incompleteness often depends on the size of the problem and the novelty of the possible solutions - Better described as customisation depending on the situation (Kleinke et al., 2011). In my case, usually, a simple method will be chosen that retains as much data as possible.

The solution describes itself in a few steps. First of all, the years 2019 up to and including 2021, in which both the structured and unstructured fields of education are included, are used to create an overview, using a Python dictionary, of the structured field of education with associated unstructured fields of education. To give more feeling, the structured variable has 114 different values, the unstructured one has more than fifty thousand values. This overview is then used to match the unstructured variable of the years 2010 through 2018 to a corresponding structured variable matched in the overview created. This has had great success and in many cases leads to a match, but certainly not for all people or all years.

From 2013 to 2018 there were enough non-matches - For example, in 2013 there were more than 600 thousand. It would be a shame to exclude all these persons from the analysis. That is why smart

comprehension is applied for these non-matches. The unstructured variable often contains some structure through numbers in the text of the variable, it concerns a *Python* string, which must indicate some kind of education field. These numbers are read out - This was done for 2019 to 2021 to get an overview and then applied again to the as-yet unmatched cases from 2013 up to and including 2018. As a result, the non-matches in many cases still receive a structured variable assigned - For example, in 2018 'only' 1,351 people cannot be matched, for 2013 this loss is the greatest with 64,203 people. A cross-comparison with what the value should have been with the structured variables shows that the solution is associated with virtually no errors. Through this simple method, the years 2013 to 2018 have been given a structured training direction, with as little loss of data as possible.

But the biggest tasking is for the years 2010 to 2012 - Where there is no other solution for both the first and the second problem than losing data. Regarding the first problem, the variable of the unstructured field of education is built up differently than the years 2019 up to and including 2021, which means that no matching can be made. There is also no description or explanation to make the matching and construct the structured variable. Regarding the second problem, the years 2010 to 2012 do not contain the level of education either. Given that educational background, both level and field, is so important for correctly recording personal characteristics, see for instance the resolution to the issues mentioned in section 3.3.1, there appear to be two solutions - Drop these years in its entirety, or only consider the persons for which data can be extracted from 2013. Dropping these years in their entirety is the most undesirable solution, so an attempt is made to limit the years 2010 through 2012 to the persons who also occur in 2013. Although the population for the years 2010-2012 will become smaller, further analysis does concern the entire desired period. This is done by individually matching the Personal IDs for the years 2010, 2011 and 2012 with all personal IDs in 2013. If so, the level and field of education from 2013 are applied. If not, then these persons are excluded from the dataset from 2010, 2011 and 2012; concerning 726-, 662-, and 526 thousand persons respectively. Although people are lost, this does ensure that the years 2010 to 2012 now have the appropriate education level and field of all persons that are still included, and the entire further analysis still considers the desired years 2010 up to and including 2021. Table C.4 provides a brief overview of the total numbers that are included before and after data preparation.

Year	Before [1] [2]	After [1] [2]	Excluded [1] [2]
	1	2	3
2010	4.605	3.879	0.726
2011	4.823	4.161	0.662
2012	4.987	4.461	0.526
2013	5.453	5.389	0.064
2014	5.525	5.428	0.097
2015	5.666	5.535	0.131
2016	5.895	5.893	0.002
2017	6.151	6.150	0.001
2018	6.397	6.396	0.001
2019	6.597	6.597	-
2020	6.648	6.648	-
2021	6.833	6.833	-

[1] The numbers concern the number of (unique) individuals in the Hoogsteopltab dataset (1) before, (2) after, and (3) excluded through data preparation;
[2] The numbers are in millions, 0.726 is therefore 726 thousand.

Table C.4: Results of the data preparation for the education dataset (Hoogsteopltab)

After solving the two problems, it is also important to perform regular data preparation. In concrete terms, this involves two steps: categorising the level of education and categorising the education field - for both categorisations, conventional categories are used, as described in a report by Statistics Netherlands and in line with international guidelines (CBS, 2021c).

The level of education is merged into five categories: primary, secondary 1 and 2, and tertiary 1

Variable	Explanation	Values
Education level	Level of education of individual	Categorical: 1. Primary, ISCED level 0 and 1 (basisonderwijs, praktijkonderwijs) 2. Secondary 1, ISCED level 2 (Vmbo, Havo/Vwo-onderbouw, Mbo1) 3. Secondary 2, ISCED level 3 (Havo/Vwo-bovenbouw, Mbo2) 4. Tertiary 1, ISCED level 4 till 6 (Mbo3, Mbo4, Hbo associate degree, Hbo/Wo-bachelor) 5. Tertiary 2, ISCED level 7 and 8 (Hbo/Wo-master, Doctor)
Education field	Field of education of individual	Categorical: 1. Generic programmes and qualifications 2. Education 3. Arts and humanities 4. Social sciences, journalism and information 5. Economics and econometrics 6. Business and administration 7. Law 8. Natural sciences, mathematics and statistics 9. Information and Communication Technologies 10. Engineering, manufacturing and construction 11. Agriculture, forestry, fisheries and veterinary 12. Health and welfare 13. Services 14. Security services

Table C.5: Overview of all included variables of Hoogsteopltab dataset

and 2. The level of education categories is based on ISCED and SOI classifications (CBS, 2021c; International Qualification Authority, 2018). It is important to note that education in the Netherlands is compulsory up to a certain level of education and that a basic qualification applies (Rijksoverheid, 2023). Table C.5 shows the five categories. An education level of at least secondary 2 is required to obtain the basic qualification and to comply with compulsory education. The basic qualification is fulfilled from the category ”secondary 2”.

The field of education is merged into ’only’ fourteen categories - it used to consist of 114 already structured categories. For all categories, see table C.5. These categories are largely similar to ISCED classifications, with a few exceptions (UNESCO, 2014). There are some education fields that focus specifically on the public sector but fall into a larger category. These education fields are listed separately. This concerns, for example, security services, which include military and police - according to the ISCED classification, this education field falls under services.

Onderwijstab

The Onderwijstab file, the file containing all current students, actually nothing needs to be adapted. This concerns a small dataset. It does have many variables, but for this research, I am only interested in the persons who are in the database. Only the IDs are therefore requested - which are used later to exclude current students from the analysis. This filtering is in line with other studies (Biesenbeek et al., 2019) - the reason being that students mainly find a ’side job’ in the private sector, which can influence the comparison with the public sector. Excluding students from the analysis thus leads to a better comparison of public and private wages.

Betab

To the Betab file, the file containing all company information, little adaptation needs to be done. This

Variable	Explanation	Values
Employer size	The size of the employer	Categorical: 1. 0-9 employees 2. 10-49 employees 3. 50-99 employees 4. 100-199 employees 5. 200-499 employees 6. 500-1999 employees 7. 2000+ employees
Urbanity	Dummy for urban location	Categorical: 1. Urban 2. Non-urban

Table C.6: Overview of all included variables of Betab dataset

also concerns the smallest dataset, as it concerns companies and not persons - With around six hundred thousand companies. It does have many variables, but of these, only the size of the company, measured by the number of employees, and the municipal location are of importance.

First, missing values were checked for, but there were none. Then, as a starter, the company size is categorised into seven categories. The execution, I think, speaks for itself. And the grouping and division of these categories can be found in section 4.1 on raw trends. The municipal location of the companies is used to determine whether these companies are located in metropolitan/urban areas or not. According to several studies into the wage gap, urbanity is important (e.g. Blackaby et al., 2018; Rattsø et al., 2020) - Applying a simple dummy variable is used to control for this. Table C.6 provides a simple overview.

Merging of datasets

The next step involves merging the datasets into one comprehensive dataset. This concerns only a small and quick step, but a step in which a lot of data can also be lost. That is why it is important to carefully analyse these steps. The Spolisbus file is of course taken as a basis, and variables from other datasets are added here based on Personal or Company IDs. The merged file contains only the persons whose variables can be merged. So, if there are persons in the Spolisbus file of whom, for example, no education data are available, then these persons are excluded from the analysis - This can drastically reduce the number of people in the merged Spolisbus dataset. Conversely, the other datasets are already limited to the persons in the Spolisbus dataset; so no one will be left out in this regard. The steps and the number of excluded persons, as well as the total number of persons in the final analysis, are described in this section - See table C.7 for a compact overview of the results of merging the datasets.

The first file that is added to the Spolisbus dataset is the Gbapersoontab - This gives people in the Spolisbus dataset personal characteristics, such as age, gender and origin. Due to the extremely high coverage of this file, the merging goes well - For 2021, only X persons from the Spolisbus dataset are excluded.

Subsequently, the Hoogsteopltab is added to the dataset, so that the final dataset also includes the education level and field of education. The lower coverage of this file with regard to the Dutch population, together with the problems that occurred in the years 2010 to 2012, means that more people are excluded from the analysis with the addition of this file.

Finally, the Betab dataset is added to the entire file, through matching on company IDs, and relevant characteristics are added for all persons about the company they work for, such as the size and the geographical location (urban dummy). The Betab file also has extremely high coverage, which also means that no people are lost when merging the company data - For every employee, his or her company information is known.

This completes the total dataset. The Onderwijstab is not used for merging here, as this file is used to exclude current students from the analysis. This step, like other exclusions, is described in the preparation of the final dataset.

Year	Spolisbus 0	Gbapersoontab 1	Hoogsteopltab 2	Betab 3
2010	8.525	8.250	3.879	3.879
2011	8.585	8.292	4.161	4.161
2012	8.504	8.227	4.461	4.461
2013	8.406	8.137	5.389	5.389
2014	8.379	8.117	5.428	5.428
2015	8.456	8.178	5.535	5.535
2016	8.588	8.288	5.893	5.893
2017	8.805	8.467	6.150	6.150
2018	9.056	9.046	6.396	6.396
2019	9.233	9.115	6.597	6.597
2020	9.145	8.985	6.648	6.648
2021	9.328	9.315	6.833	6.833

[1] Merging takes place from left to right. The steps in merging are denoted by the number below the dataset;
[2] The numbers concern the number of (unique) individuals in the dataset;
[3] The numbers are in millions, 6.833 is therefore 6.833 million.

Table C.7: Results of merging datasets with the so-far merged dataset

Preparation of final dataset

Now we can leave all separate datasets behind and only focus on the merged dataset, but there are still some steps to take to arrive at the final dataset. During this preparation of the final dataset, the total dataset is limited to only the persons for whom the analysis has to be carried out. This mainly concerns considerations to make the analysis, the comparison of the public and private sectors, more representative and therefore fairer. People who can 'skew' the values of one of the two sectors, making the comparison less representative, are mainly excluded.

The first exclusion concerns the exclusion of students. Students mainly have part-time jobs in the private sector and generally receive lower wages because they have not yet completed their education. This can skew aggregated wages in the private sector downwards. To be able to exclude students, the Onderwijstab dataset is used. This has already been described but contains all persons currently studying in the Netherlands. With this exclusion, this study is in line with recent Dutch research by Biesenbeek et al. (2019). Excluding students leads to a decrease of 1.4 million people in 2021 - For comparison, there are more than 3.7 million students in the Netherlands.

The second exclusion concerns the exclusion of extremely low earners - read people who earn below the minimum hourly wage. In the Netherlands, an absolute minimum hourly wage has been set for every employee in the Netherlands - A law within the legislative powers of the government relating to wage policy, as specified in Section 2.3.3. In this section, the development of minimum wages is also briefly mentioned - Which gives rise to the third criterion for exclusion. The exclusion of extremely low earners is also in line with other studies and leads to the exclusion of 125 thousand of people in 2021.

The third group of exclusion is in line with this minimum age and concerns the exclusion of persons below the age limit for the minimum wage. As discussed in section 2.3.3, this age has changed over from 23 years in 2010 to 21 years in 2021. For a good comparison, therefore, all persons under the age of 23 are excluded from the analysis - For all years to keep trends representative. The exclusion of people under a certain age is also in line with other research Ernest Berkhout et al. (2013).

The fourth group of exclusion is again related to the previous point and concerns the exclusion of people above a certain age, namely people who have reached the state pension age. This age has also developed - from 65 years in 2010 to 67 years in 2021. If people have reached the state pension age, they can still continue working, but working conditions change. Since 2020, civil servants are no longer even allowed to continue working if they have reached the state pension age. As a result, these persons can only work in the private sector, and since they have different working conditions, including these persons makes the analysis 'unfair'. To keep the analysis consistent over the years, all persons aged 65 and older are excluded. The exclusion of persons under the age of 23 and over the age of 64

leads to the exclusion of 320 thousand persons in 2021.

Then, interns and employees who fall under the Sheltered Employment Act (WSW) are excluded from the analysis. Interns conclude the employment contract with a purpose other than work itself - Often it is study related. As a result, these individuals have different motivations. In addition, interns do not fall under the minimum wage - In practice, hourly wages are often lower. This group is often already excluded, as minimum wages and current students are already excluded. WSW employees often receive a subsidy, in addition to the employer also receiving a subsidy. As a result, the employment contract has a different interaction that can disrupt the relationship that is actually being investigated.

At last, individuals who have an "unknown" educational background are excluded from the analysis. The idea behind the analysis is to determine wages based on human capital characteristics. If someone has an unknown educational background, personal capabilities are also unclear. Therefore this group of individuals is excluded. This exclusion has some impact with the exclusion of more than 150 thousand people in 2021. This mainly concerns people with a migration background whose educational background is unknown.

After this, the dataset is ready for analysis. The total number of people included in the analysis per year is shown in Table C.8. The above-mentioned steps are followed in order to arrive at the final number of persons included in the analysis, all the way to the right.

Year	None 0	Students 1	Wage 2	Age 3	Intern/WSW 4	Unknowns 5
2010	3.879	2.692	2.582	2.446	2.420	2.402
2011	4.161	2.973	2.861	2.720	2.689	2.669
2012	4.461	3.294	3.169	3.021	2.985	2.997
2013	5.389	4.143	3.973	3.818	3.763	3.737
2014	5.428	4.205	4.041	3.889	3.829	3.802
2015	5.535	4.302	4.132	3.970	3.911	3.886
2016	5.893	4.612	4.436	4.260	4.202	4.172
2017	6.150	4.816	4.622	4.425	4.370	4.339
2018	6.396	5.006	4.828	4.596	4.543	4.513
2019	6.597	5.172	5.021	4.749	4.699	4.540
2020	6.648	5.248	5.111	4.822	4.775	4.617
2021	6.833	5.396	5.271	4.951	4.906	4.747

[1] Exclusion takes place from left to right. The steps in exclusion are denoted by the number below the dataset;
[2] The numbers concern the number of (unique) individuals in the dataset;
[3] The numbers are in millions, 4.747 is therefore 4.747 million.

Table C.8: Results of exclusions from merged dataset towards the final dataset

Preparation of the mobility dataset

The dataset after exclusion is ready for analysis of the public-private wage gap - however, for the analysis of public sector attractiveness, there is still a step to be taken. This step is to create a sector mobility dataset used for the sectoral mobility analysis. Although it sounds simple, creating the sector mobility dataset does require some thinking.

In many cases changing jobs is not as straightforward as it may seem. To put it simply, most people do not stop job *A* at time *t* and start at job *B* at time *t+1*. Instead, jobs often overlap, or there is a period of time between job transitions. In order to include these cases correctly, and to include only the cases you want to include at all, choices have to be made. These choices are described below.

The dataset after exclusion consists of employer-employee level data. For analysing the number of people moving to and from the public sector, only those people who change sectors within or between a consecutive period are of interest. Fortunately, the data also covers the dates to which the employment relationship relates, both starting date and the ending date. These employment dates are used to implement the choices in the dataset.

Two separate operations are performed, determining if someone is switching sectors within a year, and determining if someone is switching sectors between two consecutive years - this is because the

datasets used are per year. For within a year shifters, it will be checked whether people have worked in both the public and private sectors. If this is the case, their start and final contract date will be reviewed. If the end date of the public sector job is later than the last date of the private sector job, then this person has moved to the public sector - and vice versa for moving to the private sector. If the end date is the same, then these persons are regarded as ”no clean shifters”. This could be for several reasons. It may concern the end of the year, which makes it logical that this person has two of the same end dates. It is also possible that a person quits both jobs at the same time to start his own business, for example. You do not want to include these cases and are therefore not included in the analysis.

For in-between two years shifters, the datasets of two consecutive years are combined - since the data is so data-heavy, not all years can be combined. Then we again first look at people who have worked in different sectors between the two years - for instance, the public sector in year *t* and the private sector in year *t+1*. After this, the choice is made when it is considered that they have made a shift between the years. The choice concerns the following, if the person in year *t* in either November or December still worked in sector *A*, and in year *t+1* started working in either January or February in sector *B*, then this person is regarded as a sector shifter and this person is added to year *t+1* in the sector mobility dataset. This determines whether a person went from public to private between November and February and vice versa.

Then the persons of within-year shifters and in-between-year shifters are merged to have a complete dataset of sectoral mobility shifters per year and sector (public to private and private to public). The number of individuals present in the shifters dataset per year is displayed in table C.9 below. The public-to-private shifters are referred to as ”leavers”, while the private-to-public shifters are referred to as ”joiners”. Summary statistics of these shifters are shown in section 5.1 and appendix E.

	Number of persons			**Amount of FTE**		
Year	Leavers	Joiners	Shift balance	Leavers	Joiners	Shift balance
2010	13.6	27.2	13.5	9.9	24.3	14.4
2011	27.9	39.7	11.8	20.3	32.9	12.6
2012	28.8	41.7	12.8	19.6	33.9	14.3
2013	33.0	41.2	8.3	22.7	32.5	9.8
2014	31.4	61.1	29.7	21.9	49.7	27.8
2015	33.8	59.0	25.2	23.3	48.3	25.0
2016	36.5	65.2	28.8	26.1	54.5	28.4
2017	37.2	69.7	32.5	27.5	60.0	32.5
2018	40.4	77.3	36.8	31.2	67.6	36.4
2019	37.6	82.6	45.0	29.3	72.9	43.6
2020	36.1	84.0	47.9	27.6	75.1	47.5
2021	40.4	84.0	43.6	31.3	75.7	44.4

[1] The samples consist of all employees who have joined the public sector from the private sector in 2021 (public joiner), all employees who have left the public sector to the private sector in 2021 (public leaver), or all employees in the public sector in 2021 (public stayer);
[2] The numbers concern the number of (unique) individuals in the dataset;
[3] The numbers are in thousands, 44.4 is therefore 44.4 thousand.

Table C.9: Amount of individuals shifting per year

D

Details of wage gap estimation results

This appendix presents all results obtained for chapter 4 of this research. Here too, the same structure is used as in the main report, but with more tables and figures. This section is intended to show additional results or tables of figures in the main report, not to tell an additional story. Each insight most relevant to the study is represented in the main report.

D.1. Basic statistics and trends

Basic statistics
All basic statistics are shown in Table D.1, as an extended version of the table in the body (Table 4.1).

Table D.1: Full summary statistics

	Public		Private	
Variable	2010	2021	2010	2021
Hourly wage				
Basis	21.28 (7.63)	26.68 (9.49)	18.69 (10.85)	22.31 (12.83)
Extra	24.38 (8.38)	29.29 (10.51)	22.00 (15.52)	25.00 (36.20)
Age	39.15 (10.07)	42.74 (11.08)	36.89 (10.00)	40.71 (11.39)
Gender (male)	47.42%	45.72%	59.28%	58.47%
Origin				
Native	85.60%	82.95%	82.82%	78.97%
Immigrant, 1st generation	6.12%	6.89%	8.73%	11.03%
Immigrant, 2nd generation	8.28%	10.17%	8.45%	10.00%
Education Level				
Primary	0.66%	0.71%	2.96%	3.97%
Secondary 1	2.47%	2.40%	7.28%	7.59%
Secondary 2	8.65%	7.80%	13.45%	14.12%
Tertiary 1	53.20%	53.95%	58.13%	57.99%
Tertiary 2	35.03%	35.13%	18.18%	16.82%
Education field				
Generic programmes	14.89%	6.55%	23.45%	11.90%
Education	30.96%	26.08%	3.18%	2.65%
Arts and humanities	3.63%	3.93%	2.99%	3.70%
Social sciences, journalism and information	5.34%	6.18%	3.45%	3.69%
Economics and econometrics	1.38%	1.14%	1.58%	1.00%
Business and administration	12.62%	15.48%	20.25%	21.54%
Law	4.03%	4.85%	2.01%	1.99%

Table D.1: Continued, Full summary statistics

	Public		Private	
Variable	2010	2021	2010	2021
Natural sciences, mathematics and statistics	3.36%	3.57%	2.04%	1.75%
Information and Communication Technologies	1.77%	2.70%	3.17%	3.41%
Engineering, manufacturing and construction	7.20%	8.44%	15.63%	18.26%
Agriculture, forestry, fisheries and veterinary	1.34%	1.68%	1.62%	2.21%
Health and welfare	9.40%	11.42%	11.93%	14.58%
Services	2.74%	4.72%	7.56%	11.30%
Security services	1.09%	3.25%	1.15%	2.01%
Full-time	64.20%	59.56%	67.47%	63.25%
Full-time class				
<12	1.35%	1.01%	3.07%	2.22%
12-<20	4.94%	3.35%	5.44%	3.62%
20-<25	7.82%	8.98%	7.59%	8.11%
25-<30	9.04%	12.94%	6.35%	7.04%
30-<35	16.02%	16.32%	14.42%	13.24%
35+	60.82%	57.40%	63.14%	65.77%
Contract duration (Infinite)	77.16%	81.13%	69.60%	72.22%
Sort job				
Manager	0%	0%	3.02%	3.79%
Temporary/On-call Worker	0.29%	0.32%	5.74%	7.34%
Regular	99.71%	99.68%	91.24%	88.87%
Employer size				
0-9	0.30%	0.17%	15.19%	15.30%
10-49	2.58%	1.45%	18.80%	19.35%
50-99	3.67%	2.14%	8.93%	9.07%
100-199	9.42%	6.64%	8.64%	8.87%
200-499	17.35%	17.47%	10.93%	11.48%
500-1999	25.08%	25.60%	17.18%	17.44%
2000+	41.61%	46.52%	20.36%	18.49%
Urbanity (Urban)	18.34%	44.56%	18.34%	21.02%

[1] The table has continuous, categorical and count variables, including respectively weighted means with standard deviations in parentheses, percentages indicating the occurrence of a particular value, or the total count in millions;
[2] The target population consists of all workers in the Netherlands with an employee contract, excluding students, people younger than 23 or older than 64, and people with an internship contract;
[3] The reported representative sample concerns approximately 46% of the entire target population in 2010 and 73% in 2021.

Gini coefficient
This figure shows the trend of the Gini coefficient over the period 2010 to 2021.

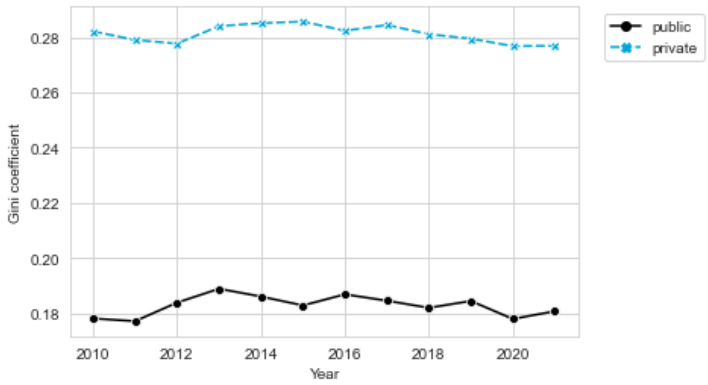

Figure D.1: Gini coefficient of the public and private sector

D.2. The public-private wage gap

Regression model estimates
All regression model coefficients are shown in Table D.2, as an extended version on the table in the body (Table 4.2).

Table D.2: Regression coefficients of the WLS model

	Public		Private	
Variable	2010	2021	2010	2021
R^2	0.45	0.45	0.44	0.44
Constant	2.84	3.02	2.76	2.89
Age	0.017	0.014	0.016	0.012
Age^2	-0.001	-0.001	-0.001	-0.001
Gender (Male)				
Female	-0.07	-0.05	-0.12	-0.11
Origin (Native)				
Immigrant, 1st generation	-0.10	-0.10	-0.14	-0.14
Immigrant, 2nd generation	-0.01	-0.02	-0.02	-0.03
Education Level (Primary)				
Secondary 1	0.09	0.16	0.08	0.12
Secondary 2	0.27	0.30	0.19	0.21
Tertiary 1	0.34	0.46	0.32	0.40
Tertiary 2	0.50	0.67	0.60	0.73
Education field (Generic programmes)				
Education	-0.04	-0.09	-0.02	-0.11
Arts and humanities	-0.05	-0.15	-0.12	-0.22
Social sciences, journalism and information	0.02	-0.09	0.19	-0.08
Economics and econometrics	0.13	0.01	0.25	0.19
Business and administration	0.01	-0.10	0.05	-0.05
Law	0.08	-0.05	0.12	0.00
Natural sciences, mathematics and statistics	-0.02	-0.11	0.03	-0.03
Information and Communication Technologies	0.00	-0.10	0.05	-0.03
Engineering, manufacturing and construction	-0.01	-0.11	-0.03	-0.11

Table D.2: Continued, Regression coefficients of the WLS model

	Public		Private	
Variable	2010	2021	2010	2021
Agriculture, forestry, fisheries and veterinary	-0.06	-0.20	-0.10	-0.21
Health and welfare	0.01	-0.06	0.03	-0.04
Services	-0.06	-0.18	-0.10	-0.18
Security services	-0.11	-0.16	-0.17	-0.22
Full-time code (Full-time)				
Part-time	-0.03	-0.11	-0.02	-0.08
Contract duration (Infinite)				
Definite	-0.11	-0.10	-0.14	-0.17
Employer size (0-9)				
10-49	0.00	-0.04	0.04	0.04
50-99	0.00	-0.03	0.07	0.08
100-199	0.02	-0.04	0.08	0.10
200-499	0.02	-0.03	0.11	0.12
500-1999	0.04	0.01	0.11	0.12
2000+	0.05	0.01	0.12	0.12
Urbanity (Non-Urban)				
Urban	0.01	0.01	0.10	0.11

[1] Age and age^2 are centred on the mean age (public sector: 39.15 in 2010 and 42.74 in 2021, private sector: 36,89 in 2010 and 40.71 in 2021). The reference level for each categorical variable is shown in parentheses. The constant represents the estimated logarithmic wage for the combination of all reference levels and the mean age;
[2] The target population consists of all workers in the Netherlands with an employee contract, excluding students, people younger than 23 or older than 64, and people with an internship contract;
[3] The reported representative sample concerns approximately 46% of the entire target population in 2010 and 73% in 2021;
[4] Each coefficient is significant for significance level p<0.01.

Data multicollinearity

Data multicollinearity is tested using mutual correlation and Variance Inflation Factor (VIF) scores. VIF scores are a statistical concept used to measure the severity of multicollinearity in regression analysis. Figure D.2 shows the mutual correlation between independent and controlling variables. As all correlations are below 0.5 (or greater than -0.5), no correlation issues are found. Though, VIF scores bring further exclusion of multicollinearity issues. Table D.3 shows that all VIF scores are well below 10, the value that is considered a threshold for multicollinearity issues. It is therefore concluded that there are no data multicollinearity issues. This ensures the reliability of the interpretation of the coefficients.

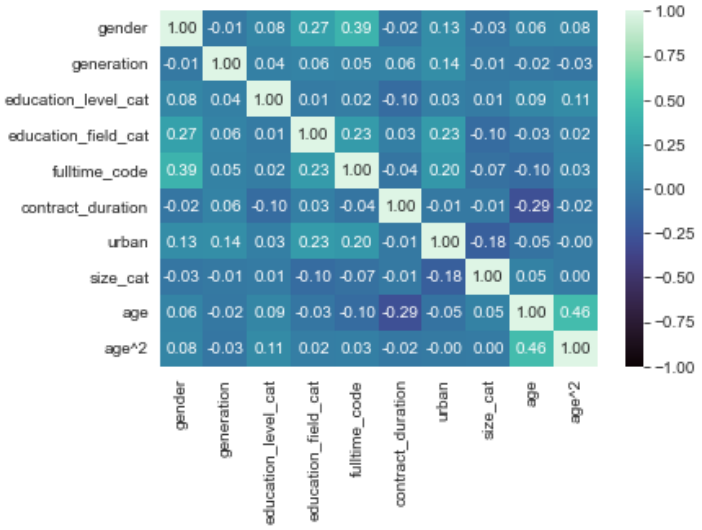

Figure D.2: Correlation heatmap of regression variables

Variable	Public sector	Private sector
Gender	2.13	2.61
Origin	1.21	1.28
Education level	1.92	1.70
Education field	2.12	2.85
Full-time code	2.39	2.55
Contract duration	1.41	1.57
Employer size	1.79	2.32
Urbanity	1.78	1.26
Age	1.50	1.12
Age^2	2.34	1.94

Table D.3: VIF scores for the public and private sector for 2021

Mean decomposition

Full values of Figure 4.4.

	Unexplained gap			Explained gap	Total gap
Year	Public adv.	Private adv.	Total	-	-
2010	0.033	-0.008	0.041	0.127	0.168
2011	0.033	-0.007	0.040	0.137	0.178
2012	0.034	-0.007	0.041	0.146	0.188
2013	0.033	-0.006	0.040	0.158	0.198
2014	0.051	-0.009	0.060	0.172	0.232
2015	0.062	-0.011	0.073	0.187	0.260
2016	0.072	-0.013	0.085	0.192	0.277
2017	0.065	-0.012	0.077	0.191	0.268
2018	0.060	-0.011	0.071	0.190	0.261
2019	0.046	-0.008	0.054	0.196	0.250
2020	0.050	-0.009	0.059	0.200	0.259
2021	0.040	-0.008	0.047	0.187	0.235

[1] The table concern the entire sample in the analysis;
[2] This decomposition concerns the three-folded Oaxaca-Blinder decomposition of the mean, decomposing the wage gap into an explained and unexplained wage gap;
[3] The unexplained wage gap consists of the public sector advantage minus the private sector advantage.

Table D.4: Estimation of wage differentials, with a breakdown by unexplained gap (public- and private advantage), explained gap and total gap

E

Details of sectoral job mobility results

This appendix presents all results obtained for chapter 5 of this research. Here too, the same structure is used as in the main report. This section is mainly intended to show additional results or tables of figures in the main report, not to tell an additional story. Each insight most relevant to the study is represented in the main report.

E.1. Sectoral job mobility analysis

Basic statistics
All basic statistics are shown in Table E.1, as an extended version on the table in the body (Table 5.1).

Table E.1: Full summary statistics of the public sector and shifters for 2021

Variable	Public stayer	Public leaver	Public joiner
Hourly wage			
Basis	26.68 (9.49)	24.28 (10.23)	23.06 (8.09)
Extra	29.29 (10.51)	28.73 (23.94)	25.06 (9.26)
Age	42.74 (11.08)	39.20 (10.76)	37.55 (10.75)
Gender (male)	45.72%	45.66%	44.53%
Origin			
Native	82.95%	80.87%	79.25%
Immigrant, 1st generation	6.89%	7.96%	7.85%
Immigrant, 2nd generation	10.17%	11.18%	12.90%
Education Level			
Primary	0.71%	0.61%	0.78%
Secondary 1	2.40%	1.96%	2.31%
Secondary 2	7.80%	6.21%	6.78%
Tertiary 1	53.95%	48.36%	56.65%
Tertiary 2	35.13%	42.86%	33.48%
Education field			
Generic programmes	6.55%	4.96%	5.53%
Education	26.08%	16.98%	16.98%
Arts and humanities	3.93%	3.72%	4.68%
Social sciences, journalism and information	6.18%	8.01%	7.67%
Economics and econometrics	1.14%	1.15%	0.84%
Business and administration	15.48%	14.96%	17.17%
Law	4.85%	4.37%	4.93%

Table E.1: Continued, Full summary statistics of the public sector and shifters for 2021

Variable	Public stayer	Public leaver	Public joiner
Natural sciences, mathematics and statistics	3.57%	4.16%	3.16%
Information and Communication Technologies	2.70%	2.76%	2.93%
Engineering, manufacturing and construction	8.44%	8.54%	8.27%
Agriculture, forestry, fisheries and veterinary	1.68%	1.52%	1.69%
Health and welfare	11.42%	21.26%	16.56%
Services	4.72%	4.70%	6.91%
Security services	3.25%	2.92%	2.69%
Full-time	59.56%	53.12%	58.38%
Full-time class			
<12	1.01%	5.04%	2.36%
12-<20	3.35%	7.09%	4.83%
20-<25	8.98%	9.86%	9.11%
25-<30	12.94%	10.78%	11.27%
30-<35	16.32%	15.18%	15.41%
35+	57.40%	52.05%	57.01%
Contract duration (Infinite)	81.13%	55.85%	31.92%
Sort job			
Manager	0%	0%	0%
Temporary/On-call Worker	0.32%	2.46%	0.81%
Regular	99.68%	97.54%	99.19%
Employer size			
0-9	0.17%	0.22%	0.22%
10-49	1.45%	1.53%	1.26%
50-99	2.14%	1.86%	1.84%
100-199	6.64%	6.30%	6.13%
200-499	17.47%	15.67%	17.50%
500-1999	25.60%	22.72%	26.35%
2000+	46.52%	51.70%	46.71%
Urbanity (Urban)	44.56%	45.58%	44.90%

[1] The table has continuous, categorical and count variables, including respectively weighted means with standard deviations in parentheses, percentages indicating the occurrence of a particular value, or the total count in thousands;
[2] The samples consist of all employees who have joined the public sector from the private sector in 2021 (public joiner), all employees who have left the public sector to the private sector in 2021 (public leaver), or all employees in the public sector in 2021 (public stayer).