University of Southampton

Faculty of Social Sciences
Department of Economics

Essays in Health and Labour Economics

by

Alexandra Nazerai

A thesis for the degree of
Doctor of Philosophy

November 2023

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Abstract

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The prevalence of obesity in the population of the UK is one of the most important health conditions with multidimensional consequences for the obese and all the society. Obesity not only has important effects on the health of individuals but it is also correlated with many other aspects of the society and economy one of which is the effect of obesity in labour outcomes. Therefore, in this work, I provide evidence with regards to the extent that individuals' BMI determines the labour market outcomes of a high and constantly increasing proportion of our society. More specifically, I estimate the causal impact of individuals' BMI on the probability to be in employment and their hourly wage for the prime working age men and women in the UK. Additionally, I further expand the analysis by providing evidence regarding the impact of individuals' BMI on their probability to be in a social interactive occupation. Moreover, I investigate whether being or not in a social interactive occupation can explain the wage differences among the obese and non-obese individuals. In addition to physical health, the study of mental health of individuals and how it can be affected by economic shocks are also of high interest in recent years. More specifically, I am interested to explore how the austerity measures introduced with the Welfare Reform Act in 2012 affected the mental health of the impacted individuals. Austerity measures introduced after the global economic crisis of 2007 had important consequences for the economies that adopted them and for the societies that had to adjust. This is the first study, to the best of my knowledge, to estimate the impact of those introduced austerity measures on individuals' mental health for the case of the UK.

I provide evidence regarding the causal effect of an increasing BMI on the probability of the prime working age men and women to be in employment and on their hourly wage for the case of the UK. I solve the endogeneity problem, that arises due to the reverse causality of BMI and labour market outcomes and/or due to omitted variable bias, with an Instrumental Variables (IV) approach. More specifically, I use a polygenic score of BMI as an IV which is the most updated method of estimating the impact of BMI on labour market outcomes. My analysis provides evidence that individuals' probability to be in employment is not determined by their BMI. Also, with regards to the hourly wage I find a statistically significant effect of an increasing BMI for the case of women but not for men. Additionally, I estimate the impact of BMI on the probability of the prime working age men and women to work in a social interactive occupation. Furthermore, I provide evidence regarding the explanatory power of social interactive occupations on the wage gap of obese and non-obese individuals. According to my findings the probability of the prime working age men is not impacted by their BMI. For the case of the prime working age women I find that experience a negative and statistically important impact. With regards to the explanatory power of being in social interactive occupation on the wage differences for obese and non-obese individuals I find that it is zero. Furthermore, I provide evidence regarding the impact of the austerity measures, introduced with the Welfare Reform Act in 2012 in the UK, on the mental health of individuals. My study contributes by

providing, for the first time to the best of my knowledge, estimates regarding the impact of the welfare reforms, introduced in the UK with the Welfare Reform Act 2012, on individuals' mental health. Based on the findings of my analysis the austerity measures related to the welfare reforms did not impact the mental health of individuals. The findings are robust when I conduct dynamic analysis, placebo falsification analysis, and heterogeneity analysis indicating that individuals do not experience differently an important worsen in their mental health due to the implementation of the welfare reforms.

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Declaration of Authorship

I declare that this thesis and the work presented in it is my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission

Signed:..... Date:.....

Acknowledgements

I would like to thank my supervisors and colleagues for their tremendous help during my PhD. I would like to thank Prof. Michael Vlassopoulos and Dr. Panagiotis Giannarakis for their continuous support and helpful supervision throughout my doctoral studies. It was a great honour to have such great supervisors as I benefited importantly from their knowledge and their experience, and I received excellent guidance towards developing the necessary skills and becoming an independent researcher capable of producing high quality research. Also, I would like to thank Prof. Corrado Giulietti for his great support and feedback throughout our excellent collaboration and joint work on Chapter 4. Additionally, many thanks to my PhD viva examiners, Prof. Carmine Ornaghi and Prof. Sotiris Vandoros, whose feedback and comments were important and helpful. Furthermore, I would like to thank Prof. Emmanouil Mentzakis for his useful feedback during my first progression review and the PhD confirmation review.

Also, many thanks to my family and friends for their support throughout my studies. Special thanks to my mother Teuta Danaj for her tireless support and trust in me which was very valuable and encouraging to me every time I needed it the most. I would also like to thank my husband Georgios Papandroulidakis for his crucial support throughout this journey and especially for helping me reach the light even during the least bright days.

To my Giorgo,

Chapter 1

Introduction

Excess weight and obesity is an important public health problem for many countries as the already high proportion of the impacted individuals is observed to have an increasing rate over time. The United Kingdom (UK) is among the countries with the highest prevalence of obesity among its adults and children as well. It is important to highlight that, according to the National Health Service (NHS) in UK, only in England in 2017 around 30% of the adult individuals and around 20% of children were classified as obese. The consequences of an unhealthy high weight are important for different aspects of the lives of the impacted individuals and for all the society. For example, overweight or obese individuals face a higher risk of some of the most commons health problems such as type II diabetes, heart disease and even some types of cancer. Also, based on the statistical evidence related to the recent pandemic, obesity is associated with an increased risk of serious illness and death from COVID-19. This leads to a high and increasing cost that the health systems across countries face. For the case of the UK, according to the Public Health England (gov.uk), the cost that was associated to health problems related to excess weight between 2014 and 2015 was £6.1 billion. The consequences of overweight and obesity do motivate researchers from different fields to explore their extent. Labour economists are highly interested regarding the impact of an increasing Body Mass Index (BMI) on the labour market outcomes of individuals and they provide useful insights. For example, there are studies that provide supportive evidence that obese individuals are paid less (Cawley (2004), Brunello and D'Hombres (2007), etc.) and are less likely to be in a job position (Rooth (2009), Garcia Jaume and Quintana-Domeque Climent (2006), etc.). Since obesity impacts an already high and constantly increasing proportion of our society, an in depth understanding of the impact of individuals' BMI on their most important labour market outcomes such as employment and hourly wage will provide insights regarding the extent that people are disadvantaged. Also, further analysis regarding the channels that an increasing BMI may affect the labour

market outcomes of individuals can provide further evidence with regards to the source of discrimination that individuals face.

Furthermore, through this work, I draw the attention to another important relation between individuals' health and the economy from the opposite point of view, thus how economic shocks can impact the health of individuals in a society. Therefore, I am also investigating how the austerity measures introduced with the Welfare Reform Act in 2012 in the UK can affect the mental health of the impacted individuals. The welfare reforms introduced by the UK government in 2012 included a number of cuts of social benefits that impacted a large proportion of our society. Some of the most important welfare reforms include the abolishment of the Council Tax Benefit (CTB), the introduction of the Bedroom Tax (BT) and the replacement of the Disability Living Allowance (DLA) by the Personal Independence Payments (PIP) that impacted working age individuals. The introduced austerity measures led to important reductions on the unearned income for vulnerable groups of the society that, due to low earned income or health related reasons to be out of the labour market, rely on their social benefits to cover their cost of living. Studies suggest that welfare reforms that lead to a reduction of the unearned income or to institutional changes impact negatively the physical health and the mental health of individuals (Arcà et al. (2020), Stuckler et al. (2017), Barr et al. (2016a), Barr et al. (2016b) and Wickham et al. (2020)). Therefore, it is important to provide an in depth understanding regarding the impact of austerity on the mental health of the affected individuals. This analysis aims to provide important insights with regards to the consequences of the introduced austerity policies to the mental health of the most vulnerable groups of the society.

In this work, I aim at exploring the extent that a health condition can determine the labour market outcomes of individuals as well as how economic shocks could affect the health of individuals. For the case of this study, I am working towards identifying the impact of obesity in labour market outcomes and the effects on mental health of individuals due to applied austerity measures. More specifically, in Chapter 2 and Chapter 3, I am investigating the impact of BMI of individuals on their labour market outcomes. I estimate the causal impact of individuals' BMI on their probability to be in employment and their hourly wage for the case of the UK. Also, I expand the analysis by providing evidence regarding the impact of individuals' BMI on their probability to be in a social interactive occupation. I investigate whether being or not in a social interactive occupation can explain the wage differences among the obese and non-obese individuals. Furthermore, in Chapter 4, I investigate how economic shocks and institutional changes may impact the mental health of people. More specifically, in the third research chapter I estimate the impact of the austerity measures, introduced in the UK with the Welfare Reform Act in 2012, on the mental health of individuals.

In Chapter 2, I provide evidence regarding the causal effect of an increasing BMI on the probability of individuals to be in employment and on their hourly wage for the

case of the UK. More specifically, I work with the wave 2 and wave 3 of the national representative data of the UK Household Longitudinal Survey (UKHLS) "Understanding Society" which I link to the extension study "Nurse Health Assessment" where the measured information regarding individuals' BMI (measured by trained nurses) is provided. Also, I add to the data of my study the information regarding the polygenic score related to individuals' BMI which I obtained with a separate application to the Genetics Team of Understanding Society. I explore the impact of BMI on individuals' labour market outcomes for the most attached working age group in the labour market, the prime working age individuals and work separately for men and women as they differ with regards to their outcomes in the labour market. Even though the existing literature provides some evidence regarding the way that BMI impacts employment and wages I contribute with my research as I provide up-to-date evidence on the extent that individuals' body weight impacts their labour market outcomes. Also, I estimate the causal effect of BMI on labour market outcomes for the most attached age group in labour market (25-54 years old). Additionally, I use a polygenic score of BMI as an Instrumental Variable (IV) which is the most updated method of estimating the impact of BMI on labour market outcomes. My analysis provides evidence that individuals' probability to be in employment is not determined by their BMI. Also, with regards the hourly wage I find a statistically significant effect of an increasing BMI for the case of women but not for men.

The methodology that I follow to conduct my empirical analysis includes the estimation of the impact of individuals' BMI on their probability in employment for men and women by estimating linear probability models with the Ordinary Least Squares (OLS) method. Also, for the case where I study how individuals' BMI determines their hourly wage, I estimate log-linear models with the OLS method separately for men and women. Additionally, I am able to provide causal estimates by following an IV approach to solve the endogeneity issue that arises when researcher conduct research regarding the impact of individuals' BMI and their labour market outcomes. For example, for the case of individuals' wages there is a threat of reverse causality as not only BMI may determine this labour market outcome for individuals but it may impact their BMI as well. Also, for the case of employment there may be another threat of bias that arises due to the fact that there may be unobserved characteristics (e.g. individuals' personality) that impact both their probability to be in employment and their BMI. For this part of my analysis I am able to work with the most up to date available genetic IV for individuals' BMI which is only recently provided for the sample of the "Nurse Health Assessment" of the UKHLS, Understanding Society. Therefore, I work with individuals' polygenic score which is highly correlated with their BMI and it is not expected to impact through other channels the outcomes of interest. My findings indicate that the probability of the prime working age men and women is not impacted by their BMI. Also, I find a negative impact of an increasing BMI on the hourly wage of individuals but this is

statistically important only for the case of women. Furthermore, when I extent the analysis to the sample of all the working individuals the findings confirm the findings of the main analysis and support the validity of my analysis.

Furthermore, in Chapter 3, I explore the impact of individuals' BMI on their probability to be in a social interactive occupation. In this chapter, I aim to provide more insights whether men and women are excluded from certain occupations due to their BMI. The existing literature provides evidence that obese individuals are less likely be in job positions that involve high interaction with customers(Rooth (2009)). Also, qualitative studies document the belief of obese men and women that they are discriminated in the labour market due to their BMI (Giel et al. (2010)). Furthermore, in their experimental study Popovich et al. (1997) provide evidence that obese individuals is likely to be excluded and not to be hired in occupations that require high physical activity. The interest of researchers to contribute in the area of discrimination in the labour market with regards' to individuals' BMI remains high and an important effort should devoted on uncovering the channels that may explain any potential discrimination. Therefore, it is important to provide insights whether individuals' BMI determines their probability to be employed in certain occupations. Additionally, I am motivated to provide important insights whether individuals with higher BMI are disadvantaged with regards to their probability to hold a job position in certain occupations due to specific fitness requirements or not and whether this can be a channel that explains any disadvantages with regards to their wage.

I estimate the causal effect of individuals' BMI on their probability to be in a social interactive occupation. For the purpose of my analysis, I work with the same data sets and samples as in the Chapter 3. Also, I classify the occupations to social interactive and non-social interactive based on the level of interaction that the position requires with the potential customers and the employers. Hence, I identify the non-social interactive occupations to be those that involve very low interaction or no interaction with the customers and very limited interaction with the employers (the person who hires for the position). Furthermore, I classify the occupations with a second criterion that is related to the level of the strength/physical requirement. This helps me to exclude the occupations that have high fitness requirements and to conduct again my analysis in the new sample where I do not expect individuals with a higher BMI to be excluded because they may not meet formal requirements (fitness requirements). Thus, the results in that case is expected to provide supportive evidence whether individuals' BMI impacts their probability to be in social interactive occupations due to social beliefs that individuals with higher BMI (overweight, obese) may be lazier and less productive although they do not lack any required skill for the job position. Also, I explore whether or not being in a social interactive occupation can explain any potential wage gap of obese and non-obese individuals.

Moreover, I estimate the impact of individuals' BMI on the probability of the prime working age men and women to be in a social interactive occupation by estimating linear probability models with the OLS method. Additionally, I conduct the analysis regarding the causal effect of BMI on the hourly wage and the probability to hold a job position that involves social interaction on the sample where the occupations with high fitness requirements are excluded. Therefore, I work with log-linear models and linear probability models which I estimate with OLS method. Furthermore, similarly to my first research chapter, I work with the most up to date genetic IV (polygenic score correlated with BMI) for individuals' BMI to provide causal estimates. I explore the explanatory power of being in a social interactive occupation on the wage gap of the obese and non-obese individuals by conducting an Blinder-Oaxaca decomposition analysis for men and women.

I contribute to the literature of this research area as I provide for the first time, to the best of my knowledge, causal estimates regarding the extent that individuals' weight determines the probability of the prime working age men and women to be in a social interactive occupation. Also, my classification of occupations based on the level of fitness requirements allows me to construct a sample where only occupations that do not include formal skills that individuals with higher BMI may lack (high physical strength) are included. Therefore, I further contribute by providing insights whether individuals are disadvantaged by being excluded from certain occupations not because they do not meet the formal requirements but because their BMI is treated as a sign of lower productivity based on existing social beliefs. Furthermore, my study provides evidence on the level that being in a social interactive occupation can explain the observed differences in wage between obese and non-obese individuals. This aspect of my analysis is important to explore whether a potential discrimination of obese individuals from certain occupations impacts further their labour market outcomes and their life as they may earn less since they may be excluded from high paid jobs due to beliefs in the society that they are less productive. According to my findings the probability of the prime working age men is not impacted by their BMI. For the case of the prime working age women I find that experience a negative and statistically important impact. With regards to the explanatory power of being in a social interactive occupation on the wage differences for obese and non-obese individuals I find that it is zero. This finding is important as it provides supportive evidence that a potential exclusion of individuals from certain occupations, based on their BMI, does not determine another important labour market outcome such as wages by forcing them to be occupied in job positions that pay less.

In Chapter 4, towards investigating the impact of austerity measures on mental health of individuals, I work with the data set of the first five waves of the (UKHLS) "Understanding Society" as it provides rich information regarding the source of the unearned income of individuals. Also, the above data set is appropriate for the

analysis of my study as it includes the General Health Questionnaire (GHQ) regarding individuals' mental health which is derived by self reported questions to which participants answer. In my analysis, I work with the reversed GHQ - 12 item in order a decrease on the score to be interpreted as negative impact on the mental health of individuals. I conduct my empirical analysis by applying the Difference in Differences (DiD) method where I rely on the hypothesis that the treatment group and the control group have similar trends before the implementation of the reforms with regards to the outcome of interest (parallel trends assumption). I provide supportive evidence that the assumption of parallel trends is not violated in my analysis and therefore I provide causal estimates. Based on the findings of my analysis the austerity measures related to the welfare reforms did not impact the mental health of individuals. The findings are consistent when I conduct heterogeneity analysis indicating that individuals do not experience differently the treatment according to their characteristics (gender, age group, or area of residence).

This is the first time, to the best of my knowledge, that the impact of the welfare reforms, introduced in the UK with the Welfare Reform Act 2012, on individuals' mental health is explored. Hence, my work adds to the literature related to the impact of the reduction of unearned income from social benefits on the mental health of individuals. Also, I contribute by providing evidence with regards to the impact of institutional changes on the social benefit system on the mental health of the affected individuals. Furthermore, my analysis provides important insights regarding the extent of the impact of specific welfare reforms (CTB, BT, and DLA/PIP), that affect high proportion of the general population, on their mental health.

In the following chapters, I am discussing the aforementioned research questions as follows: In Chapter 1, I presented and discussed my main motivation on the research questions and the general aims for investigating these issues. In Chapter 2, I am discussing the impact of BMI on individuals' probability to be in employment and on their hourly wage. In Chapter 3, I am expanding the analysis on the BMI's impact on labour market outcomes by investigating the effect on the probability of individuals to be in a social interactive occupation. Also, I provide evidence regarding the explanatory power of being in a social interactive occupation on the wage gap of obese and non-obese individuals. In Chapter 4, I am exploring the effects of austerity measures and economic shocks in the mental health of individuals. Finally, in Chapter 5, I am exhibiting my main conclusions and discuss the findings of this work.

Chapter 2

The impact of Body Mass Index on labour market outcomes in the UK

2.1 Introduction

The United Kingdom (UK) is one of the countries that faces a high rate of prevalence of obesity among its adult population and children. More specifically, according to the National Health Service (NHS), only in England in 2017, almost 30% of the adults and almost 20% of the children are classified as obese. The consequences of obesity are complex and multi-dimensional, such as poor quality in daily life of individuals and their general health status as well as increase in the cost of health services. Obese individuals have a higher risk to suffer from type II diabetes, heart disease, and even from some types of cancer. According to the Department of Health and Social Care (2020), the illness related to obesity impose to the NHS an annually cost of approximately 6 billion. Additionally, in the recent COVID-19 pandemic, statistical evidences support that higher BMI is correlated with higher risk of serious illness and death from COVID-19. Since obesity affects an already high and constantly increasing proportion of people, an in depth understanding of its impact in other areas of our society and economy is very important. Studies suggest that obese individuals are disadvantaged in labour market as they may be paid less (Böckerman et al. (2019), Cawley (2004), Brunello and D'Hombres (2007)) or may have lower probability to find a job position (Rooth (2009), Garcia Jaume and Quintana-Domeque Climent (2006)). Hence, a detailed study and analysis of the impact of BMI in labour market has the potential of providing insights regarding the extent at which individuals are impacted with regard to the most important labour market outcomes such as employment and wages.

In this chapter, I estimate the impact of Body Mass Index (BMI) on labour outcomes for prime working age individuals for the case of the UK. For the purposes of my analysis,

I work with the data set of the UK Household Longitudinal Survey (UKHLS) "Understanding Society" as it is a representative data set of the population in the UK and it provides an appropriate data set since it is rich in information regarding individuals' personal characteristics, demographics and labour outcomes. Additionally, I link on the main survey of Understanding Society the data set of the "Nurse Health Assessment" extension study of Understanding Society which provides the information regarding individuals' measured BMI (measured by trained nurses). Although the existing literature provides some evidence regarding the impact of obesity on employment and wages, I contribute to the field by providing up-to-date evidence about the extent that the most attached age group of labour market is disadvantaged due to potential lower productivity or discrimination. My empirical analysis provides evidence that an increasing BMI has not a significant impact on the probability of prime working age men and women to be in employment. Also, I find that BMI impacts negatively the hourly wages of both men and women but the causal effect is shown to be statistically important only for the case of women.

With regards to the methodology I follow for this analysis, I estimate the impact of BMI on employment and wages for both men and women with linear models. Therefore, I estimate the impact of BMI on the probability of men and women to be in employment by estimating linear probability models with the Ordinary Least-Squares (OLS) method. Also, I estimate log-linear models with the OLS method for the case where I explore how individuals' BMI determines the hourly wages of men and women. Furthermore, I solve the endogeneity problem that is encountered when we estimate the impact of BMI on labour market outcomes with an instrumental variable (IV) approach. More specifically, I use a polygenic score of BMI as an IV which is the most updated method of estimating the impact of BMI on labour market outcomes. The endogeneity problem in this study arises due to the reverse causality of BMI and labour income. Hence, BMI not only affects wages but it is affected by this same labour outcome itself (Cawley (2004), Lindeboom et al. (2010)). For example, individuals' income may determine the quantities and the quality of food they consume as a result their BMI is impacted accordingly. Also, for the outcome of employment, there may be unobserved characteristics that may determine both individuals' BMI and the corresponding labour market outcomes causing an omitted variable bias.

Towards understanding and solving this research problem, I follow an IV approach since through this method it is possible to provide causal estimates. More specifically, there are two families of instruments for individuals' BMI. The first category includes regional instruments where researchers work with average BMI or the prevalence of obesity in the area that individuals live (Morris (2007), Mora (2010), Font et al. (2010), Mora and Gil (2013), and Barbieri (2018)). The second family of instruments for individuals' BMI includes genetic IVs where more frequently the BMI of a family member (i.e. a relative such as a parent or a sibling) of the individual is used as the

instrument for individuals' BMI (Cawley (2004), Brunello and D'Hombres (2007), Lindeboom et al. (2010), and Hughes et al. (2019)). Both categories of the available instruments face criticisms from researchers who support that there may not be not enough evidence to support that the exclusion restriction for a valid IV is satisfied as in the case of the regional IVs there are concerns that the regional factors may impact the labour outcomes through other channels except of individuals' BMI (Cawley (2015)). Furthermore, regarding the second category of genetic IVs, the criticisms related to the exclusion restriction arise from the fact that common genes with family members may affect not only individuals' BMI but their labour outcomes as well leading to omitted variable bias (Cawley (2015)). In my study, I conduct the analysis by working with a genetic IV which is a polygenic score related to individuals' BMI and, although my IV belongs to the second family of the available IVs for individuals' BMI, it does not suffer from the potential issue of affecting individuals' labour outcomes through any other channel except through their BMI (Böckerman et al. (2019), Hughes et al. (2019), Tyrrell et al. (2016), Cawley (2015)). I obtained the genetic information (polygenic score of BMI) with a separate application to the Genetics Team of the UKHLS "Understanding Society". I provide evidence regarding the causal impact of individuals' BMI on their labour market outcomes for the prime working age individuals. The results confirm that there is a consistent negative sign of the impact of BMI on the probability of employment for both genders but the IVs estimators do not indicate any significant impact for men or for women. Also, regarding the impact of BMI on individuals' hourly wage, the results of the analysis support that there is no statistically important impact of individuals' BMI for men while there is a negative and statistically important disadvantaging of women with regards to their hourly wage.

Moreover, I provide robust evidence regarding the impact of BMI on individuals' labour market outcomes by conducting the empirical analysis on the sample of all working age individuals. The findings confirm that, similarly to prime working age individuals, BMI does not impact the probability of men and women to be in employment. Additionally, I provide evidence regarding the impact of BMI on the hourly wage of all working age men and women. Based on the findings exhibited in this part of my analysis, it is suggested that a consistent, negative and statistically different from zero impact for the working age women exist but no causal impact of BMI is found on the case of men. Thus, there is supportive evidence regarding the validity of the analysis of the impact of BMI on individuals' hourly wage as well.

Therefore, my study updates our understanding regarding the impact of individuals' BMI on their main labour market outcomes, such as employment and wages, for the most attached age group in the labour market. For example, my finding that individuals' BMI does not have a causal impact on the probability of men and women to be in employment contradicts the findings of the study Morris (2007) where the author uses older data (Health Survey for England, rounds 1997 and 1998) and

regional IV. On the other hand, my finding are supportive of the output of the study by Lindeboom et al. (2010) who works with a UK data set and uses the BMI of a biological relative as an instrument of individuals' BMI. Therefore, my findings are more in line with studies that support that an increasing BMI is not penalised with regards to the probability of individuals to be in employment as there may be an update in the society's norms and beliefs for individuals with a higher BMI as the average BMI in the population increases (Barbieri (2018)).

Furthermore, I contribute to the literature regarding the impact of BMI on individuals' wage where the findings of the existing literature are mixed. More specifically, my finding that individuals' BMI reduces the hourly wage of women is in line with the study of Cawley (2004) where a negative effect is found on the wage for the case of white women in the US. In this chapter, I do not provide by race analysis as my sample does not include observations from the ethnic minority boost sample. My findings contradict the findings of the study Béatrice d'Hombres and Giorgio Brunello (2005) where the authors use data of different European countries and find a negative impact of an increasing BMI on the hourly wage of both men and women. Additionally, my causal estimates confirm the negative and important impact of a higher BMI on the hourly wage of women and I update the corresponding finding for men where I do not find a statistically important impact by working with data from the UK and updating the findings from older studies with data from the same country as in the study by Sargent and Blanchflower (1994).

Additionally, I am able to provide causal estimates by working with the most recent and valid instrumental variable of individuals' BMI, a polygenic score, which is shown to have high explanatory power of BMI's variation. Also, another advantage of working with this IV is that it is not likely to violate the exclusion restriction condition required for a valid instrument as there is not other channel, even biological, that may impact the outcomes of interest. Therefore, I work similarly to Böckerman et al. (2019), Hughes et al. (2019), Tyrrell et al. (2016) to estimate the causal effect of individuals' BMI. My study differs from the study of Böckerman et al. (2019) as the authors work with data from Finland and also they estimate the impact of BMI on individual annual wage and earnings while I work with the hourly wage as it is not expected to be impacted by potential different working time arrangements. Additionally, the studies Hughes et al. (2019) and Tyrrell et al. (2016) work with data from the UK but only in the study Hughes et al. (2019) the same national representative data set as in my study is used where information for individuals' employment outcomes are available. My study contributes in addition to the findings of the study Hughes et al. (2019) as I provide causal estimates of individuals' wage and not their monthly earnings. Also, my findings with regards to the impact of BMI on the probability of individuals to be in employment are relevant to the most attached working age group to the labour

market and my analysis does not include individuals in retirement as in the study of Hughes et al. (2019).

The structure of this chapter is organised as follows: In Section 2.1, I have presented and discussed the motivation, aims and objectives of this study. In Section 2.2, I study and present important background related to the effects of obesity on labour market outcomes and important findings from the literature. In Section 2.3, I present the data sets, the samples, the variables that I include in my analysis and I present the statistical analysis of the descriptive statistics for the variables of interest in the samples of my study. In Section 2.4 I discuss the econometric methods that I use for the empirical analysis toward estimating the causal effect of individuals' BMI on their labour market outcomes. In Section 2.5, I present and analyse the findings from the empirical analysis regarding the impact of individuals' BMI on their labour market outcomes. Finally, in Section 2.6, I present my conclusions and discuss further my findings as well as how these results can contribute on a better understanding of the scale of the impact of an increasing BMI in one of the most important aspects of the life of the impacted individuals.

2.2 Literature Review

Some researchers support that obesity is a side effect of the technological progress Lakdawalla et al. (2005), while others explain the increase of obesity as a network effect Christakis (2007). Also, in their study Dioikitopoulos et al. (2020) provide evidence that historic cultural characteristics, such as higher level of long-term orientation (patience), lead to lower obesity rates nowadays due to inter-generational transmission of behavioural choices. Additionally, studies shed light on the effect of income insecurity on peer-to-peer spread of obesity Barnes et al. (2013) while evidence suggest that employment status, and more specifically unemployment, may affect the body mass index differently for underweight people than overweight Hughes and Kumari (2017). The consequences of obesity are complex and multi-dimensional, such as poor quality of daily life of individuals and a negative impact on their general health status as well an important increased cost of health services either private Cawley and Meyerhoefer (2012) or public as in the case of the UK Allender and Rayner (2007).

Researchers from the field of labour economics are motivated to provide insights regarding the impact of this public epidemic in the labour market regarding the way that it affects individuals' productivity, relations on workplaces, job experience and labour market outcomes. Obesity can affect labour market participation and outcomes by preventing individuals to pursue daily job-related targets or by limiting their performance (i.e. reducing their productivity). Additionally, although obesity is not an obstacle for all job occupations, some social stereotypes (i.e. obese individuals can

be considered to be lazier or less socialised) make them less acceptable and preferable in the labour market (Puhl and Brownell (2001), Rooth (2009) and expose obese to a hostile society which discriminates and stigmatised them Puhl and King (2013).

Obesity impacts negatively the employment and wages of individuals and have different affects based on their gender, age and ethnicity. In the United States of America (USA), obesity has a negative impact on wages of white women according to Cawley (2004) while in the European Union (EU), the wages of both males and females are lessen due to obesity Brunello and D'Hombres (2007). Additionally, in their study Böckerman et al. (2019) support that an increasing BMI reduces individuals' wages, their years of employment while it increases their probability to rely on social benefit system. Regarding the impact of obesity on employment, in their study Caliendo and Lee (2013) find that obese women are penalised on the labour market by having lower probability to find a job, while an experimental study suggest that obese people are discriminated on the labour market when they apply for job positions Rooth (2009). Additionally, Garcia Jaume and Quintana-Domeque Climent (2006) employ the data set of the European Community Household Panel (ECHP) to estimate the impact of obesity on employment and wages for several European countries. According to the authors obesity was associated with a higher probability of being unemployed for women in most cases except of the Denmark while the opposite seems to be true for men.

The impact of obesity on labour market outcomes is studied in the UK as well with the findings to suggest that in general obese women are more penalised on the labour market compared to men. In their study, Lindeboom et al. (2010) estimate the effect of obesity on employment and wages and conclude that obesity is negatively associated with the probability to find a job for both women and men while it is negatively associated with wages for the case of women. The authors employ the data set of the British National Child Development Study (NCDS) and adopt an IV approach to solve the problem of endogeneity and reversed causality that may arise by estimating labour outcomes with explanatory variable the Body Mass Index (BMI) of individuals. Additionally, an older study conducted by Harper (2000) based on the data set of the NCDS, supports that obesity has a negative impact for women but not for men. More specifically, the author estimates the impact of physical appearance on wages, employment, and family income and explores whether variation that were found are due to employer discrimination, and occupational effects (which also includes differences in productivity). Based on the author's findings, obesity is not penalised for men in the labour market or on marriage market but obese women gain 5% less compared to their non-obese counterparts and are less likely to success on the marriage market. Additionally, in a research paper by Sargent and Blanchflower (1994), one of the first studies that explores the impact of obesity in labour market outcomes, the effect of obesity on early age on the earning at age 23 of individuals was

estimated. The authors based their analysis on the data set of the NCDS. Their findings suggest that obesity of women at age 16 had a negative impact on their wages at age 23. For the case of men, the authors did not find any wage penalty at age 23 due to obesity at a younger age.

Furthermore, a different approach and explanation of the impact of obesity on labour market outcomes is proposed by Brown (2011) who estimates the impact of selection on the marriage and the labour markets on the effect of obesity on wages. For the purpose of this study the waves 14 and 16 (2004, 2006) of the British Household Panel Survey (BHPS) are employed by the author. According to the author, obese men are less penalised on the marriage market than obese women. While in the labour market, the author found that single men and married women face a discrimination for their marital status. The author also founds that when the estimation of the wage equation is done based on selection only on the labour market then the impact of BMI on wages is positive for single men, single women as well as for married men. On the other hand, when the author controls for selection on the labour and the marriage market then he founds a wage premium of BMI only on married men. In the study, Brown (2011) does not deal with the endogeneity issue of the reverse causality of obesity and wages but assumes that endogeneity of BMI and wages does not lead to bias results.

Other important findings are presented by Morris (2007), that employs the Health Survey of England (HSE) data set and covers the period 1997-1998, and highlights the impact of obesity on employment. In his study, Morris (2007) finds that obesity impacts negatively the probability to find a job for males and females. More specifically, Morris (2007) estimates the impact of obesity on employment with three different methods. Firstly, he estimates obesity's impact on employment by using an univariate probit model and finds that obese men have 2.1% lower probability to find a job compared to non-obese male individuals. On the other hand, that effect has an opposite sign for females while it is small and insignificant. In the second method used, a matching model is employed to estimate the mean effect of obesity on employment for the cases of those who are obese. The impact of obesity on employment for men remains negative and significant and for women remains insignificant. Finally, the author estimates the impact of obesity on employment and controls for endogeneity by working with an IV approach and finds that the sign of the impact does not differ for males, instead it remains significant while the magnitude increases. On the other hand, the IV estimator is negative and significant for female. The authors use a representative data set of England (HSE).

By choosing a different subgroup of the UK population, Averett et al. (2012) estimate the impact of obesity on wages, employment, work limitation and white collar work of immigrants in the UK for the time period 2004-2006. The data set used in this study was the BHPS. They find that obese men immigrants face a wage penalty contrary to the obese native men who instead have a wage premium. Also, the findings showcase

that for the case of immigrants women the findings do not suggest any significant effect. Additionally, obesity has a negative effect on the probability for the immigrant men to be in a white collar job although the data suggests that immigrants are more likely to have managerial occupations compared to the native individuals. On the other hand, for the obese immigrants women the findings suggest that they have an increased probability to find a job by almost 9% contrary to the negative impact of obesity on employment for the native women. For the case of immigrant women, the data show that obesity is positively correlated with the work limitation. Although the findings of Averett et al. (2012) suggest very interesting associations of obesity and labour market outcomes, the authors do not solve the problem of endogeneity that can be caused due to the reversed causality of obesity and labour market outcomes.

Other interesting studies provide insights regarding the impact of an increasing weight of individuals in labour market outcomes and work with their BMI. In one of the most recent studies regarding this area of research, Hughes et al. (2019) estimate the impact of individuals' BMI on their monthly earnings and their partners' earnings. The authors conduct their analysis by working with two data sets. More specifically, they work with the UK Household Longitudinal Study (UKHLS) and the English Longitudinal Study of Ageing (ELSA) data sets. The authors construct a genetic IV for individuals' BMI to deal with the endogeneity issue that arises from the aforementioned reverse causality. Based on their findings, BMI impacts negatively individuals' earnings and their probability of employment. When they estimate the impact of BMI by relying on a valid IV they find a negative and significant effect for both sexes but with a weaker impact on the wages of women. In this study, Hughes et al. (2019) include in their sample individuals older than 64 years old while it would be interesting if their reference group was individuals highly attached to the labour market.

Finally, Ferrie et al. (2007) study BMI and change in BMI from age 25 as predictors of short and long sickness absence. More specifically, Ferrie et al. (2007) based their analysis on the Whitehall II study (Phase 1, 1985-1988) which includes British civil servants London-based office staff of age 35 to 55 years when they entered on that data set. Based on the authors' findings obesity at age 25 (which was a self-reported information when individuals entered on the Whitehall II study) is a good predictor of the long absences while obesity at Phase 1 is a good predictor for the short and long absence of men and women. On the other hand, by being underweight at Phase 1 was a good predictor of short absences in case of men and by being overweight at age 25 could not predict sickness absences at Phase 1. Chronic obesity (obesity at 25 and at Phase 1) was a good predictor of long absences in men. The findings of this study cannot easily be generalised due to the fact that the data set is not representative of the general population of the country.

2.3 Data

For the purpose of this study, I work with the data set of the UK Household Longitudinal Survey (UKHLS) "Understanding Society: Waves 1-10, 2009-2019 and Harmonised BHPS: Waves 1-18, 1991-2009: Special Licence Access" for the waves 2 and 3. Also, I link the main survey of the UKHLS Understanding Society of waves 2 and 3 with the data of Waves 2-3 Nurse Health Assessment (2010-2012). In the sub-study of Understanding Society "Nurse Health Assessment", adult participants that were included in this study extension, had a physical health assessment by trained nurses and data on physical measures, bio-markers, questionnaire (answered by the participants), and blood samples were collected (for more information on the study and the criteria to participate on Nurse Health Assessment, please visit the website: Understanding Society: Waves 2-3 Nurse Health Assessment, 2010-2012).

Additionally, I obtained, after submitting a special request, data related to the polygenic scores specific to individuals' BMI which is available by the study of METADAC and was provided to me by the Genetics Team of Understanding Society. Therefore, the sample of my study includes individuals from the General Population component of the main survey of Understanding Society who had completed the second's wave interview and were selected for the health assessment sub-questionnaire and provide blood samples during the nurse assessment. Also, I include in my sample the participants of the Nurse Health Assessment who provided blood sample from the third wave of Understanding Society. More specifically, I include the participants of the BHPS components. Hence, the initial size of the available sample for my study includes 13,286 individuals from which the available polygenic score related to their BMI and a valid measure of their BMI was provided for only 9,330 participants.

Furthermore, it is important to provide further details regarding the sample and the selection of the participants on the Nurse Health Assessment. Hence, based on the criteria of the sub-study of Understanding Society, Nurse Health Assessment, individuals from the Northern Ireland and individuals from the ethnic minority boost sample were not included. Additionally, pregnant women were not eligible to participate on the sample of nurse assessment. The exclusion of the pregnant women from the sample is useful for my study as it solves an important issue that researchers used to face when they conducted studies related to BMI by working with the data provided by the UKHLS Understanding Society. More specifically, before the additional data collection during the Nurse Health Assessment sub-study the only wave that individuals' BMI is provided in the data set of Understanding Society is wave one were individuals report their BMI. In the first wave there is no available information (variable) to help the researchers to identify and to isolate the women who were pregnant at the time of the survey. The best possible solution was to exclude

women who reported to be inactive due to maternity leave. Since the researchers were not able to exclude all pregnant women they had to recognise the measurement error, in their analysis, imposed by the fact that pregnant women report a BMI that is affected by their pregnancy. Based on the waves BH14 and BH16 of the British Household Panel Survey (BHPS), where the information of pregnancy is provided, the proportion of the pregnant women over the working age women is 2.17% and 2.35%, respectively. Therefore, I would expect that I could have incorrectly included around 2% of my sample in my analysis. The benefit of the sample of Nurse Health Assessment is important for my study as pregnant women are excluded and I do not expect that participants report a BMI impacted by exogenous variables (such as pregnancy).

I exclude from my study non-working age individuals (less than 16 years old, and more than 64 years old) as I provide evidence regarding the impact of BMI on individuals' labour market outcomes. Also, my analysis focuses on the prime working age individuals since this group of people are more attached on the labour market. The age group (16-24 years old) are individuals who have currently entered the labour market after the completion of their education while the third age group (55 - 64 years old) are individuals who approach retirement. Thus, I include in my analysis the prime working individuals, thus individuals of the 25-54 years old age group who are considered to be highly attached in the labour market.

In this study, I work with individuals' BMI which is the measure that researchers use to classify individuals based on their weight and height as healthy or not healthy weight individuals (Cawley (2004), Caliendo and Lee (2013)). More specifically, according to the NHS, BMI is calculated as the ratio of an adult's weight (in kilograms) over his or her squared height (in meters). The classifications based on individuals' BMI are: underweight (BMI less than 18.5), normal weight ($18.5 \leq BMI \leq 24.9$), overweight ($25 \leq BMI \leq 29.9$), obese ($30 \leq BMI \leq 39.9$), and severely obese ($40 \leq BMI$). In my analysis, I exclude individuals with unhealthy weight. Hence, I exclude underweight individuals and individuals with severe obesity in order to exclude individuals who may suffer from important health issues related to BMI that may impact their performance and their participation in labour market.

Moreover, when I estimate the impact of BMI on employment I create the variable that indicates whether an individual is in employment or not. Therefore, I identify individuals in employment as those who are self employed or in paid employment while in not employment are unemployed and inactive individuals. This is a common definition of employment in the literature. For example the same definition of employment is provided in the study by Morris (2007). The sample for this part of my analysis is limited to 1661 men and 2220 women. Also, I control for personal and regional characteristics such as age, level of education, and region. Additionally, I control for family characteristics such as marital status, the number of children in

household as well as individuals' self assessed health, long-standing illness or impairment.

Furthermore, the second labour market outcome that I include in my analysis is individuals' hourly wage. To construct this variable I work similarly to the method presented in Brown (2011). Thus, I construct the variable of hourly wage based on the provided information regarding individuals' usual gross pay per month in their current job and the number of hours normally worked per week. More specifically, the individuals' hourly wage is the ratio of the usual gross pay per month in their current job over the product of the number of hours normally worked per week multiplied by 4.33 (the number of weeks per month): $hourly \quad wage = \frac{Usual \quad gross \quad pay \quad per \quad month}{(number \quad of \quad hours \quad normally \quad worked \quad per \quad week) \times 4.33}$. Thus, this research question is relevant only to individuals who are currently in paid employment (employees). I include the same controls as in the case of the analysis of the impact of BMI on the probability on employment by excluding the control of employment status. Also, I include in my analysis controls for individuals' occupation (the classification of occupations is provided on Appendix A, A.1) and sector. The sample for the analysis of wages includes 1243 men and 1589 women.

Finally, I provide evidence regarding the causal impact of individuals' BMI on labour market by working with a valid instrumental variable of individuals' BMI from the second family of available IVs used in the literature of the BMI and labour market outcomes. More specifically, the information regarding individuals' polygenic score related to their height and BMI provides a unique valid IV from the family of genetic IVs of individuals' BMI. Hence, I conduct my empirical analysis by working with an externally weighted polygenic score based on the GWS for height and BMI studied by Loic Yengo et al. (2018) and I am working similarly to Hughes et al. (2019) to provide causal estimates of individuals' BMI on their labour market outcomes.

2.3.1 Descriptive statistics

In this section, I present the descriptive statistics of the samples that I include in my empirical analysis. More specifically, due to heterogeneity between the two sexes regarding their labour market outcomes, I present within sex descriptive statistics of obese and non-obese individuals for the outcomes that are included in the empirical analysis and the corresponding control variables. I present the mean and the corresponding standard deviation for continues variables. For the discrete variables, I present the proportion of each category with regards to obese and non obese individuals. The statistical analysis is weighted with the cross-sectional blood person weight of the UKHLS Nurse health assessment to obtain representative results.

Table 2.1 presents the descriptive statistics of obese and non-obese prime working age (25-54 years old) men and women of the sample that I rely on to estimate the causal effect of obesity on individuals' employment. From the Table 2.1, it is important to note that the proportion of obese men in employment is not highly smaller than the proportion of the non-obese men in employment. This observation indicates that we should not expect for obese men to be disadvantaged regarding their probability to be in employment as compared with non-obese male individuals. For the case of women, as shown in the second half of the Table 2.1, the proportion of obese women out of employment is around 35% while the corresponding proportion of non-obese women out of employment is around to nine percentage points less. Therefore, according to the descriptive statistics I observe that it is more likely for a woman to be out of employment when she is obese than when she is not an obese individual.

Additionally, the prevalence of obesity is positively correlated with individuals' age. Thus, the proportion of the obese men on the age group 35-44 years old is almost eight percentage points higher than the corresponding proportion among individuals of age 25-34 years old. It is important to note that there is an increase on the prevalence of obese for the age group 45-54 years old individuals compared to the 35-44 years old individuals but now the increase is smaller. Similarly, the proportion of obese women among 35-44 years old is more than 10 percentage points higher compared to the corresponding proportion for the age group 25-34 years old. Also, the proportion of obese women increases further for the age group 45-54 years old although this increase is small.

Furthermore, individuals with higher education are less likely to be obese compared to individuals that hold any other qualification or do not have any qualification. This is not surprising since education level may affect individuals' obesity status through different channels. For example, it could be expected that more educated individuals can be better informed regarding the benefits of a healthy diet and lifestyle (e.g. exercise). Also, they may have better labour outcomes (e.g. higher wages) which enable them to maintain a more expensive diet and lifestyle (e.g. pay for gym facilities and services). Therefore, according to the descriptive statistics presented on Table 2.1, the proportion of obese individuals is around to seven and ten percentage points more for men and women, without a degree, respectively.

Additionally, regarding the distribution of the obese and non-obese individuals based on their family characteristics Table 2.1 provides some evidence worth discussing. Hence, I observe that it is more likely to find obese men and obese women on the sample of the non-single individuals. More specifically, the proportion of the non-single obese men is almost five percentage points higher than the proportion of the single obese men. Also, the proportion of the non-single obese women is around six percentage points higher than the proportion of the single obese women. This exhibited pattern is in line with the expectation that it is more likely the single

individuals to be individuals from the youngest age group of our sample (individuals that are never married) although this category includes individuals who are single after a separation from their partner (divorced, widow etc.). Hence, by following the same logic I understand that the lower proportion of obese individuals on the sample of the single individuals is in line with the observation that the prevalence of obesity is lower among younger individuals, as I discuss on the corresponding part of this section (above). Finally, regarding the number of children it is important to observe that women who report to have four children are importantly less likely to be obese but the small proportion of the obese in women with that high number of children cannot be sufficient evidence as the corresponding size of that group on the sample of the study is small.

Also, I present the descriptive statistics regarding the distribution of obese and non-obese individuals per region in the Great Britain. Table 2.1 showcases that the lowest proportions of obese individuals, for both men and women, is found in London among all the regions. Therefore, less than 22% of men and less than 20% of women who live in London report to be obese. On the other hand the regions with the highest proportions of obese individuals are the East Midlands and the Scotland. More specifically, although both regions have high proportions of obese men and obese women compared to the remaining regions, East Midlands is the region with the highest proportion of obese men (36.95%). The highest proportion of obese women is found in Scotland where 33.97% of women report to be obese. Also, it is important to notice that the highest difference in the proportions of obese men and obese women is observed in the North East where the pool of obese men is almost nine percentage points smaller than the pool of the obese women.

Finally, it is important to highlight that there is a negative correlation of obesity and individuals' self assessed health. For example, there is an almost 30 percentage points difference of the proportion of the obese men that claim to have an excellent health from those who state that have a poor health. More specifically, the proportion of obese men, among the men who report to have an excellent health, is less than 15% while the corresponding proportion of obese women is even smaller (less than 14%). These figures change importantly for the next category of the self assessed health. Hence, I observe an increase relatively close to ten percentage points of obese men and obese women on the corresponding groups of individuals who report their health to be very good. As the categories of the self assessed health correspond to worse health statuses the proportions of obese men and women increases and I notice that in the two last categories, fair and poor, the figures are similar for both sexes with those who report to have a fair health status to have the highest proportions of obese men and women. The exhibited patterns regarding the proportions of obese men and women based on their self-assessed health status provides supportive evidence regarding the expectation that obesity may be correlated with health issues therefore obese

individuals should be expected to have poorer health status. Regarding the fact that I observe, in the data, a higher proportion of obese men and obese women among those who report a fair health status compared to the corresponding proportions of the pool of the individuals who report to have poor health may be explained by the fact that the information regarding individuals' health is a self-reported measure (variable) and not the result of an official assessment from health professionals. Furthermore, the second control variable that is included in my analysis regarding individuals' health is the one that provides the information whether individuals suffer from a long-standing illness or impairment. The descriptive statistics regarding the distribution of obese and non-obese individuals for this variable provides supportive evidence that the prevalence of obesity is higher among individuals with important health conditions. Therefore, according to the results of the statistical analysis presented on Table 2.1, the pool of individuals with a long-standing health condition includes almost nine percentage points more obese individuals than the group of people who do not report to suffer from a long-standing health condition. The corresponding figures are even worse for women. Hence, the proportion of obese women on the sample of women with a long-standing illness or impairment is 13.5 percentage points higher than the proportion of the obese women on the pool of women who do not report to suffer form a long-standing health condition.

Table 2.1: Descriptive Statistics: Employment for obese and non obese individuals (25-54 years old)

Employment	**Men**		**Women**	
	Non-obese (%)	**Obese (%)**	**Non-obese (%)**	**Obese (%)**
In employment	72.32	27.68	74.35	25.65
Non employment	70.71	29.29	64.97	35.03
Age group				
25 - 34	78.00	22.00	79.81	20.19
35 - 44	70.36	29.64	69.01	30.99
45 - 54	68.74	31.26	68.73	31.27
Education				
Degree/Higher degree	76.96	23.04	78.62	21.38
No degree	68.92	31.08	67.42	32.58
Marital Status				
Single	75.45	24.55	75.89	24.11
Not single	70.23	29.77	70.40	29.60
Number of children				
0	73.75	26.25	72.00	28.00
1	72.04	27.96	68.94	31.06
2	67.42	32.58	74.52	25.48
3	71.91	28.09	72.49	27.51
4	72.90	27.10	83.25	16.75
5	100.00	0.00	100.00	0.00
Region				
North East	75.52	24.48	67.06	32.94
North West	68.04	31.96	71.28	28.72
Yorkshire and the Humber	76.03	23.97	70.08	29.92
East Midlands	63.05	36.95	69.52	30.48
West Midlands	67.81	32.19	70.52	29.48
East of England	75.77	24.23	73.45	26.55
London	78.34	21.66	80.37	19.63
South East	73.26	26.74	78.78	21.22
South West	75.76	24.24	71.88	28.12
Wales	72.08	27.92	66.75	33.25
Scotland	68.06	31.94	66.03	33.97
Self assessed health				
Excellent	85.05	14.95	86.49	13.51
Very good	76.01	23.99	76.77	23.23
Good	67.42	32.58	63.43	36.57
Fair	54.30	45.70	55.10	44.90
Poor	55.25	44.75	57.88	42.12
Long-standing illness or impairment				
Yes	65.54	34.46	62.56	37.44
No	74.38	25.62	76.06	23.94

The analysis is weighted by the cross-sectional blood person weight of Nurse health assessment (UKHLS). I present the number of respondent's children (natural, adoptive, foster or step) aged under 16 in the household. Computed from the household grid.

Table 2.2 presents the descriptive statistics of the sample where I estimate the causal impact of individuals' BMI on their hourly wage. More specifically, the first information presented in Table 2.2 is the mean of the hourly wage for obese and non-obese men and women. Therefore, it is important to highlight the differences between the groups of interest (obese and non-obese) for both men and women. Hence, I observe that obese men are paid less than the non-obese men in my sample. More specifically, based on the descriptive statistics, an obese man is paid less than £0.9 per hour for each £1 that a non-obese man earns per hour. Similar difference is observed regarding the hourly wage of obese and non obese women where an obese woman earns around £0.9 for each £1 that a non-obese woman earns. Therefore, I expect a negative impact of BMI on individuals' earnings to be shown on the empirical analysis. Additionally, I note that, in general, the distribution of the prevalence of obesity on the different categories for the control variables on the sample of only currently employee individuals is similar as for the sample that I rely on to estimate the impact of BMI on employment.

In Table 2.2, it is shown that the prevalence of obesity is higher in age groups that include older individuals. This observation is in line with the descriptive statistics that correspond to the sample where I estimate the impact of BMI on the probability of individuals to be in employment (Table 2.1). An important observation regarding the distribution of the obese and non-obese individuals across the different age groups, as shown in Table 2.2, is related to the fact that men and women exhibit different patterns. More specifically, in case of men I observe that the proportion of obese men on the age group of 35-44 years old is only around five percentage points higher corresponding to the percentage of the obese men on the group of 25-34 years old men. In case of women I observe that the proportion of obese women of age 35-44 years old is close to 14 percentage points more that the proportion of obese women on the group of 25-34 years old women which a pattern more similar to that exhibited on the Table 2.1. Also, with regards to the increase on the proportion of obese individuals on the third year group (45-54 years old) it is not very high (compared to the previous age group) for both men and women.

Additionally, the distribution of obese and non-obese individuals based on their level of education shows that it is more likely to find an obese individual on the sample of people that do not hold a degree or have even higher level of education and this is the case independently of the sex the individuals. Another important observation is that for the case of men the proportion of obese individuals who report to have a degree/higher education is higher than the corresponding proportion of obese-women. Also, regarding the prevalence of obesity based on the marital status of individuals I note that it is higher among not-single individuals for both men and women. More specifically, in case of men the proportion of obese men that are not single is three percentage points higher than the corresponding part of single men.

Also, in case of women the difference is even higher as the proportion of obese women who report to not be single is close to nine percentage points higher than the proportion of obese-women who are single. Hence, as in the case of the analysis based on the descriptive statistics presented on Table 2.1, the above observations are in line with the expectation that single individuals are mainly younger individuals who are never married and the lower prevalence of obesity on their group is in line with the lower prevalence of obesity which is found in younger age groups of individuals. Additionally, it is important to highlight that, by comparing men to women, I observe that the proportion of obese men who report to be single is six percentage points higher than the proportion of obese women who are single.

Moreover, in Table 2.2, I show the distribution of obese and non-obese individuals based on the region that they report to live in the Great Britain. It is important to highlight that, although London is one of the regions that the proportions of obese men and obese women are relatively lower compared to most of the regions, the lowest proportion of obese men is found in the region of the Yorkshire and the Humber while the region of the South East has the lowest proportion of obese women. Also, in the region of Scotland the proportions of obese men and obese women are among the highest proportions shown on the Table 2.2. For the case of women the proportion of obese women in Scotland is the highest compared to all the other regions on the sample. For the case of men the highest proportion of obese men is found on the region of the West Midlands.

Furthermore, the pattern exhibited from the distribution of obese and non-obese individuals based on their self assessed health for both sexes indicates a negative correlation as an improvement on the health status is correlated with a lower probability of obesity. More specifically, for the case of men the proportion of obese individuals is more than nine percentage points higher among individuals who report to have very good health compare to the group of men who report to have excellent health. The proportion of obese men increases from group to group as the reported health status deteriorates. Thus, the proportion of the obese men on the last group, individuals with poor health, is almost 38 percentage points higher compared to the corresponding proportion of the first group (individuals who report to have excellent health). Additionally, in the case of women the pattern is similar and I observe that the proportion of obese women who report to have very good health is more than ten percentage points higher than the proportion of obese women from the pool of women who report to have excellent health. The increase on the prevalence of obesity as the reported health status deteriorates continues up to the group of women who report to have fair health status. Hence, the proportion of obese women with fair self reported health is 28 percentage points higher than the proportion of obese women who report to have excellent health. The pattern differs for the case of women on the last group/category of self assessed health. Therefore, the proportion of obese women

who report to have poor health is more than 19 percentage points lower compared to the proportion of obese women who report to have fair health. Moreover, it is important that in the case of the second health variable included in my analysis (Long-standing illness or impairment) the data shows that the prevalence of obesity among the individuals who report to suffer from a long-standing condition is higher than the prevalence of obesity on the group of individuals who do not suffer from a long-standing illness or impairment. This finding is in line with the expectation that obese individuals may be more likely to suffer from a health condition (e.g. obesity may cause or it may be caused or worsen by long-standing health conditions).

Additionally, Table 2.2 showcases that for both men and women the lowest proportions of obese individuals are found among the groups of individuals who have a professional or a managerial occupation.Therefore, a lower level of skills required in an occupation is correlated with a prevalence of obesity. It is important to highlight that there is an important difference, in terms of descriptive statistics, on the proportion of obese women who report to hold a professional occupation and the corresponding proportion of men. More specifically, the proportion of obese women with a professional occupation is more than nine percentage points higher that the proportion of obese men with similar occupations. A potential approach to explore the reasons for this observed difference is to search whether there is any evidence that the average age of women with a professional occupation is higher than the average age of men with similar occupation. Hence, based on the expectation that women may be disadvantaged on the labour market and that they may have opportunities to hold professional occupations later in their life than men as a result I may have on the sample of women older individuals than those that I have on the sample of men, thus the difference on the prevalence of obesity among the two groups may be due to the difference of the prevalence of obesity on the different age groups as it is discussed in this section. This is beyond the scope of my study and I do not provide further evidence towards explaining the above finding. Finally, The proportion of obese men in the public sector is higher than the proportion of obese men in the private sector. For the case of women, the opposite is supported by the data. Hence, obese women are more likely to be in the private sector that the public sector although the difference of the prevalence of obesity between the two sectors for women is not very high.

TABLE 2.2: Descriptive Statistics: Hourly wage of obese and non obese individuals (25-54 years old)

Hourly wage	**Men**		**Women**	
	Non-obese (%)	**Obese (%)**	**Non-obese (%)**	**Obese (%)**
Hourly wage (mean)	16.06	14.44	12.28	11.21
	(10.65)	(8.43)	(7.73)	(6.26)
Age group				
25 - 34	75.42	24.58	84.06	15.94
35 - 44	70.16	29.84	70.11	29.89
45 - 54	68.38	31.62	68.92	31.08
Education				
Degree/Higher degree	75.48	24.52	78.42	21.58
No degree	68.08	31.92	69.63	30.37
Marital Status				
Single	73.12	26.88	79.78	20.22
Not single	70.34	29.66	71.00	29.00
Region				
North East	69.48	30.52	68.19	31.81
North West	67.82	32.18	74.89	25.11
Yorkshire and the Humber	78.09	21.91	70.03	29.97
East Midlands	65.18	34.82	66.83	33.17
West Midlands	64.11	35.89	75.51	24.49
East of England	77.78	22.22	75.02	24.98
London	75.48	24.52	81.52	18.48
South East	73.30	26.70	81.82	18.18
South West	74.19	25.81	73.76	26.24
Wales	73.89	26.11	69.19	30.81
Scotland	64.79	35.21	66.48	33.52
Self assessed health				
Excellent	83.46	16.54	85.86	14.14
Very good	74.15	25.85	75.55	24.45
Good	67.17	32.83	64.88	35.12
Fair	50.85	49.15	57.85	42.15
Poor	45.88	54.12	77.31	22.69
Long-standing illness or impairment				
Yes	65.17	34.83	66.73	33.27
No	73.00	27.00	75.93	24.07
Occupation				
Professional	83.41	16.59	74.21	25.79
Manager	71.63	28.37	78.06	21.94
Skilled	71.66	28.34	73.34	26.66
Semi-skilled	71.06	28.94	72.76	27.24
Unskilled/Other	55.33	48.41	63.83	38.30
Sector				
Private Sector	71.99	28.01	72.87	27.13
Public Sector	69.53	30.47	74.50	25.50

Standard deviation in parentheses. The analysis is weighted by with the cross-sectional blood person weight of Nurse health assessment (UKHLS).

2.4 Empirical methods

In this section, I estimate the impact of obesity on employment and individuals' hourly wage. I estimate the impact of obesity on employment for the prime working age individuals with Linear Probability Models (LPM) with the Ordinary least-squares (OLS) method. Additionally, I estimate log-linear models with the OLS for the impact of obesity on individuals' hourly wage.

2.4.1 Linear probability models

$$Y_i = \alpha_0 + \beta_1 BMI_i + \gamma_k X_k i + \epsilon_i, \quad i = 1, ...N \tag{2.1}$$

The outcome variable Y corresponds to the binary dependent variables of employment. The variable BMI is the continuous variable of individuals' BMI. The vector X includes the control variables for personal characteristics, family information, region, and self assessed health, that I included in the analysis. I estimate three specifications for each model. The first specification explains the impact of individuals' BMI on the corresponding labour market outcome without including any other control variable. In the second specification, I control for for individuals' age group, their marital status, level of education and the region that individuals live. The third specification includes control variables for the number of children of individuals (dependent children less than 15 years old) and respondents' health status. More specifically, in the third specification, I control for self assessed health of individuals and whether individuals suffer from a long-standing illness or disability. Finally, ϵ is the error term in each regression and i denotes the i^{th} person in the sample.

Regarding the interpretation of the coefficients, there is an advantage provided of estimating binary outcomes with linear models instead of probit and logit models, that we can interpret directly the coefficients of the explanatory variables. More specifically, the impact of BMI on the probability of employment will be equal to the percentage points given by multiplying the magnitude of each coefficient by 100. For example, a coefficient as $\beta = -0.1$ is interpreted such as that an increase on individuals' BMI by one unit decreases the likelihood of the corresponding outcome by 10 percentage points.

2.4.2 Log-linear models

$$ln\omega_i = b_0 + \beta_2 BMI_i + \lambda_k X_k i + u_i, \quad i = 1, ...N \tag{2.2}$$

The logarithmic linear models estimate the impact of BMI on the individuals' hourly wage. More specifically, in these models β is interpreted as the percent change in

individuals' hourly wage when BMI increases by one unit. The vector X_k includes the control variables that are included in the model for each specification that I estimate. Similarly to the models of employment, I estimate three specifications of the wage equation. The first includes only individuals' BMI as explanatory variable while on the second model I add controls for the age group of individuals, the marital status, whether individuals hold a degree (have higher education), and their region in the Great Britain. The third specification includes the additional controls for health status of individuals. Hence, I control the self assessed health and whether individuals report to suffer from a long-standing health condition. Finally, I include the controls regarding individuals' occupation and sector at which they work.

2.4.3 The Instrumental Variable analysis

When we estimate the impact of BMI on labour market outcomes we encounter the problem of endogeneity. For example, regarding the specifications where I estimate the impact of BMI on individuals' hourly wage, I am concern regarding the endogeneity issue that arises due to the reverse causality of BMI and individuals' income. More specifically, individuals' BMI not only affects wages but it is affected by this same labour outcome as well. For example, different income levels may determine the levels of food that individuals intake, their ability to buy nutrition foods which have different price from less nutrition foods and impact differently our BMI. Finally, wage may affect individuals' decision to devote time on body exercise. Additionally, regarding the second outcome of interest which is the probability of individuals to be in employment, the endogeneity issue arises from a potential reverse causality where obesity affects individuals' probability to be in a job position but at the same time individuals' performance in job may affect individuals' BMI.

Towards solving the endogeneity problem when using BMI as explanatory variable I need to employ a valid instrumental variable (IV) which will ensure that the only way it affects the labour market outcomes is through individuals' BMI (exclusion restriction). At the same time, the IV should be highly correlated with the endogenous variable (i.e BMI) but not correlated to any other explanatory variable of the corresponding outcome of interest. There are two groups of IVs that are widely used in the literature when estimating the impact of obesity on the labour market outcomes. The first group of studies supports that individuals' BMI can be predicted from the prevalence of obesity on individuals' area of residence, thus BMI/obesity is a peer effect Morris (2007), Font et al. (2010), Mora (2010), Mora and Gil (2013), Barbieri (2018). On the other hand, there is an alternative direction found in literature which suggests that genetic factors can predict individuals BMI and can provide a valid IV for it (Cawley (2004), Brunello and D'Hombres (2007), Lindeboom et al. (2010), Hughes et al. (2019)).

Firstly, the family of regional IVs for individuals include the mean of individuals' BMI and the prevalence of obesity in the area that individuals live. Regional IVs are expected to be highly correlated with individuals' BMI as they provide an average measure of food intake and physical exercise in the area of residence of individuals, thus they capture the impact on individuals' BMI from their environment (Morris (2007), Chu and Ohinmaa (2016)). Further supportive evidence regarding the relationship of the average BMI in the area that individuals live and their own BMI is provided by McKennie et al. (2018) who find that individuals moving from a state with lower BMI on average to a state with higher BMI on average observe an increase to their own BMI. The data of the study is from the Unites States of America (USA). Additionally, individuals' BMI is expected to be impacted by the average BMI of the environment as a result of social norms as it is supported that peers' average BMI influences individuals' BMI (Barbieri (2018), Mora and Gil (2013)).

Additionally, regarding the second requirement of a valid IV, that of the exclusion restriction, it requires that the only channel the average BMI of the area of residence impacts individuals' labour market outcomes is through their own BMI. This condition can be violated if average BMI impacts individuals' BMI through regional factors such as mean income, level of employment, and health. To provide supportive evidence that the exclusion restriction is not violated, researchers usually include additional controls in the analysis for the mean of income in the area that individuals live, unemployment rate and region of residence (Morris (2007) and Barbieri (2018)). Therefore, the instrumental variables provided by the regional average of BMI in the area an individual lives continue to face the criticisms that there may not be enough evidence that the proposed IVs do not impact the outcome of interest through any other channel except of the individuals' BMI.

Furthermore, regarding the second family of IVs for individuals' BMI, which are the genetic IVs, I rely to a specific genetic information which is found to be highly correlated with individuals' BMI. More specifically, in their study Loic Yengo et al. (2018) find that independent genome-wide significant (GWS) single nucleotide polymorphisms (SNPs) explain 6% of the variation of individuals' BMI adjusted for 20 genotypic principal components (PCs). Additionally, in their study, Hughes et al. (2019) construct a genetically IV of BMI based on the SNPs reported on the GWS study by Loic Yengo et al. (2018). Furthermore, Hughes et al. (2019) support that the number of suggested SNPs by the aforementioned study to be associated with individuals' BMI at $p \leq 5 \times 10^{-8}$, which were available in the Understanding Society, and passed the quality controls is 480. Hence, I instrument the individuals' BMI in my sample according to the list of SNPs proposed by Hughes et al. (2019) for the UK Understanding Society Survey.

The polygenic score IV of individuals' BMI that I rely in my analysis is a valid IV as it is shown to be highly correlated with individuals' BMI, based on the above discussion,

and it is not expected to impact individuals' labour market outcomes through any different channel except of their BMI. Hence, by conducting the empirical analysis with a second IV (genetic IV), I provide important evidence regarding the causal effect of BMI on individuals' labour outcomes.

In this following section, I estimate the Two-Stage Least Squares (2SLS) IV estimator for all the IV models for employment and the log of hourly wages. Finally, I conduct endogeneity and weak instrument tests. More specifically, I conduct an Wu-Hausman test for endogeneity. The test compares the estimates of OLS and 2SLS. The null hypothesis is that the two estimates have not different probability limit, thus there is not an endogeneity issue. Additionally, I conduct an F-statistic test for weak instrument. The null hypothesis on this statistic test is that the coefficient of the IV variable on the first stage regression of the 2SLS analysis is zero.

2.4.3.1 The Two-Stage Least Squares (2SLS) IV estimator

Towards dealing with endogeneity when estimating the causal effect of BMI on labour market outcomes, I rely on the 2SLS IV estimator(s). Thus, I rely to variables that predict my endogenous variable and impact the outcome variable only through the endogenous variable. In the first step (First stage equation), the endogenous variable (BMI) is estimated by the IV which is the polygenic score responsible mainly for individuals' BMI.

The second step estimates the impact of the predicted values of the endogenous variable from step one on the outcome of interest (Second stage equation). Finally, the proposed IV predicts the outcome of interest (wage and employment) on the reduced form.

- First stage equation

$$BMI_i = \alpha_0 + \beta_1 Z_i + \gamma_k X_{ki} + \nu_i \tag{2.3}$$

  - Z_i: Instrumental variable of BMI
  - X_{ki}: Vector of controls for personal, labour, and demographic characteristics
  - ν_i: Error term of the regression

- Second stage equation

$$Y_i = \alpha_0 + \delta_1 \hat{BMI}_i + \zeta_k X_{ki} + \eta_i \tag{2.4}$$

  - $Y_i : wage, employment, sociallyinteractiveoccupation$

- Reduced form

$$Y_i = \alpha_0 + \theta_1 Z_i + \mu_k X_{ki} + \nu_i \tag{2.5}$$

2.4.4 Robustness checks

Towards providing robust evidence regarding the impact of BMI on labour market, I conduct the empirical analysis for all the working age individuals by working similarly to the main analysis. Therefore, in this part of my study I estimate the impact of individuals' BMI on the probability of all working age individuals (16-64 years old) to be in employment. Additionally, I estimate the impact of an increasing BMI on individuals hourly wage. I conduct the empirical analysis separately per individuals' sex. Hence, I investigate whether expanding the age range and including younger individuals and older individuals with different levels of attachment on the labour market affect the findings of the analysis.

2.5 Results

In this section, I discuss the results of the empirical analysis regarding the causal impact of BMI on employment, and the hourly wage of the prime working age individuals. More specifically, in Table 2.3, I present the results of the empirical analysis regarding the impact of BMI on the probability of men and women to be in employment when the IV of BMI is the polygenic score. The complete results of the estimated models and their output are provided on the Appendix A.2. Additionally, Table 2.4 presents the results of the empirical analysis regarding the impact of BMI on the hourly wages of individuals when I work with the genetic IV. Also, I provide the complete output of the estimated models where all coefficients are available (main explanatory variable and additional control variables) on Appendix A.2.

2.5.1 The impact of BMI on employment

Table 2.3 presents the results of the empirical analysis regarding the impact of BMI on the probability of individuals to be in employment for prime working age men and women. More specifically, I present the results of the estimation of three different OLS models for men. The first model does not include any control variable and I estimate the impact of individuals' BMI on the probability of men to be in employment. I find no significant effect on the first model. When I add controls for the age group, the marital status, the education level, and the region that men live the result is not different. On the other hand the last model where I controls for the number of the dependent children of individuals and their health status the coefficient of interest is significantly different from zero but it's magnitude is very small. Furthermore, when I account for the endogeneity problem of individuals' BMI and their labour market outcomes I estimate three IV models (2SLS). I find that there is a negative coefficient which indicates that an increase of individuals' BMI, on the sample of men, leads to the decrease on the probability of men to in employment by 1-2 percentage points but none of the models provides a coefficient significantly different from zero. Therefore, the findings from the empirical analysis, after accounting for the endogeneity issue of BMI, indicate that an increasing BMI does not impact the probability of men to be in employment. This finding is in line with the evidence provided by the descriptive statistics that obese men are not (importantly) less likely to be in employment compared to non-obese men (Table 2.1). Furthermore, it is important to highlight that, based on the F-statistic for weak instrument, the polygenic score is a good predictor of the endogenous variable (individuals' BMI) since the value of the test is higher than a problematic value of 10 for each IV model.

Additionally, from the table that presents the total output of the empirical analysis for the sample of men (Appendix A.2, Table A.2) it is important to highlight that the

probability of men to be in employment decreases importantly when they are 45-54 years old compared to the probability in employment to individuals of the age group of 25-34 years old. Also, more that ten percentage points lower is the probability of single men to be in employment compared to non-single men. Moreover, men who hold a university degree or have higher education have significantly higher probability to be in employment compared to men who do not hold a degree. Also, the findings suggest that men with better health compared to men who report to have poor health have an increased probability of employment and that increase is found to be between 33 - 47 percentage points higher. Statistically important for the probability of men to be in employment is the second health control variable as well which indicates that men with long-standing health conditions are less likely to be in employment. Finally, the higher the dependent number of children (under 15 years old) the lower the probability of men to be in employment.

In Table 2.3 the last three columns present the results of the empirical analysis regarding the impact of individuals' BMI on the probability of women to be in employment. The first three rows showcase the results of the OLS models where I do not account for the endogeneity issue of BMI and labour market outcomes. Hence, on the first model where I estimate the impact of BMI on the probability of women to be in employment, without including any additional control, I find a statistically important coefficient which indicates that an increase of BMI by one unit decreases the probability of women to be in employment by more than five percentage points. This finding is inline with the descriptive statistics in Table 2.1 where the proportion of obese women in employment was shown to be lower than the proportion of non-obese women in employment. When I control for the age group of women, their marital status, level of education and the region that they live the impact is lower but it remains statistically important. On the last model where I include controls for the number of dependent children under the age 15 years old and the health of women, the remaining impact of an increasing BMI on the probability of women to be in employment is almost zero and the coefficient is not statistically important while the model seems to explain close to 20% of the variation of the probability of individuals to be in employment.

Furthermore, when I account for the endogeneity issue of BMI and the probability of women to be in employment, by using a polygenic score as a valid instrumental variable for individuals' BMI, I find no causal effect of an increasing BMI on the probability of women to be in employment. More specifically, all the three IV models provide coefficients that are not statistically different from zero. Regarding the power of the IV, the F-statistic test of weak instrument is more than a problematic value of ten for each IV model. This result provides supportive evidence that the proposed IV predicts well the endogenous variable (BMI).

Finally, I present the total output of the empirical analysis regarding the impact of BMI on the probability of women to be in employment on Appendix A.2, Table A.2. The findings suggest that women of age 35-44 years old have a higher probability of women of age 25-34 years old to in employment by around seven percentage points. When I compare the age group of 25-34 years old to women of 45-54 years old, and I include all the control variables (i.e. third model), I do not find a statistically important difference on the probability of women to be in employment. The impact of the marital status on the probability of women to be in employment is in the same direction as on the sample of men but the magnitude of the coefficient is lower now. Also, the probability of women to be in employment increases by almost 13 percentage points when they have a degree or even higher education compared to women without a degree. Other important determinants on the probability of women to in employment are the health variables that I include in my analysis. More specifically, I find that women with better self assessed health have an increased probability (between 3-6 percentage points) to be in employment compared to women who report to have poor health. Also, long-standing health conditions decrease the probability of women to be in employment by five percentage points. Finally, the number of children impacts importantly the probability of women to hold a job position. This impact is negative and the coefficient indicates that an increase of the number of children by one child decreases the probability of women to be in employment by 11 percentage points.

TABLE 2.3: The impact of BMI on the probability of employment for prime working age men and women

	Men			**Women**		
	(1)	(2)	(3)	(1)	(2)	(3)
Impact of BMI	0.003	0.003	0.00621***	-0.00542***	-0.00373**	0.0005
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
R-Squared	0.001	0.069	0.192	0.004	0.056	0.195
Impact of BMI (IV)	-0.02	-0.01	-0.01	-0.01	-0.004	0.01
	(0.01)	(0.011)	(0.011)	(0.01)	(0.01)	(0.01)
F-statistic: First-stage	45.18	52.99	46.44	82.99	83.91	68.20
Observations	1,641	1,641	1,641	2,220	2,220	2,220

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI, Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, Long standing illness or disability, and the number of children under age 15.

2.5.2 The impact of BMI on hourly wages

Table 2.4 presents the results of the empirical analysis regarding the impact of BMI on the hourly wage of the prime working age men and women. In general there is no evidence that BMI has an important impact on the hourly wage of men. More specifically, when I estimate the OLS model where the only explanatory variable on

the model is individuals' BMI the coefficient is not statistically different from zero and its magnitude is also zero. Also, on the second model where I control for the age group of men, their educational level, their marital status and the region that they live the coefficient is not statistically important. The coefficient remains non-statistically significant on the third model which explains more than 24% of the variation of the wages of the prime working age men and includes the additional controls regarding the occupation and the sector of their job. Furthermore, in Table 2.4 I also provide the results of the empirical analysis when I account for the endogeneity issue that arises from the reverse causality of individuals' BMI and their hourly wage. The corresponding results of the IVs models do not provide supportive evidence regarding an impact of individuals' BMI on the hourly wage of men. The coefficients of all the three models are not statistically different from zero, thus my analysis indicates that an increasing BMI does not impact the hourly wage of the prime working age men. Also, I present the total results of the empirical analysis regarding the impact of BMI on the hourly wage of men on Appendix A.2, Table A.3 (first two columns). It is important to highlight that the factors with a significant impact on the hourly wage of men include age group, marital status, level of education and occupation. The F-statistics for weak instrument provide supportive evidence that I do not work with a weak instrument of individuals' BMI as the value of the test is higher than ten (higher than a problematic value), in each model, confirming that the proposed IV is a good predictor of the endogenous variable.

Additionally, regarding the impact of BMI on the hourly wage of women the results on Table 2.4 show that it is negative and statistically different from zero. More specifically, from the analysis where I estimate the OLS models, and I don't account for the endogeneity issue that arises from the reverse causality of BMI and hourly wages, I find a persistent negative impact of an increasing BMI on the hourly wage of women. On the first model where the only explanatory variable is the individuals' BMI I find that an increase of BMI by one unit decreases the hourly wage of women by 1%. When I control for the age group of women, their level of education, whether they are single or not and the region that they live in the Great Britain the impact of an increasing BMI remains statistically different from zero on a model that explains almost 19% of the variation of women's hourly wage. The coefficient of the last model, where I control for the health variables (self assessed health and long-standing health conditions) and the occupation of women as well as the sector that they work in, is statistically important. Furthermore, I provide evidence regarding the causal impact of BMI on the hourly wage of women by relying on the polygenic score related to height and BMI, provided in my data, as a valid IV of individuals' BMI. According to the findings of my empirical analysis the IV estimates support that an increase on the BMI of the prime working age women by one unit decreases their hourly wage by almost 3%. Moreover, I provide the total output of the empirical analysis regarding the impact of BMI on the hourly wage of women on Appendix A.2, Table A.3 (second two columns). Based on

the results of the analysis the other important factors of the hourly wage of women include their age group, whether they have higher education, their occupation and sector. The proposed IV passes the weak instrument test in all models as the value of F-statistics (for weak instrument) is higher than a problematic value of 10. Hence, the proposed IV is shown to be a good predictor of the endogenous variable (BMI).

TABLE 2.4: The impact of BMI on the hourly wage of prime working age men and women

	Men			**Women**		
	(1)	(2)	(3)	(1)	(2)	(3)
Impact of BMI	0.000	-0.001	0.002	-0.0109***	-0.00533**	-0.002
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
R-Squared	0.000	0.186	0.244	0.010	0.192	0.267
Impact of BMI (IV)	-0.03	0.01	0.04	-0.0302**	-0.0302**	-0.0257**
	(0.026)	(0.022)	(0.024)	(0.013)	(0.012)	(0.013)
F-statistic: First-stage	35.38	40.87	34.53	73.67	76.69	64.54
Observations	1,243	1,243	1,243	1,589	1,589	1,589

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI. Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability, occupation, and sector.

It is important to highlight that the findings of this section provide evidence that an increasing BMI decreases the hourly wage only for the prime working age women. These findings improve our understanding with regards to the impact of BMI on the labour market outcomes of individuals. More specifically, taking into account that my analysis in Section 2.5.1 does not provide evidence in favour of an important negative impact of BMI on the probability of men and women to be in employment, a negative impact on their hourly wage could be understood either as the result of a potential lower productivity or as the result of a potential discrimination of individuals with a higher BMI.

My analysis enhances our understanding regarding the potential channel that individuals with a higher BMI are disadvantaged in the labour market. Therefore, based on my findings, I expect that the channel through which an increasing BMI is penalised in the labour market for the case of women is more likely to be a potential discrimination that they may face rather than a potential lower productivity that women with a higher BMI may have. My interpretation is supported by the fact that in the case of a negative impact of individuals' BMI on their hourly wage due to a decreasing productivity we should have the same finding in both samples independently of the gender of individuals. Since, such an impact is found only on the sample of women it leads the researcher to explore further any potential discrimination that women with an increasing BMI may face in the labour market with regards to their hourly wage due to social and/or personal preferences. Therefore, the findings in

this section motivates further analysis with regards to the channels that women with a higher BMI are discriminated and this discrimination is mirrored on their hourly wage. One direction can be the exploration of whether women with increasing BMI are excluded (discriminated) from job positions that pay higher wages and whether that can explain the differences in the hourly wage of the obese and non-obese women. I contribute further in that direction as this is the subject of my next chapter.

2.5.3 Results from robustness checks

2.5.3.1 Empirical analysis: Working age individuals

In this section, I present the results of the empirical analysis regarding the impact of individuals' BMI on their probability to be in employment and their hourly wages. I conduct the analysis separately for men and women as these two groups differ with regards to their labour market outcomes. Additionally, I conduct a similar empirical analysis to the main analysis of my study, presented in Section 2.5, but in this case I include in my sample all working age individuals to provide robustness evidence regarding the validity of my finding on a different sample. Therefore, I additionally include younger individuals from the group of 16-24 years old who should be less attached to the labour market as it is expected that they should be recently graduated individuals with short work experience. Also, I include older individuals who are less attached to the labour market as they are closer to their retirement (55-64 years old).

In Table 2.5, I present the results of the empirical analysis regarding the impact of BMI on the probability of working age individuals to be in employment. The findings do not indicate an important impact of BMI on this labour market outcome. More specifically, I showcase the results of the analysis when I estimate OLS models. For the case of men I find statistically important coefficients but their magnitude is zero, especially on the third model which explains almost 87% of the variation of the probability of employment for men. Additionally, when I account for the endogeneity issue of BMI and the labour market outcome of employment the impact of an increasing BMI on the probability of working age men to be in employment is zero. The F-statistics of the test for weak instrument is higher than a problematic value of 10, in all models, which provides supportive evidence that the proposed IV (polygenic score) is a good predictor of individuals' BMI. Hence, the empirical analysis regarding the impact of BMI on the probability of men to be in employment provides evidence in line with the findings of the main analysis.

Additionally, Table 2.5 showcases the results of the empirical analysis regarding the impact of BMI on the probability of all working age women to be in employment. More specifically, I firstly present the results of the OLS models where I work with individuals' BMI and I explore how it determines the probability of women to be in a

job position. The analysis indicates that, in all models, an increasing BMI does not impact the probability of the working age women to be in employment. When I estimate the IVs models, where the polygenic score, provided in my data, is used to predict individuals' BMI, I find that the coefficient is never statistically different from zero and its magnitude is almost zero. The findings in this part of the analysis confirm the findings of the main analysis regarding the impact of BMI on the probability of women to be in employment. In each model the provided polygenic score is shown to be a good predictor of individuals' BMI as it passes the F-statistics test for weak instrument.

TABLE 2.5: The impact of BMI on the probability of employment for working age men and women

	Men			Women		
	1	2	3	1	2	3
Impact of BMI	0.00437***	0.00220*	0.000600**	-0.00228	-0.00140	0
	(0.00131)	(0.00118)	(0.000298)	(0.00144)	(0.00125)	(0.000337)
R-Squared	0.007	0.156	0.869	0.002	0.149	0.893
Impact of BMI (IV)	0.00331	-0.00273	0.00106	-0.00682	-0.00521	0.000546
	(0.0105)	(0.00991)	(0.00390)	(0.00722)	(0.00697)	(0.00227)
F-Statistic: First Stage	31.95	29.15	29.38	94.65	85.26	77.27
Observations	2,903	2,903	2,903	3,814	3,814	3,814

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Model (1): BMI. Model (2): Age, education, region. Model (3): additional health controls, marital status.

In Table 2.6, I exhibit the results of the empirical analysis regarding the impact of BMI on working age individuals' hourly wage. More specifically, I show that in the case of the working age men, when I account for the endogeneity issue that arises from the reverse causality of BMI and wages, an increasing BMI does not impact importantly the hourly wage of this group. This finding is in line with the finding of the main analysis that the hourly wage of (prime working age) men is not determined by their BMI. None of the presented models provides evidence that the proposed IV of individuals' BMI is weak as the F-statistics is higher than ten in every IV model.

Also, in Table 2.6, I showcase the results of the empirical analysis regarding the impact of BMI on the hourly wage of all working age women. From the results presented in Table 2.6 it is shown that when I do not account for the endogeneity issue that arises from the reverse causality of BMI and wages then the impact of an increasing BMI on the hourly wage of the working age women is underestimated. Therefore, I find that an increase of BMI by one unit means that the hourly wage of the working age women decreases approximately by 2%. The impact remains statistically significant for each specification included in the analysis. Thus, the empirical analysis on the sample of the working age women confirms the findings shown in Section 2.5.2 regarding the

impact of BMI on the hourly wage of women. Regarding the power of the IV, based on the F-statistic for weak instrument, the instrument is a good predictor of the endogenous variable since the value of the test is higher than a problematic value of 10 for each IV model.

Table 2.6: The impact of BMI on the hourly wage of working age men and women

	Men			Women		
	1	2	3	1	2	3
Impact of BMI	0.00580**	0.00291*	0.001	-0.00299*	-0.00119	0
	(0.00226)	(0.00175)	(0.00175)	(0.00154)	(0.00126)	(0.00120)
R-Squared	0.006	0.224	0.308	0.004	0.250	0.311
Impact of BMI (IV)	-0.00563	-0.00847	0	-0.0167*	-0.0182**	-0.0151*
	(0.0193)	(0.0194)	(0.0198)	(0.00945)	(0.00851)	(0.00850)
F-Statistic: First Stage	48.3	43.11	40.05	77.57	75.15	68.38
Observations	1,886	1,886	1,886	2,431	2,431	2,431

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Model (1): BMI. Model (2): Age, education, region. Model (3): additional health controls, marital status, controls for occupation, and sector.

2.6 Discussion and conclusions

In this chapter, I estimate the causal effect of BMI on the labour market outcomes of men and women in the UK. More specifically, I investigate the impact of Body Mass Index (BMI) on the hourly wage and the probability of employment for the case of the prime working age individuals (25-54 years old). I work with the data set of the UK Household Longitudinal Survey "Understanding Society" and the "Nurse Health Assessment" to answer such research questions. Also, I solve the endogeneity problem, where for the case of wages arises due the reverse causality while there is an omitted variable bias threat for both wages and employment as there may be unobserved characteristics that affects' individuals' labour market outcome and their weight, with an IV approach. More specifically, I use a polygenic score, correlated specifically to the weight and the BMI, as an instrumental variable (IV) as it is the most updated method of estimating the impact of BMI on labour market outcomes. Therefore, I provide causal estimates by working with an instrument with the advantage that is the only available instrument where it is expected that the exclusion restriction required for an valid IV is satisfied as the polygenic score is not expected to impact the labour market outcomes through any other channel (such as biological) except of individuals' BMI. I obtained the additional information regarding the polygenic of individuals' BMI with an application to the Genetics Team of Understanding Society as it was not yet available on the sample of the "Nurse Health

Assessment". Furthermore, I provide robust evidence regarding my findings as I conduct the analysis for all working age individuals.

From the analysis in this chapter, the findings suggest that BMI does not affect the probability of prime working age men to be in employment. More specifically, when I account for the endogeneity issue, I find a negative but not statistically important impact of an increasing BMI on the probability of men to be in employment. The findings confirm the observation suggested by the descriptive statistics where the proportion of the obese men in employment was not importantly lower than the proportion of the non-obese men in employment. At the same time, the impact of BMI on the probability of women to be in employment is also not statistically different from zero. Therefore, I find that, when I do not account for the endogeneity issue that arises from the reverse causality of individuals' BMI and their employment status, there is a small but statistically important impact of the increasing BMI on the probability of women to be in employment. These findings are supportive with the observation of the descriptive statistics where the proportion of the obese women in employment is lower than the proportion of the non-obese women in employment. The empirical analysis shows that when I do not account for additional important determinants of individuals' employment status and when I do not account for the endogeneity issue of BMI and employment then the impact of BMI on the probability of women to be in employment is overestimated.

Additionally, I provide evidence regarding the impact of individuals' BMI on their hourly wage by contributing to the existing literature with up to date estimates in an area where the evidence from previous studies are mixed. More specifically, I estimate the causal effect of BMI on the hourly wage of the prime working and men and women. I conduct the analysis of individuals' BMI and I find that, accounting for the endogeneity issue of BMI and labour market outcomes, an increase of BMI does not cause any change on the hourly wage that men earn. The finding is consistent in all the models that I include in my analysis. Furthermore, the same empirical analysis on the sample of the prime working age women reveals that women are disadvantaged in labour market due to an increasing BMI. More specifically, I find that if the BMI of women increases by one unit then the hourly wage of women decreases by approximately 3%. I showcase that if we do not account for the endogeneity problem of BMI and individuals' wage the impact of BMI on the hourly wages of women will be underestimated.

Also, I conduct the empirical analysis for all the working age men and women similarly to the main analysis and I provide supportive evidence regarding the robustness of my findings. Hence, I confirm that, similarly to prime working age individuals, BMI does not impact the probability of men and women to be in employment. Moreover, individuals' hourly wage is found to be negatively impacted for both men and women but the impact is statistically important only in the case of

women. I find that an increase of BMI by one unit decreases the hourly wage of working age women by around 2%.

Taking all the above into account, I provide up-to-date evidence on the extent that individuals' body weight impacts their labour market outcomes. Also, I estimate the causal effect of BMI on labour market outcomes for the most attached age group in labour market (25-54 years old). Furthermore, I use a polygenic score of BMI as an IV which is the most updated method of estimating the impact of BMI on labour market outcomes. The important benefit of this IV is that it is highly correlated with the endogenous variable and it is not expected to impact the outcome of interest through any other channel except of the endogenous variable. Furthermore, I contribute with my study by providing more insights regarding the impact of BMI on wages since the literature provides mixed evidence.

Since the BMI in our societies increases and more and more people face the consequences of an unhealthy BMI, it is important that researchers provide insights regarding the causal impact of that health condition on the different aspects of our lives. Therefore, I provide evidence regarding the impact of BMI on the labour market outcomes of the impacted individuals towards improving our understanding regarding the scale at which, what is referred as the obesity epidemic in our era, determines the way that people participate in the labour market during the most productive time of their life. Thus, my study contributes in the area that increases our understanding of whether social norms and beliefs about individuals with higher BMI changes and adjusts over time as more and more members of our societies are impacted and the averages BMI in our populations increases. Also, my study enhances and improves the available tools to policymakers when they design policies towards ensuring an environment of equal opportunities to all citizens.

Chapter 3

Body Mass Index and Social Interactive Occupations

3.1 Introduction

Excess weight and obesity observed across countries lead to an escalating global epidemic according to the World Health Organization (WHO). With the proportion of overweight and obese individuals constantly increasing, researchers from different fields provide evidence with regards to the consequences of this public health problem on the impacted individuals and as well as in societies. Similarly to Chapter 2, in this chapter (Chapter 3), I provide evidence regarding the extent that individuals' Body Mass Index (BMI) impacts the labour market outcomes of these individuals. More specifically, in Chapter 3, I aim to provide more insights whether men and women are excluded from certain occupations due to their BMI. Based on the existing literature a higher BMI decreases the probability of individuals to be in job positions that involve high interaction with customers (Rooth (2009)) as well as in managerial job positions Hughes et al. (2019). Additionally, obese men and women report to be discriminated in the labour market due their higher BMI according to qualitative studies that document and report their personal experience (Giel et al. (2010)). Moreover, according to the findings of the experimental study by Popovich et al. (1997) the probability to hire obese individuals in job positions that involve high physical activity is lower. Therefore, in the research area of health and labour economics there is a high interest of uncovering and providing useful insights with regards to the channels that individuals with higher BMI may be disadvantaged in the labour market. Thus, I am motivated to provide insights whether individuals' BMI determines their probability to be employed in certain occupations. Additionally, I aim to provide important insights whether individuals with higher BMI are disadvantaged with regards to their probability to hold a job position in certain occupations due to specific fitness

requirements or not and whether this can be a channel that explains any disadvantage with regards to their wage.

In this chapter, the main research question I answer is regarding the impact of BMI on the probability of individuals to hold a job in a social interactive occupation. I work with the same data sets and samples as in Chapter 2, and more specifically, in Section 2.3. Also, I classify the occupations to social interactive and non-social interactive based on the level of interaction that the position requires with the potential customers and the employers. Hence, I identify the non-social interactive to be those that involve very low interaction or no interaction with the customers and very limited interaction with the employers (the person who hires for the position). Furthermore, it is expected that obese may be discriminated during the hiring process either because employers expect that obese individuals may be less productive or due to the general belief that obese are lazier than non-obese individuals. It is important to distinguish the occupations in which the fitness of an individual should be important for the potential job position. Hence, it is useful to isolate the occupations that, due to certain requirements of specific fitness, we expect the discrimination that obese may face could be more related to the fact that they do not meet that quota. Thus, in that case it is expected that employers may discriminate potential employees due to differences in the expected productivity of obese and non-obese individuals. On the other hand, in occupations that fitness is not required to acquire the job position, the discrimination that obese individuals face is more likely to come from the belief that obese are lazier or due to personal preferences determined by social norms. Therefore, I exclude the occupations that have high fitness requirements and I conduct again my analysis in the new sample where I do not expect individuals with a higher BMI to be excluded because they may not meet formal requirements (fitness requirements). The results in this case is expected to provide supportive evidence whether individuals' BMI impact their probability to be in social interactive occupations due to social beliefs that individuals with higher BMI (overweight, obese) may be lazier and less productive although they do not lack any required skill for the job position. Also, I explore whether or not being in a social interactive occupation can explain any potential wage gap of obese and non-obese individuals.

I conduct my analysis regarding the impact of individuals' BMI on the probability of the prime working age men and women to be in a social interactive occupation by estimating linear probability models with the OLS method. Moreover, I estimate the causal effect of BMI on the hourly wage and the probability to hold a job position that involves social interaction on the sample where the occupations with high fitness requirements are excluded. Hence, I work with log-linear models and linear probability models which I estimate with OLS method. Similarly to the analysis performed in Chapter 2, I work with the most up to date genetic IV (polygenic score correlated with BMI) for individuals' BMI to provide causal estimates. I explore the

explanatory power of being in a social interactive occupation on the wage gap of obese and non-obese individuals by conducting an Blinder-Oaxaca decomposition analysis for both men and women.

To the best of my knowledge, this is the first time that the causal impact of individuals' BMI on their probability to be in social interactive occupations will be studied, estimated and analysed by working with the most updated and valid genetic IV of individuals' BMI (polygenic score). Also, my classification of occupations based on the level of fitness requirements allows me to construct a sample where only occupations that do not include formal skills that individuals with higher BMI may lack (high physical strength) are included. Therefore, I further contribute by providing insights whether individuals are disadvantaged by being excluded from certain occupations not because they do not meet the formal requirements but because their BMI is treated as a sign of lower productivity based on the existing social beliefs. Furthermore, my study provides evidence on the level that being in a social interactive occupation can explain the observed differences in wage between obese and non-obese individuals. Thus, I consider important to explore whether a potential discrimination of obese individuals from certain occupations impacts further their labour market outcomes and their life as they may earn less since they may be excluded from high paid jobs due to beliefs in the society that they are less productive. According to my findings the probability of the prime working age men to be in a social interactive occaption is not impacted by their BMI. For the case of the prime working age women, I find that they experience a negative and statistically important impact. With regards to the explanatory power of being in social interactive occupation on the wage differences for obese and non-obese individuals, I find that it is zero. This finding is important as it provides supportive evidence that a potential exclusion of individuals from certain occupations, based on their BMI, does not determine another important labour outcome such as wages by forcing them to be occupied in job positions that pay less.

I conduct further analysis to provide evidence that my findings are robust when I work with different definitions of social interactive occupations. More specifically, I work with the definition of social interactive occupations provided by Barbieri (2018). Based on my analysis in this chapter, the results indicate that social interactive occupation has no explanatory power regarding the wage gap of obese and non-obese individuals for both men and women. Similarly, I rely on the definition of the Occupational Information Network (ONET, developed under the sponsorship of the US Department of Labor/Employment and Training Administration) in order to identify the occupations that involve social interaction with customers, co-workers and/or with employers and I conduct a similar analysis for further investigation and evidence regarding the explanatory power of social interactive occupations on the wage gap of obese and non-obese individuals and the results support my main analysis. More specifically, I find that social interactive occupations do not explain the

wage differences of obese and non-obese prime working age men and women. Also, I provide supportive evidence regarding the impact of social interactive occupations on individuals' hourly wage in order to verify the results of the Oaxaca decomposition analysis. The findings suggest that being or not in a social interactive occupation has no statistically important explanatory power on individuals' hourly wages for both men and women. Similarly, when I rely on the definition of Barbieri (2018) and ONET to identify the social interactive occupations, the results of the analysis support my main findings suggesting no explanatory power of this factor on the prediction of the hourly wage of the prime working age men and women. Hence, I confirm that the findings from the Oaxaca decomposition are robust and that the small probability of being excluded from those occupations (especially for women) due to an increasing BMI does not deepen the wage gap of obese and non-obese individuals given that people are not excluded from occupations that pay importantly higher wages.

The structure of this chapter is organised as following: In Section 3.1, I introduce and discuss the motivation and the approach of my study. In Section 3.2, I present important studies from the literature regarding the impact of obesity on individuals' labour market outcomes and regarding the mechanisms that explain how the obese individuals is expected to be disadvantaged in labour market. In Section 3.3, I present the data sets and how I link the different data sets for the purpose of my analysis and I discuss how I work towards constructing the required variables to conduct my empirical analysis. Also, the descriptive statistics regarding the main outcomes of interest and the control variables that are included in my analysis are presented in Section 3.3.1. In Section 3.4, I discuss the econometric methods that I use for the empirical analysis towards estimating the causal effect of individuals' BMI on their probability to be in social interactive occupation and regarding the explanatory power of being in a social interactive occupation in the hourly wage gap of obese and non-obese individuals. In Section 3.5, I showcase and analyse the output of the empirical analysis of my study. In Section 3.6, I summarise on the contributions of my study in the research area but also in our better understandings of the extent that individuals' BMI determines the category of the occupation that they report to have and what is the explanatory power of that important information of the wage gap of obese and non-obese individuals.

3.2 Literature Review

An increasing BMI is associated with lower labour market outcomes. More specifically, researchers provide evidence that higher BMI and obesity decreases the probability of individuals to be in employment (Hughes et al. (2019), Kuroki (2019), Henry and Kollamparambil (2017), Monsivais et al. (2015), Caliendo and Lee (2013), Huffman and Rizov (2014), Averett (2011), Lindeboom et al. (2010), Greve (2008), Morris (2007),

Härkönen (2007), Tunceli et al. (2006), Klarenbach et al. (2006), Paraponaris et al. (2005), Cawley et al. (2005), Cawley (2004), Morris (2004)). Additionally, overweight and obese individuals may be disadvantaged in labour market with regards to the wage that they receive (Moro et al. (2019), Hughes et al. (2019), Chu and Ohinmaa (2016), Johar and Katayama (2012), Kan and Lee (2012), Lundborg et al. (2010), Ljungvall and Gerdtham (2010), Lindeboom and Lundborg (2009), Shimokawa (2008), Brunello and D'Hombres (2007), Béatrice d'Hombres and Giorgio Brunello (2005), Cawley (2004), Baum and Ford (2004), Sargent and Blanchflower (1994)).

It is of high interest for the researchers in this area to be able to uncover the mechanisms that drive the observed patterns regarding the differences in labour market outcomes for people with an increasing BMI. Hence, there are studies that provide evidence that health conditions associated with an increasing BMI lead individuals out of the labour market. For example, according to the review study Robroek et al. (2013), where the researchers conduct a meta analysis in 28 studies, overweight and obesity are among the main factors for early exit of individuals from the labour market through disability pension or directly unemployment status. Additionally, in their study Houston et al. (2009) provide evidence that overweight young individuals who are classified as obese in their middle age are more likely to exit the labour market sooner, through early retirement, compare to their counterparts.

By working on the direction to provide further evidence regarding the mechanism behind the labour market outcomes' gap between the obese and non obese individuals researchers explore how this group of individuals is treated based on the level of social interaction that job positions involve. The motivation is related to the fact that obese individuals is expected to be discriminated in labour market through two different channels, statistical discrimination by the potential employer or current employer (the employer expect obese individuals to be less productive) and social norms (preferences of customers). Hence, it is expected that in occupations which involve higher level of social interaction obese individuals may be more disadvantaged in terms of labour market outcomes. For example, in their study Moro et al. (2019) estimate the impact of obesity on individuals' earning by focusing on occupations with higher level of interaction with customers, co-workers and/or employers. More specifically, the authors use the data of the National Longitudinal Survey of the Youth 1979 (a nationally representative sample of the American youth) and the occupational classification provided by the Occupational Information Network (O*NET), which is developed under the sponsorship of the U.S. Department of Labor/Employment and Training Administration (USDOL/ETA), to conduct their analysis. Moro et al. (2019) identify the social interactive occupations by constructing a measure based on the available information provided by ONET regarding the "skills" and the "abilities" required for a job. Thus, the authors use the constructed measure to identify how important is personal interaction to perform a job. Therefore, the authors find that

accounting for self-selection in occupations obesity decreases the wages of white women and the wage gap is higher in case of occupations that involve social interaction with customers, co-workers, or/and employers. Additionally, relying on the same data Harris (2019) provides evidence regarding the impact of individuals' body weight in their choices regarding their participation in labour market. Hence, the author uses the data of the National Longitudinal Survey of the Youth 1979 and relies on the occupational classification provided by the Dictionary of Occupational Titles (DOT) which is the predecessor of the ONET. More specifically,Harris (2019) finds that obese individuals earn less in occupations that involve higher level of social interaction. Also, a high BMI prevents individuals to move between white-collar occupations, compared to their counterparts, while it also reduces their returns to experience.

Additionally, Barbieri (2018) estimates the impact of BMI on the probability of individuals to be in employment and provide further analysis by dividing the occupations to social interactive and non-social interactive. More specifically, the author relies on the data of Health Survey of England (HSE) and works with semi-parametric regression models to estimate the impact of BMI on the probability of employment for women and men. Barbieri (2018) attempts to solve the endogeneity issue, that arises when researchers estimate the impact of BMI/obesity on labour outcomes, by working with regional instrumental variables of individuals' BMI. According to the paper's findings the highest probability for women to be in employment is found when their BMI is equal to 25 while for men the corresponding probability is found to a BMI closer to the lower cutoff of obesity. Hence, the author supports that the findings may reflect a change on social norms towards overweight individuals and how the excessive weight is treated in the society nowadays. Most importantly, Barbieri (2018) creates two groups of occupations where the first includes the occupations that involve social interaction with customers, colleagues, and employers (social occupations) and the second group includes the remaining occupations which are characterised as non-social. The findings of the study suggests that the probability of men to be in social occupations, and in non-social occupations is higher (as previously) close to the lower cutoff of the obese category. For women the findings suggest that the probability of employment is at the highest rate for a BMI equal to 24 in the case of non-social occupations and a BMI equal to 25 for the case of the social occupations.

Also, in their study Johar and Katayama (2012) estimate the impact of BMI on individuals' wages across the wage distribution. More specifically, the authors conduct the analysis for the case of the United States and use data from the National Longitudinal Survey of the Youth 1979 to conduct a quantile regression analysis. They find that an increasing BMI decreases the wages of both men and women but for white women the wage gap is higher towards the top of the wage distribution while for white men the largest difference is found close to the median of the wage distribution.

When the authors conduct the analysis for the pool of the occupations that involve social interaction they find that the above wages gaps are even larger for both men and women. Additional evidence regarding the impact of obesity on individuals' wages is provided on the study Han et al. (2009). More specifically, the authors work with the data of the National Longitudinal Survey of the Youth 1979 for their study and confirm the negative relationship of obesity with the hourly wage of men and women. Also, the authors confirm that obese individuals are more disadvantaged in labour market, regarding the hourly wage that they receive, when they hold job positions that involve social interaction with customers or/and co-workers.

Furthermore, in the experimental study Rooth (2009) the author provides evidence that obesity/appearance decreases the probability of employment. More specifically, the authors work with pairs of identical applicants where the photo of one per pair is modified to appear the individual as an obese. The applications where submitted and the outcome in terms of interview calls were importantly lower for both men and women that appeared to be obese individuals compared to their counterparts. The experiment was conducted in the Swedish labour market and the occupations that were selected include both high an low interaction with customers (computer professionals, business sales assistants, preschool teachers, accountants, nurses, restaurant workers (mostly waiters), and shop sales assistants). Based on the findings of the study, Rooth (2009) discusses that the difference on the probability of obese and non-obese individuals to receive a call back for a job interview may be due to the discrimination that obese individuals face from potential employers as they may expect that obese employees may be less productive. Furthermore, the even higher difference on the probability of obese individuals to gain the chance of a job interview in occupations that involve higher level of interaction with customers may be an evidence that obese individuals are discriminated due to customers' preferences.

Also, in the study by Morris (2006), the author estimates the impact of BMI on individuals' occupational attainment. More specifically, the author uses data of the Health Survey for England (HSE) and constructs the occupational attainment as the mean hourly wage per occupation for men and women. Also, the author solves the problem of endogeneity of BMI and labour market outcomes by employing regional instrumental variables of individuals' BMI. The author estimates the impact of BMI on occupational attainment by working with the Ordinary least-squares (OLS) method and the Instrumental Variable (IV) method. According to Morris (2006), an increasing BMI does not impact the occupational attainment of men but it has a negative and significant impact on the same labour market outcome for women. The findings are not similar when the instrumental variable analysis is conducted but the author supports that there is no evidence of endogeneity in the analysis, thus the results of the OLS analysis are preferred.

Additionally, part of the study by Harper (2000) provides evidence regarding the impact of obesity on individuals' earning as a factor of appearance. More specifically, the author uses the data of the National Child Development Study (NCDS) to estimate the impact of physical appearance on hourly wage, employment status, and household income. The relevant part of the study provides supportive evidence that obese individuals are disadvantaged regarding their labour market outcomes with the negative impact being higher regarding the probability of obese individuals to be in occupations that involve social interaction with customers. Also, obese women face higher discrimination that comes from employers during the hiring process. Hence, Harper (2000) provides supportive evidence that obese individuals (especially obese women) face discrimination that is directed both from employers (during the hiring process) and from customers as they are less preferred in occupations that involve higher interaction with customers.

As it is shown in this section there is rich research regarding the impact of an increasing BMI/obesity on labour market outcomes and how they are determined from the fact that of being or not in an occupation that involves higher level of social interaction with customers, co-workers and/or employers. This is the first study where a genetic instrumental variable (IV) of individuals' BMI is used to to provide evidence whether an increasing BMI determines the probability of individuals to be in social occupations. Additionally, I provide evidence on the impact that a different probability to be in certain occupations may have on the wages of individuals. Hence, I provide evidence on whether an increasing BMI prevents individuals to be in occupations with higher wages, thus it (partially) explains the wage gap among individuals with higher BMI (obese) compare to individuals with lower BMI (normal and overweight).

3.3 Data

For the purpose of my analysis, I rely on the data set provided by "Understanding Society: Waves 1-10, 2009-2019 and Harmonised BHPS: Waves 1-18, 1991-2009: Special Licence Access" for the waves 2 and 3. Also, I link to the main survey the information of the corresponding waves that is provided by the data of "Understanding Society: Waves 2-3 Nurse Health Assessment, 2010-2012". Additionally, in order to obtain the information regarding individuals' local authority district, I link on my data this corresponding information provided by "Understanding Society: Waves 1-10, 2009-2019 and Harmonised BHPS: Waves 1-18, 1991-2009: Special Licence Access, Local Authority District".

More specifically, I link the files "indresp_protect" and "indresp_ns" for wave 2 and wave 3 of Understanding Society (Special Licence Access). The sample of wave 2 corresponds to 15,632 observations, only 14 observations of "indresp_ns" did not

match with observations of the file "indresp_protect". Similarly, the sample of wave 3 corresponds to 5,051, in that case only 2 observations of "indresp_ns" were not matched with observations of "indresp_protect". The created files that contain the linked data per wave are "wave2indresp_and_nurse.dta" and "wave3indresp_and_nurse.dta" for wave 2 and wave 3 respectively.

Furthermore, on the constructed files "wave2indresp_and _nurse.dta" and "wave3indresp_and _nurse.dta" I linked the information regarding individuals' local authority district (LAD) to each wave "oslaua _protect.dta". Hence, the sample of wave 2 corresponds to 15,628 since only 4 individuals did not match to a LAD. Similarly, the sample of wave 3 contains 5,049 observations as for 2 individuals the corresponding information regarding their district was not provided. The constructed files are "wave2indresp_and_nurse_LAD.dta" and "wave2indresp_and_nurse_LAD.dta" for wave 2 and wave 3 respectively.

Additionally, I constructed a single file where I append the files "wave2indresp_and_nurse_LAD.dta" and "wave2indresp_and_nurse_LAD.dta". Thus, I created the files "wave23indresp_and_nurse_LAD.dta" which includes 20,677 observations. Finally, I linked to the file "wave23indresp_and_nurse_LAD.dta" the information regarding individuals' polygenic score. The total number of observations for which the polygenic score is provided corresponds to 9,921 individuals (Provided file by the Genetics Team at Understanding Society). The constructed file, by linking the file "wave23indresp_and_nurse_LAD.dta" and the file that contains individuals' polygenic score, includes 9,919 observations. Two individuals for whom the polygenic score was provided did match with observations of the file "wave23indresp_and _nurse_LAD.dta".

Furthermore, I estimate the impact of obesity on the probability for individual to be occupied in a social interactive occupation. I construct the dummy variable, where 1 corresponds to socially interactive occupations and 0 to non-socially interactive occupations. I define the group of the social interactive occupations and the group of the non-social interactive occupations by relying on a rule closely related to Barbieri (2018). Therefore, I identify the non-social interactive occupations to be those occupations that have very low interaction/or no interaction with customers and very limited interaction with employers. Additionally, I classify at the unit level classification of the Standard Occupational Classification 2000 (SOC2000) to socially interactive and non-socially interactive and I create the two groups of occupations. Below I provide a sample of occupations classified into the two categories in order to showcase my strategy of classification. The full list of occupations classified into social interactive occupations and non-social interactive occupations is provided on Appendix B, Section B.1.

Furthermore, I provide robustness support regarding the explanatory power of social interactive occupations on the hourly wage differences between obese and non-obese individuals as I rely on different definitions of social occupations. More specifically, I rely on the classification of occupations to social and non-social which is provided by Barbieri (2018). The author in the study Barbieri (2018), categorises the occupations, as they are provided based on the Standard Occupational Classification 2000 (SOC2000), into social and non-social by working at the minor group level (three digits). Also, I rely on the classification of occupations to social and non-social that is provided by the Occupational Information Network (O*NET) which is developed under the sponsorship of the U.S. Department of Labor/Employment and Training Administration (USDOL/ETA) through a grant to the North Carolina Department of Commerce. More specifically, the ONET identifies the social occupations by classifying the occupations provided on the 2018 Standard Occupational Classification (SOC) by the U.S. BUREAU OF LABOR STATISTICS. The available list with the social occupations, as it is constructed by the ONET, is updated in 2019 (more information can be found on: Occupational Information Network (O*NET)). The list includes occupations that involve collaboration with others, communication, and teaching others (the list with the social occupations can be found on: Social occupations (O*NET 2019 classification)). The classification of occupations to social and non-social provided by ONET is at the unit level of the U.S. SOC2018. Hence, it is required to map the provided classification to the Standard Occupational Classification 2000 (SOC2000) provided by the United Kingdom Office for National Statistics (ONS). I achieve the mapping by relying on the International Standard Classification of Occupations (ISCO) provided by International Labour Organization (ILO). More specifically, I map the classification of the occupations by ONET to U.S SOC-2000. Additionally, I have the map of the U.S SOC2010 to ISCO 2008 (more information can be found on: isco-Crosswalks) and I was able to work backward to produce the map U.S SOC2000 to ISCO 2008. Also, I relied on the UK SOC2000 to ISCO-2008 mapping provided by the ONS as part of the "Environmental Accounts" (more information and the original data can be found on: ISCO 2008 to UK SOC2000). Finally, all the described steps enabled me to construct the UK SOC-2000 list of social occupations based on the provided list of ONET. I was not able to map four of the occupations from the list of 138 social occupations. The list is available on Appendix B, Section B.2.

Additionally, as it is explained above, there are two sources of discrimination that an individual may face in labour market. Firstly, obese individuals may be less likely to be selected on job positions that have certain fitness requirements. This may happen due to the fact that employers may expect that individuals' excess weight may prevent them from pursuing some job - related tasks which consequently may reduce their productivity. Secondly, although excess weight is not an obstacle for all the occupations, obese individuals may be less likely to be in a job position due to social norms and beliefs that they are lazier and less productive workers (Rooth (2009)).

Thus, in order to be able to provide supportive evidence that obese individuals may be discriminated in the labour market even though they are not disqualified for the job position due to their excess weight it is important to classify the occupations into categories based on their fitness requirements. Hence, I classify the occupations at a unit level of classification of the Standard Occupational Classification: SOC2000 into three categories based on their fitness requirements. More specifically, the first group includes occupations that do not have any fitness requirements and the expectation is that obese individuals should not be less likely to hold a job position on that category. The second category includes occupations that require some fitness but it is it expected that excess weight should not prevent individuals from holding such a job position. Finally, the third category includes occupations that have the highest level of fitness requirements and it is more likely that individuals with excess weight may find those jobs challenging. I provide below a sample of occupations classified into social interactive occupations and their level of fitness requirements. The full list of occupations classified based on the above criteria is provided as on Appendix B, Section B.1.

TABLE 3.1: Sample of occupations classified by fitness level and social interaction

	Social Interactive	**Non - Social interactive**
Fitness level (0)	Marketing and sales managers	Call centre agents/operators
	Educational assistants	Financial and accounting technicians
Fitness level (1)	Electrical/electronics technicians	Building and civil engineering techn.
	Bakers, flour confectioners	Glass and ceramics process op.
Fitness level (2)	Senior officers in fire, ambulance, prison and related services	Metal making and treating process op.
	Physiotherapists	Road construction operatives

3.3.1 Descriptive statistics

Table 3.2 showcases the proportions of prime working age individuals in social interactive occupations and non-social interactive occupations per fitness requirement level. From the distribution of the total sample I observe that the majority of the individuals are occupied in jobs that do not have any fitness requirements. Hence, in the total sample more than 60% report to have a job position without any fitness requirement. Furthermore, another quart of individuals is occupied in jobs with some fitness requirement but those jobs are not expected to be very heavy (physically). The remained and the smallest proportion of the participants report to hold a job position that require important physical strength.

Additionally, it is important to highlight the differences on the distribution of individuals who report to hold a social interactive occupation and those who hold a job that does not involve social interaction across the different levels of fitness requirements. The findings suggest that individuals who hold jobs that involve social interaction are jobs with the lowest fitness requirements (or non fitness requirements). More specifically, it is worth noting that the proportion of individuals who hold a social interactive job that does have any fitness requirement is almost 14 percentage

points higher than the proportion of individuals who report to hold a job without social interaction and without fitness requirements. Also, in Table 3.2 it is shown that as the level of fitness requirement increases the differences on the proportions between those who hold a job which involves social interaction and those who are occupied in jobs without social interaction change. Hence, when jobs have a fitness requirement of level one then I observe that the proportions of individuals who report to hold a social interactive job is only 2 percentage points higher than the proportion of individuals who report to be in a job that does not involve any social interaction. Last but not least, for occupations with a high level of fitness requirement (fitness requirement of level 2) they are more frequently jobs without social interactions. Therefore, the proportion of individuals who report to hold a job position with level of fitness requirements equal to 2 is almost 16 percentage points less than the proportion of individuals who are occupied in a job without social interaction and with level 2 of fitness requirements.

Table 3.2: Distribution of individuals in social interactive occupations and non-social interactive occupations by fitness requirement level

Proportion (%)	Fitness (0)	Fitness (1)	Fitness (2)	Total
Non-social interactive	53.64	24.29	22.07	100
Social Interactive	67.29	26.41	6.3	100
Total	62.83	25.72	11.45	100

In Table 3.3 I present the statistical analysis regarding the distribution of obese and non-obese individuals per level of fitness requirements in their job position (total sample). As it is showcased in the Table 3.3, the proportion of obese individuals who hold a job position with zero level of fitness requirements is less than 7 percentage points than the corresponding proportion of non-obese individuals. On the other hand the proportion of obese individuals who hold a job position with the highest level of fitness requirements (fitness requirements equal to 2) is higher than the proportion of non-obese individuals. This finding is not expected since obesity is a health condition that is expected to be associated with additional health conditions and in general it is expected that obese individuals would not prefer to hold job positions with high fitness requirements in order to prevent damaging their health further. Therefore, since the results of Table 3.2 provide evidence that individuals that are occupied in a job position with lower fitness requirements are more likely to be individuals who hold a job position that involves social interactions, there is a motivation to explore further whether the unexpected result in Table 3.3 may be explained based on a lower probability of obese individuals to be in a social interactive occupation. Further statistical analysis is provided on the subsections 3.3.1.1 and 3.3.1.2 where I work on the sample of prime working age individuals for both men and women.

Table 3.3: Distribution of obese individuals and non-obese individuals by fitness requirement level

Proportion (%)	Fitness (0)	Fitness (1)	Fitness (2)	Total
Non-obese	64.89	24.12	10.98	100
Obese	57.4	29.92	12.68	100

3.3.1.1 Prime working age men and women

In Table 3.4 I present the descriptive statistics of the sample where I estimate the impact of individuals' BMI on their probability to be in a social interactive occupation. Based on the results of the statistical analysis the proportion of obese men in social interactive occupations is lower by almost five percentage points compared to the proportion of obese men in occupations that do not include any social interaction. For the case of women, the descriptive statistics provides evidence that obese women are less likely to be in a social interactive job than non-obese women. Furthermore, with regards to the distribution of obese and non-obese per level of fitness requirements in their job position is worth discussing that the results suggest a high likelihood of obese individuals to be in a job where physical strengthen is required. More specifically, in Table 3.4, it is shown that the proportion of obese men in occupations with fitness requirements of level two higher than the proportion of men in occupation with no fitness requirements. Also for the case of women, it is important to highlight that the proportion of obese women in job positions that do not require any physical strength is higher but very close to the proportion of women in jobs with fitness requirements of level two. Therefore, I observe, based on the descriptive statistics, that obese individuals are less likely to be found in a social occupation while they have unexpected high probability to be in jobs that require important physical strength.

Additionally, it is important to analyse the results of the statistical analysis of all the control variables included in my empirical analysis. Thus, as it is showcased on Table Table 3.4 the distribution of obese and non-obese individuals per age category suggest that obesity is positively correlated with individuals' age as it is less likely for the obese individuals to be found in the group of youngest people. More specifically, in the case of men I observe that the proportion of obese men in the age group 35-44 years old is more than seven percentage points higher than the proportion of obese men in the age group of 25-34 years old. The difference is higher for the case of women as the proportion of obese women in the age group of 35-44 is more than 13 percentage points higher than the corresponding proportion in the age group of 25-34 years old women. Also, it is worth noticing that although the likelihood to find an obese individual on the group of 45-54 years old is higher compared to the age group of 35-44 years old the difference is not very high for both men and women.

Furthermore, based on the descriptive statistics, the likelihood to find an obese individuals on the group of people with lower education is higher than on the group of people who hold a degree or have even higher level of education. Therefore, in the case of men I observe that the proportion of obese individuals without a degree is more than 7 percentage points higher than the proportion of obese men with a degree or higher education. Also, in the sample of women the figures are worse as the proportion of obese women with a degree or with even higher level of education is more than 8 percentage points lower than the proportion of obese women without a degree. Additionally, from the distribution of obese and non-obese individuals with regards to their marital status it is worth discussing that, in general, the proportion of obese who report to be not single is higher than the proportion of single obese individuals. In the sample of men the proportion of obese non-single individuals is more than 4 percentage points higher than the proportion of singe obese men. This finding may be expected as the distribution of the obese and the non-obese men across the different age groups provides evidence that obese men are less likely to be very young individuals. Hence, since we may expect that older individuals may be less likely to be single, then this higher proportion of obese men in the group of non-single men than the corresponding proportion of the group of the single men may not be an unexpected finding. Furthermore, a similar analysis for the case of women includes the observation that the proportion of obese non-single women is higher than the proportion of obese single women by more than 8 percentage points. By following the same logic as in the case of men, I can argue that the higher proportion of obese women on age groups that include older people in my sample may be an useful observation to help us to be better understand the latter finding regarding the distribution of the obese and the non-obese women based on their marital status.

Moreover, it is important to highlight that individuals' health status is negatively correlated with obesity. More specifically, as it is shown in the Table 3.4, the proportion of obese men among men who report to have an excellent health is more than 9 percentage points lower than the proportion of obese men among the men who report to have very good health. As the self reported health worsen the proportion of obese men exhibits a negative correlation per category of health status. This expectation is in line with the fact that obesity is a health condition that may cause or may be related with other health conditions that individuals face. Therefore, in groups of individuals with important health problems the proportion obese individuals may be higher as obesity may be the reason that individuals report to have poor health or it may correlated with other health complications. Similarly, in the sample of women I observe that the proportion of obese women increases from the category of the self reported health excellent to fair a finding in line with expectation discussed above. However, it is worth noticing that the proportion of obese women in the category where women report to have poor health is lower than the corresponding proportion on the previous category (fair). Therefore, in the sample of women, the likelihood to

find an obese women in the sample of women who report to have poor health is not much higher than it is in the sample of women who report to have very good health. Additionally, the distribution of obese and non-obese individuals on the categories of the second health variable in my data provides supportive evidence on the expectation that obesity is positively correlated with individuals' probability to suffer from important health conditions. Therefore, the proportion of obese individuals, for both men and women, is higher among individuals who report to suffer from a long-standing health problem than the group of individuals who do not report such a health condition. Finally, the proportion of obese men in the public sector is higher than the proportion of obese men in the private sector while on the sample of women the opposite holds.

Table 3.4: Descriptive Statistics: Social Interactive occupation for obese and non obese individuals (25-54 years old)

	Men		Women	
	Non-obese (%)	**Obese (%)**	**Non-obese (%)**	**Obese (%)**
Social Interactive Occupation	74.49	25.51	74.54	25.46
Non Social Interactive Occupation	69.14	30.86	73.40	26.60
Level of fitness required in different occupations				
0	74.48	25.52	76.26	23.74
1	66.14	33.86	70.05	29.95
2	71.95	28.05	77.16	22.84
Age group				
25 - 34	77.81	22.19	83.81	16.19
35 - 44	70.46	29.54	70.70	29.30
45 - 54	68.38	31.62	70.40	29.60
Education				
Degree/Higher degree	76.27	23.73	78.82	21.18
No degree	68.95	31.05	70.29	29.71
Marital Status				
Single	74.90	25.10	80.20	19.80
Not single	70.59	29.41	71.78	28.22
Region				
North East	70.78	29.22	69.05	30.95
North West	68.64	31.36	75.40	24.60
Yorkshire and the Humber	78.77	21.23	71.50	28.50
East Midlands	64.33	35.67	69.22	30.78
West Midlands	65.96	34.04	74.42	25.58
East of England	78.58	21.42	74.89	25.11
London	77.03	22.97	82.84	17.16
South East	73.98	26.02	80.56	19.44
South West	73.79	26.21	73.93	26.07
Wales	71.38	28.62	69.89	30.11
Scotland	66.49	33.51	68.98	31.02
Self assessed health				
Excellent	84.70	15.30	85.82	14.18
Very good	75.19	24.81	76.50	23.50
Good	67.89	32.11	65.41	34.59
Fair	49.82	50.18	59.33	40.67
Poor	45.25	54.75	74.84	25.16
Long-standing illness or impairment				
Yes	64.72	35.28	67.71	32.29
No	74.08	25.92	76.48	23.52
Sector				
Private	71.74	28.26	72.74	27.26
Public	69.60	30.40	74.71	25.29
Not-reported	76.68	23.32	81.00	19.00

The analysis is weighted by with the cross-sectional blood person weight of Nurse health assessment (UKHLS).

Finally, Table 3.5 presents the average hourly wage of the occupations that include social interaction and for the occupations that do not include any social interaction for men and women. It is important to highlight that for both men and women it is shown that the hourly wage is higher, in average, in social interactive occupations than in non-social interactive occupations. More specifically, for the case of the men individuals it is shown that individuals in non-social interactive occupations are paid £0.88 per £1 that earn men in social interactive occupations. Similarly in the sample of women I observe that those who work in a non-social interactive occupation earn £0.93 per per each £1 that earn women in social interactive occupations. Therefore, Table 3.5 provides supportive evidence that individuals in social interactive occupations are paid better, in general, compared to individuals in non-social interactive occupation. This finding in addition to the finding that obese individuals are less likely to be in a social interactive occupation motivates the part of my empirical analysis regarding the explanatory power of the information for an individual to hold a job position that involves social interaction on the wage gap of obese and non-obese individuals.

Table 3.5: Average hourly wage of social interactive occupations and non-social interactive occupations by sex

Hourly wage (mean)	Men	Women
Non - social interactive occupation	14.60	11.32
	(8.32)	(7.22)
Social interactive occupation	16.49	12.18
	(11.37)	(7.43)

Standard deviation in parentheses. The analysis is weighted by with the cross-sectional blood person weight of Nurse health assessment (UKHLS).

3.3.1.2 Prime working age men and women on the sample that occupations with fitness level 2 are excluded

I conduct my empirical analysis on the sample where I excluded the observations of individuals who report to hold a job position with fitness requirements of level two. I limit the sample based on that criteria in order to provide evidence regarding the extent of the impact of individuals' BMI on their probability to be in a social interactive occupations when the job position does not have any requirement regarding a certain and high level of physical strength. Thus, I exclude from my analysis occupations in which an individual with a higher BMI may be expected to be excluded due to a lower expected productivity. Therefore, Table 3.6 showcases the descriptive statistics for the labour market outcomes hourly wage and social interactive occupations on the sample that occupations with fitness requirement of level two are not included. I observe that, for both men and women, obese individuals receive lower hourly wage compared to non-obese individuals. Also, the proportion of obese men in social interactive occupations is smaller compared to the corresponding proportion of obese men in

non-social interactive occupations. Similarly for women it is shown that the proportion of obese women in social interactive occupations is lower than the corresponding proportion of obese women in non-social interactive occupations.

Additionally, I present the descriptive statistics regarding the control variables that I included in my analysis. Based on the findings provided on Table 3.6 I show that, as in the total sample that I analyse in Section 3.3.1.1, it is less likely for obese individuals to be encountered on the groups of young people compared to groups of older working age individuals. More specifically, for the case of men I observe that the proportion of obese men in the age group 25-34 years old is almost 8 percentage points lower than the proportion of obese men in the other two age groups of my sample. The difference on the likelihood to find an obese individual among younger women compared to the groups of older women is higher than the case of the sample of men. Hence, the proportion of obese women of the age group 25-34 years old is almost 13 percentage points lower that the proportion of obese women in the age groups 35-54 years old. Also, the lower probability of obese individuals to hold a degree or to have even higher education is consistent in my sample as well. So, I observe that for the case of men the proportion of obese men in the sample of individuals with a degree or even higher level of education is almost 9 percentage points lower that the proportion of obese men on the sample of individuals that do not have higher education. A similar difference is shown on the sample of women regarding the likelihood to find an obese women in the sample of better educated women compared to the sample of women that do not report to hold a degree. With regards to the proportions of obese individuals based on their marital status, I observe that the proportion of obese men among single men is around 4 percentage points lower than the proportion of obese men among non-single men. Also, in the sample of women the likelihood of a women to be obese in the sample of single women is lower than the likelihood a women to be obese in the sample of the non-single women as the proportion of the former is more than 8 percentage points lower than the proportion of the latter.

Furthermore, similarly to Table 3.4, Table 3.6 shows that the proportion of obese individuals increases for the categories of individuals with worse health status. More specifically, for the case of men it is worth discussing that the proportion of obese individuals among men who report to have poor health is almost 49 percentage points higher than the proportion of obese men who report to have excellent health. For the case of women I observe a higher proportion of obese women for the categories of individuals who report worse health status compared to the group of those women with fair health while the proportion of obese women among women who report to have poor health is shown to be lower. Therefore, the proportion of obese women with fair self reported health is more than 25 percentage points higher than the proportion of obese women among women with excellent health. Additionally, supportive evidence that the likelihood to encounter an obese individual among individuals with

worse health is higher than the likelihood to find an obese individual in the group of people with better health is provided by the second health control variable that I included in my analysis. Therefore, in Table 3.6 it is shown that, for both men and women, the proportion of obese among individuals who report to suffer from a long-standing illness or disability is around 9 percentage points higher that the proportion of obese among individuals without an long-standing condition.

TABLE 3.6: Descriptive Statistics: Social Interactive occupation for obese and non obese individuals (25-54 years old) when occupations with fitness requirement of level two are excluded

	Men		**Women**	
	Non-obese (%)	**Obese (%)**	**Non-obese (%)**	**Obese (%)**
Social Interactive Occupation	74.90	25.10	74.66	25.34
Non Social Interactive Occupation	67.97	32.03	72.51	27.49
Hourly wage (mean)	16.88	14.68	12.30	11.24
	(11.27)	(8.90)	(7.80)	(6.32)
Age group				
25 - 34	77.24	22.76	83.64	16.36
35 - 44	69.49	30.51	70.87	29.13
45 - 54	69.58	30.42	70.20	29.80
Education				
Degree/Higher degree	76.70	23.30	78.79	21.21
No degree	67.71	32.29	70.15	29.85
Marital Status				
Single	74.85	25.15	80.06	19.94
Not single	70.64	29.36	71.73	28.27
Region				
North East	68.01	31.99	69.37	30.63
North West	68.93	31.07	75.27	24.73
Yorkshire and the Humber	78.69	21.31	70.86	29.14
East Midlands	63.40	36.60	69.79	30.21
West Midlands	65.92	34.08	75.02	24.98
East of England	80.03	19.97	74.85	25.15
London	79.03	20.97	82.64	17.36
South East	72.81	27.19	80.36	19.64
South West	73.54	26.46	73.57	26.43
Wales	72.42	27.58	68.80	31.20
Scotland	66.39	33.61	69.26	30.74
Self assessed health				
Excellent	83.56	16.44	85.54	14.46
Very good	76.13	23.87	76.44	23.56
Good	67.73	32.27	65.32	34.68
Fair	47.92	52.08	60.13	39.87
Poor	35.02	64.98	74.84	25.16
Long-standing illness or impairment				
Yes	64.62	35.38	67.80	32.20
No	74.09	25.91	76.36	23.64
Sector				
Private	71.95	28.05	72.60	27.40
Public	70.97	29.03	74.82	25.18
Not-reported	74.69	25.31	80.66	19.34

Standard deviation in parentheses. The analysis is weighted by with the cross-sectional blood person weight of Nurse health assessment (UKHLS). The mean of hourly wage is provided for the sample that all individuals provide information regarding their income and hours worked per week (this is approximately 100 observations less than the total sample).

Table 3.7 presents the results of the statistical analysis regarding the average hourly wage on social interactive occupations and non-social interactive occupations for both men and women. Similarly to the analysis presented in Section 3.3.1.1, there is supportive evidence that the social interactive occupations have a higher average hourly wage for both genders. More specifically, for the case of men I show that a man in a job position that does not involve social interaction earns £0.92 per £1 that earn men in job positions with social interaction. Also, for the case of women I observe that a woman in non-social interactive job earns £0.94 per £1 that earn women in job positions with social interaction.

TABLE 3.7: Average hourly wage of social interactive occupations and non-social interactive occupations by sex

Hourly wage (mean)	Men	Women
Non - social interactive occupation	15.53	11.47
	(8.86)	(7.37)
Social interactive occupation	16.79	12.16
	(11.84)	(7.47)

Standard deviation in parentheses. The analysis is weighted by with the cross-sectional blood person weight of Nurse health assessment (UKHLS).

3.4 Empirical methods

In this section, I estimate the impact of BMI on the probability of individuals' to be in social interactive occupations as well as the explanatory power of being in a social interactive occupation on the pay gap of obese and non-obese individuals. Hence, I estimate the impact of prime working age men and women to be in a social interactive occupation with Linear Probability Models (LPM) with the Ordinary least-squares (OLS) method. Additionally, since there may be a threat of endogeneity of individuals' BMI and their probability to be in a social interactive occupation I rely on the Instrumental Variable method to solve this issue. Hence, I provide causal estimator by relying on the Two-Stage Least Squares (2SLS) IV estimator. Also, I rely on the Blinder-Oaxaca decomposition method to explain the wage gap between obese and non-obese individuals.

3.4.1 Linear probability models

The Linear Probability Models (LPM) that I use to estimate the impact of BMI on the probability of individuals to be in a social interactive occupation:

$$Y_i = \alpha_0 + \beta_1 BMI_i + \gamma_k X_k i + \epsilon_i, \quad i = 1, ...N \tag{3.1}$$

The outcome variable Y corresponds to the binary dependent variables of being or not in a social interactive occupation. The variable BMI is the continuous variable of individuals' BMI. The vector X includes the control variables for personal characteristics, family information, region, and self assessed health, that I included in the analysis. I estimate three specifications for each model. The first specification explains the impact of obesity on the corresponding outcome of interest without including any other control variable. In the second specification, I control for personal and regional characteristics such as age, marital status, education, and region. The third specification includes control variables for number of children under age 15, self assessed health and long standing illness or disability. Finally, ϵ is the error term in each regression and i denotes the i^{th} person in the sample.

3.4.2 The Instrumental Variable analysis

I solve the endogeneity issue due to the potential reverse causality of BMI and social interactive occupations by relying on the Instrumental Variable method. I use the most up to date instrumental variable of individuals' BMI which contains certain genetic information which is found to be highly correlated with individuals' BMI. More specifically, in their study Loic Yengo et al. (2018) find that genome-wide significant (GWS) single nucleotide polymorphisms (SNPs) explain 6% of the variation of individuals' BMI adjusted for 20 genotypic principal components (PCs). Additionally, in their study, Hughes et al. (2019) construct a genetically IV of BMI based on the SNPs reported on the GWS study by Loic Yengo et al. (2018). Furthermore, Hughes et al. (2019) support that the number of suggested SNPs by the aforementioned study to be associated with individuals' BMI at $p \leq 5 \times 10^{-8}$, which were available in the Understanding Society, and passed the quality controls is 480. Hence, I instrument the individuals' BMI in my sample according to the list of SNPs proposed by Hughes et al. (2019) for the UK Understanding Society Survey.

The polygenic score IV of individuals' BMI that I rely in my analysis is a valid IV as it is shown to be highly correlated with individuals' BMI, based on the above discussion, and it is not expected to impact individuals' labour market outcome through any different channel except of their BMI. Hence, by conducting the empirical analysis with a genetic IV, I provide important evidence regarding the causal effect of BMI on individuals' probability to be in a social interactive occupation. In this sub-section I will present the stages of the Two-Stage Least Squares (2SLS) IV estimator:

- First stage equation

$$BMI_i = \alpha_0 + \beta_1 Z_i + \gamma_k X_{ki} + \nu_i \tag{3.2}$$

  - Z_i: Instrumental variable of BMI
  - X_{ki}: Vector of controls for personal, labour, and demographic characteristics
  - v_i: Error term of the regression

- Second stage equation

$$Y_i = \alpha_0 + \delta_1 B\hat{M}I_i + \zeta_k X_{ki} + \eta_i \tag{3.3}$$

  - $Y_i : wage, employment, sociallyinteractiveoccupation$

- Reduced form

$$Y_i = \alpha_0 + \theta_1 Z_i + \mu_k X_{ki} + v_i \tag{3.4}$$

In the first step (First stage equation), the endogenous variable (BMI) is estimated by the IV which is the polygenic score responsible mainly for individuals' BMI. The second step estimates the impact of the predicted values of the endogenous variable from step one on the outcome of interest (Second stage equation). Finally, the proposed IV predicts the outcome of interest (probability to have on a socially interactive occupation) on the reduced form.

3.4.3 Blinder-Oaxaca decomposition

I rely on Blinder-Oaxaca decomposition to explain the wage gap between obese and non-obese individuals. I am more interested on the explanatory power of being in a social interactive occupation on the wage gap of obese and non-obese prime working age people.

The general Blinder - Oaxaca decomposition:

$$\bar{Y} = \beta_0 + \Sigma \beta_j \bar{x} \tag{3.5}$$

$$\Delta\bar{Y} = (\beta_0{}^1 - \beta_0{}^2) + \Sigma(\beta_j{}^1 \bar{x_j}{}^1 - \beta_j{}^2 \bar{x_j}{}^2) \tag{3.6}$$

$$\Delta\bar{Y} = (\beta_0{}^1 - \beta_0{}^2) + \Sigma_j^k \beta_j{}^1 (\bar{x_j}{}^1 - \bar{x_j}{}^2) + \Sigma_j^k \bar{x_j}{}^1 (\beta_j{}^1 - \beta_j{}^2) + \Sigma_j^k (\bar{x_j}{}^1 - \bar{x_j}{}^2)(\beta_j{}^1 - \beta_j{}^2) \tag{3.7}$$

Three fold decomposition:

$$\Delta\bar{Y} = \Sigma_j^k \beta_j{}^1(\bar{x_j}^1 - \bar{x_j}^2) + \Sigma_j^k \bar{x_j}^1(\beta_j{}^1 - \beta_j{}^2) + \Sigma_j^k(\bar{x_j}^1 - \bar{x_j}^2)(\beta_j{}^1 - \beta_j{}^2) \tag{3.8}$$

Components:

- Explained difference based on the characteristics of the two groups (obese and non-obese individuals): $\Sigma_j^k \beta_j{}^1(\bar{x_j}^1 - \bar{x_j}^2)$
- Unexplained difference by the observed characteristics of the two groups (obese and non-obese individuals): $\Sigma_j^k \bar{x_j}^1(\beta_j{}^1 - \beta_j{}^2)$
- Interaction term of the difference based on the observed characteristics and the coefficients of the observed characteristics: $\Sigma_j^k(\bar{x_j}^1 - \bar{x_j}^2)(\beta_j{}^1 - \beta_j{}^2)$

3.4.4 Robustness checks

I conduct empirical analysis regarding the impact of BMI on the probability of individuals to be in a social interactive occupation by relying on two different definitions. Firstly, I conduct the analysis based on the definition of social interactive occupations provided by Barbieri (2018). Secondly, I estimate the impact of an increasing BMI on the probability of men and women to be in social interactive occupations by working with the definition of ONET. The aim of the robustness analysis based on different definitions of social interactive occupations provide supportive evidence regarding the validity of the findings of my main analysis where I rely on the classification of occupation to social and non-social based on the level that I expect them to involve social interaction mainly with customers and employers.

Additionally, I estimate log-linear models with the OLS for the impact of obesity on individuals' hourly wage and I include the control for individuals to be in a social interactive occupation. In this part of the analysis I provide supportive evidence that since the explanatory power, of being or not in a social interactive occupation, on individuals' wages is limited then the results of the Oaxaca decomposition are not unexpected. I conduct this part of the analysis by estimating log-linear models:

$$ln\omega_i = b_0 + \beta_2 SocialOccupation_i + \lambda_k X_k i + u_i, \quad i = 1, ...N \tag{3.9}$$

The logarithmic linear models estimate the impact of being in a social interactive occupation on the individuals' hourly wage.

3.5 Results

In this section, I will showcase and analyse the results of the empirical analysis regarding the impact of BMI on individuals' probability to be in a social interactive occupation. Additionally, I will present and discuss the results of the empirical analysis regarding the effect of holding a social interactive occupation on the wage gap of obese and non-obese individuals.

3.5.1 The impact of BMI on the probability of individuals to be in social interactive occupation

In Table 3.8, I present the analysis regarding the impact of an increasing BMI on the probability of individuals to be in a social interactive occupation. More specifically, when I do not account for the endogeneity problem, that arises when we conduct research regarding the impact of individuals' BMI on their labour market outcomes, I am not able to identify an impact of an increasing BMI on the probability of individuals to be in a social interactive occupation. Hence, I find that the impact of an increasing BMI is almost zero for both men and women and all the coefficients are not statistically important. Additionally, the second part of Table 3.8 showcases the results of the empirical analysis when I use the genetic instrumental variable of individuals' BMI to estimate the impact of the increase of the body mass index on the probability of individuals to hold a job that involves social interaction with customers, co-workers and/or employers. This part of the analysis provides evidence that an increasing BMI reduces the probability of individuals to be in social interactive occupations for both men and women. More specifically, an increase of BMI by one unit decreases the probability of men and women to be in a social interactive occupation by around 2% but this impact is statistically important only for women. With regards to the power of the instrumental variable it is shown from the results of the corresponding F-statistics that the IV is not week as the value of the F-statistics is higher than a problematic value of 10 for each model. Therefore, the polygenic score is shown to be a good predictor of individuals' BMI.

Table 3.8: The impact of BMI on the probability to be in a social interactive occupation for all prime working age individuals

	Men			**Women**		
	(1)	(2)	(3)	(1)	(2)	(3)
Impact of BMI	-0.00189	0.00143	0.00302	-0.000725	-0.000469	-0.000244
	(0.00316)	(0.00315)	(0.00323)	(0.00209)	(0.00213)	(0.00219)
R-Squared	0.000	0.068	0.078	0.000	0.018	0.020
Impact of BMI (IV)	-0.02	-0.02	-0.02	-0.0222**	-0.0200*	-0.0218*
	(0.017)	(0.016)	(0.017)	(0.011)	(0.011)	(0.012)
F-statistic: First-stage	54.93	60.71	54.15	74.11	77.21	67.37
Observations	1,487	1,487	1,487	1,737	1,737	1,737

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI. Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability and the number of children under age 15.

Table 3.9 presents the results of the empirical analysis regarding the impact of BMI on individuals' hourly wage and their probability to be in social interactive occupations. The presented results include only the Instrumental Variable estimations and the sample of the analysis does not include occupations with level two fitness requirements. Therefore, in the sample where a fitness requirement is not an objective obstacle for obese individuals to hold a job position, a finding that obese individuals are disadvantaged with regards to their probability to be in a social interactive occupation would be understood as a potential exclusion of individuals with a higher BMI from certain job positions probably due to social norms and believes and not due to lower expectations regarding their productivity.

Based on the results of the empirical analysis showcased on Table 3.9, I find that an increasing BMI does not have a causal effect on the hourly wage of men. On the hand in the case of women it is important to highlight that an increase of BMI by one unit decreases the hourly wage of women by around 3%. Furthermore, with regards to the impact of an increasing BMI on the probability of individuals to be in a social interactive occupation the results indicate that it affects negatively both men and women. Hence, when I account for the endogeneity issue that arises from omitted variable bias as there may be determinants that impact both individuals' BMI and their probability to hold a job position that involves social interaction, I find that the impact of an increasing BMI on the probability of men to be in a social interactive occupation is negative but it is not statistically important. For the case of women the output of the empirical analysis provides coefficients that are negative and statistically different from zero. More specifically, an increase of BMI by one unit decreases the probability of women to be in a social interactive occupation by around 2%.

TABLE 3.9: The impact of BMI on hourly wage and the probability to be in a social interactive (Occupations with fitness of level II are excluded) - IV output

	Men			**Women**		
Hourly wage	(1)	(2)	(3)	(1)	(2)	(3)
Impact of BMI	-0.0335	0.00138	0.0359	-0.0277**	-0.0287**	-0.0244*
	(0.0305)	(0.0253)	(0.0291)	(0.0130)	(0.0120)	(0.0127)
F-statistic: First-stage	26.53	31.98	25.09	72.39	75.93	63.44
Observations	1,004	1,004	1,004	1,550	1,550	1,550
Social Interactive occupation						
Impact of BMI	-0.0148	-0.0147	-0.0137	-0.0220**	-0.0196*	-0.0209*
	(0.0202)	(0.0186)	(0.0207)	(0.0104)	(0.0103)	(0.0114)
F-statistic: First-stage	36.57	43.35	36.40	73.81	76.57	66.04
Observations	1,163	1,163	1,163	1,694	1,694	1,694

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI, Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability. In case social interactive occupation the third model includes the control for the number of children under age 15. In case of hourly wage the third model includes the additional controls for occupation and sector.

3.5.2 The effect of being on a social interactive occupation on the wage gap of obese and non obese individuals - Oaxaca Decomposition analysis

In this section, I present and analyse the results of the empirical analysis regarding the explanatory power of the information of whether an individuals is in a social interactive occupation on the hourly wage gap of obese and non-obese individuals. More specifically, this part of the empirical analysis is motivated by the descriptive statistics which provide supportive evidence that obese individuals, both men and women, are less likely to hold a job position that involves social interaction (Table 3.4 and Table 3.6), their hourly wage is lower than the hourly wage of non-obese individuals (Table 2.2 and 3.6, and that the average hourly wage in social interactive occupations is higher than the hourly wage among occupations that do not involve social interaction (Table 3.5 and Table 3.7). Additionally, the empirical analysis and the findings in the Section 3.5.1 where it is shown that an increasing BMI has a negative and statistically significant impact on the hourly wage of women and their probability to be in a social interactive occupation enhances the motivation to explore the explanatory power of being in a social interactive occupation on the wage gap of obese and non-obese especially for the sample of women.

Tables 3.10 and 3.11 present the results regarding the Oaxaca decomposition analysis regarding the factors that explain the wage gap between obese and non obese individuals. More specifically, I provide evidence regarding the explanatory power of being in a social interactive occupation on the wage differences observed between obese and non-obese working age individuals. More specifically, in Table 3.10 I provide the overall decomposition output for the sample of men and women

separately. Therefore the first part of the tables (four first rows) present the mean predictions for obese and non-obese groups and their difference in their log-hourly wage. More specifically, for the case of men I observe that the mean of log-hourly wage is 2.606 and 2.541 for non-obese and obese individuals respectively. Hence, their wage gap is 0.0647. Also, the "endowments" indicate the mean increase of the wage of obese individuals in case they had the same characteristics as the non-obese individuals. Thus, the increase of 0.0427 indicates that differences in observed characteristics among the two groups account for around 66% of their wage gap. The term "coefficients" indicates the change of the wage of obese men when we apply the coefficient of non-obese individuals to the characteristics of obese individuals. Moreover, the term "interaction" accounts for the simultaneous effect of differences in "endowments" and "coefficients". Similarly, in the sample of women it is important to highlight that the mean of log-hourly wage of obese individuals is 2.282 and for the non-obese women it is equal to 2.378 which leads to a wage gap equal to 0.0961. Additionally, it is important to highlight that, for the case of women, the differences of the two groups based on their observed characteristics can explain more than 96% of the wage gap of obese and non-obese individuals.

Table 3.10: Oaxaca Decomposition analysis' results - Overall (Prime working age individuals)

	Men	**Women**
VARIABLES	Overall	Overall
Non- obese	2.606***	2.378***
	(0.0214)	(0.0147)
Obese	2.541***	2.282***
	(0.0268)	(0.0261)
difference	0.0647*	0.0961***
	(0.0343)	(0.0299)
endowments	0.0427**	0.0926***
	(0.0201)	(0.0235)
coefficients	0.0118	0.0378
	(0.0333)	(0.0276)
interaction	0.0103	-0.0343*
	(0.0197)	(0.0198)
Observations	1,241	1,585

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

Furthermore, since the aim of my study is to provide evidence regarding the explanatory power of the information whether an individual holds a job position that involves social interaction, I present the impact and the explanatory power of all the

determinants that I include in my analysis. More specifically, I showcase the results with the detailed output of the analysis for the term "endowments" for bot men and women in Table 3.11. It is important to highlight, based on the output of the analysis, the explanatory power of being or not in a social interactive occupation on the wage gap of obese and non-obese individuals is zero as for both men and women the coefficients are very small and they are are not statistically different from zero. With regards to the explanatory power of other determinants included in my analysis I observe that education is a common factor for both the samples of men and women. In the sample of men I find that health has an important explanatory power of the wage gap of obese and non-obese individuals as well.

Additionally, in Tables B.14 and B.15 (Appendix B.3) I present the results of the empirical analysis regarding the effect of holding a social interactive occupation on the wage gap of obese and non-obese individuals for the sample that occupations with level two of fitness requirement are excluded for both men and women. The decomposition output is in line with the results presented and discussed earlier in this section. Therefore, for the sample of men I observe that the wage gap of obese and non-obese individuals is equal to 0.1 (difference of log-hourly wage of the two groups). Also, the differences on the observed characteristics (included in my study) account for more than 57% of the wage gap among obese and non-obese men. Furthermore, for the case of women, I find that the wage gap of obese and non-obese corresponds to 0.0956 which is mainly explained due to differences in observed characteristics of the two groups (almost 98%). Most importantly, as it is shown in Table B.15, I do not identify any explanatory power of the information of whether individuals hold a job position that involves social interaction on the wage gap of obese and non-obese men and women. Finally, I confirm that the differences of the two groups with regards to their likelihood to have or not a university degree has an important explanatory power with regards to their wage gap for both men and women. Also, I confirm that health has an important explanatory power on the wage gap of obese and non-obese individuals for the case of men.

TABLE 3.11: Oaxaca Decomposition analysis' results - Endowments (Prime working age individuals)

	Men	**Women**
VARIABLES	Endowments	Endowments
Social Interactive Occupation	0.00201	-0.000105
	(0.00275)	(0.00126)
Age group: 35 - 44	-0.00345	-0.00783
	(0.00580)	(0.00546)
Age group: 45 - 54	-0.0111	-0.00967
	(0.00760)	(0.00720)
Marital status: Single	-0.00412	0.000996
	(0.00440)	(0.00563)
Education: University degree or equivalent	0.0243**	0.0535***
	(0.00954)	(0.0142)
North East	3.74e-06	0.000655
	(0.000569)	(0.00189)
North West	-0.00263	-0.000578
	(0.00341)	(0.00154)
Yorkshire and the Humber	-0.000136	0.00194
	(0.00352)	(0.00252)
East Midlands	0.000398	0.00374
	(0.00307)	(0.00352)
West Midlands	0.000323	-0.000565
	(0.00312)	(0.00136)
East of England	0.00337	-0.000899
	(0.00397)	(0.00320)
London	0.00782	0.000770
	(0.00713)	(0.00373)
South East	0.00146	0.00875
	(0.00260)	(0.00634)
South West	0.000568	-3.30e-05
	(0.00154)	(0.000840)
Wales	7.16e-05	0.00157
	(0.000839)	(0.00220)
Excellent	0.0441**	0.0322
	(0.0208)	(0.0317)
Very good	0.0241	0.00325
	(0.0153)	(0.00898)
Good	-0.0214	-0.00941
	(0.0140)	(0.0241)
Fair	-0.0263	0.0109
	(0.0167)	(0.0158)
Long-standing illness	0.00172	0.00119
	(0.00412)	(0.00463)
Private Sector	0.0117	0.00212
	(0.0173)	(0.00277)
Public Sector	-0.0101	
	(0.0161)	
Observations	1,241	1,585

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

Furthermore, it is important to highlight the insights that we gain from the findings of my analysis with regards to the explanatory power of being or not in a certain category of job occupations (social interactive jobs) on the differences of the hourly wage among obese and non-obese individuals. More specifically, my motivation to explore whether differences on the hourly wage of obese and non-obese individuals can be explained due to their lower probability to be in job positions with higher payments was initiated by the finding on my previous chapter (Chapter 2). Therefore, since I find in Chapter 2 that an increasing BMI does not impact the probability of men and women to be in employment but it decreases the hourly wage of women, I aimed to provide more evidence with regards to the potential channels that women are disadvantaged. I reason that I expect that women are more likely to be disadvantaged in the labour market, with regards to their hourly wage, due to social norms/beliefs/preferences rather than due to a potential lower productivity as such an effect of an increasing BMI had to be confirmed on the case of men as well.

In this chapter, I explore one potential direction that could improve our understanding regarding the discrimination that women with an increasing BMI may face in the labour market and it leads them to lower hourly wages. Firstly, I provide evidence whether an increasing BMI determines the probability of individuals, especially of women, to be in a job position that involves higher interaction with customers and/or with employers. The supportive evidence that women are less likely to be in such a job position, when they have a higher BMI, increased my interest to explore whether this can explain part of the differences on the hourly wage between obese and non-obese women. Additionally, the descriptive data with regards to the differences of the payments between the social interactive occupations and non-interactive occupations confirms that being excluded from social interactive occupations one is excluded from higher paid job positions. Thus, I explore how much of the wage differences among obese and non-obese could be explained by the information that they are occupied in social interactive job or not. The analysis provides evidence that this information has not any explanatory power. More specifically, I find that being or not in a social interactive occupation is not the channel that can explain the wage differences among obese and non-obese individuals for both men and women.

Taking all the above into account, my analysis provides evidence that we cannot explain the potential discrimination that women with a higher BMI experience in the labour market through the proposed channel. Therefore, my findings improve our knowledge and understanding as they provide solid evidence that being or not in a social interactive occupation is not the channel that can explain the differences on the hourly wages of obese and non-obese women. My findings does not disprove that women with an increasing BMI are discriminated in the labour market. Instead, the findings only provide evidence that a valid potential channel which could be expected to explain the wage differences of obese and non-obese women is not supported by the

output of my analysis. Hence, it is important in future research to rely on that knowledge and explore other potential channels towards providing evidence on the channels that explain the wage differences among obese and non-obese individuals.

3.5.3 Results from robustness checks

3.5.3.1 The effect of being in a social interactive occupation on the wage gap of obese and non obese individuals - Oaxaca Decomposition analysis - Different definitions of social interactive occupations

Tables 3.12 and 3.13 showcase the results of the Oaxaca decomposition analysis regarding the explanatory factors of the wage gap between the prime working age obese and non-obese individuals by working with the definition of social interactive occupations as it is proposed by Barbieri (2018). The decomposition output provides evidence that the explanatory power of the information whether an individual holds a job position that involves social interaction is zero on the wage gap of obese and non-obese individuals for both men and women. Therefore, when I identify the social interactive occupations similarly to Barbieri (2018) the findings confirm the evidence of the main analysis presented and discussed in Section 3.5.2. More specifically, when I focus on the output of the analysis on the sample of women, as this is the main sample of interest since my study have provided supportive evidence that an increasing BMI has causal and negative impact on women's probability to be employed in a social interactive occupation as well as it decreases their hourly, I find that wage gap of obese and non-obese women is equal to 0.0961 (difference of log-hourly wage of the two groups). Also, similarly to the main analysis, I observe that differences of the two groups with regards to their characteristics account for around 90% of the wage gap of obese and non-obese women. In other words the increase on the log-hourly wage of obese women would be equal to 0.0876 if they had similar characteristics to non-obese women. Based on the detailed decomposition output regarding the explanatory power of each characteristic on the wage gap of obese and non-obese women, presented in Table 3.13, knowing whether someone is in a social interactive occupation cannot explain any part of the difference of wages between obese and non-obese women. Furthermore, from the included determinants in my I analysis I find that whether an individual holds a university degree or an equivalent degree or not it has an important explanatory power on the wage gap of obese and non-obese women.

Additionally, similarly to the main analysis of my study, I conduct the Oaxaca decomposition analysis on the sample that the occupations that require level two fitness are excluded and I provide the results in the Tables B.16 and B.17 (Appendix B.3). From the overall decomposition output I observe that the results confirm the findings of the main analysis as well as the findings where I work with the total

sample (Tables 3.12 and 3.13). More specifically, it is worth noticing that the largest part of the wage gap for obese and non-obese individuals is explained mainly due to differences in characteristics among the two groups. This finding is consistent in both samples of men and women. For the case of women it is worth noticing that the increase in log-hourly wage of obese women would be 0.0911 if they had similar characteristics to non-obese women. Most importantly, the results presented in Table B.17 provide supportive evidence regarding the validity of the findings of my main analysis that the information that individual holds a social interactive job cannot explain the wage gap of obese and non-obese people. Also, the most important characteristic with large explanatory power on the wage gap of the compared groups is the information of whether an individual holds a university degree or not. Also, for the case of men another important characteristic to explain the differences in wage between obese and non-obese men is the information whether men have an excellent self reported health or not.

Table 3.12: Oaxaca Decomposition analysis' results - Overall (Prime working age individuals - Social occupations defined by Barbieri (2018))

	Men	**Women**
VARIABLES	Overall	Overall
Non-obese	2.606***	2.378***
	(0.0214)	(0.0147)
Obese	2.541***	2.282***
	(0.0268)	(0.0261)
difference	0.0647*	0.0961***
	(0.0343)	(0.0299)
endowments	0.0399*	0.0876***
	(0.0201)	(0.0241)
coefficients	0.0118	0.0412
	(0.0333)	(0.0277)
interaction	0.013	-0.0327
	(0.02)	(0.0206)
Observations	1,241	1,585

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

TABLE 3.13: Oaxaca Decomposition analysis' results - Endowments (Prime working age individuals - Social occupations defined by Barbieri (2018))

	Men	**Women**
VARIABLES	Endowments	Endowments
Social Interactive Occupation	0.00157	-0.00379
	(0.00246)	(0.00422)
Age group: 35 - 44	-0.00338	-0.00804
	(0.00569)	(0.00552)
Age group: 45 - 54	-0.0109	-0.0103
	(0.00748)	(0.00730)
Marital status: Single	-0.00397	0.00102
	(0.00426)	(0.00562)
Education: University degree or equivalent	0.0228**	0.0532***
	(0.00921)	(0.0141)
North East	-7.55e-06	0.000795
	(0.000568)	(0.00193)
North West	-0.00258	-0.000645
	(0.00336)	(0.00168)
Yorkshire and the Humber	-0.000864	0.00203
	(0.00353)	(0.00259)
East Midlands	0.000566	0.00391
	(0.00307)	(0.00358)
West Midlands	0.000216	-0.000638
	(0.00312)	(0.00148)
East of England	0.00336	-0.000939
	(0.00396)	(0.00334)
London	0.00778	0.000491
	(0.00709)	(0.00373)
South East	0.00146	0.00849
	(0.00261)	(0.00629)
South West	0.000623	-3.55e-05
	(0.00159)	(0.000904)
Wales	0.000125	0.00155
	(0.000868)	(0.00218)
Excellent	0.0413**	0.0330
	(0.0205)	(0.0317)
Very good	0.0230	0.00350
	(0.0148)	(0.00900)
Good	-0.0204	-0.00982
	(0.0135)	(0.0241)
Fair	-0.0240	0.0107
	(0.0165)	(0.0158)
Long-standing illness	0.00196	0.00114
	(0.00410)	(0.00458)
Private Sector	0.0101	0.00204
	(0.0159)	(0.00268)
Public Sector	-0.00864	
	(0.0147)	
Observations	1,241	1,585

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

Tables 3.14 and 3.15 present the results of the empirical analysis of the Oaxaca decomposition regarding the explanatory factors of the wage gap between obese and non-obese individuals from the information that individuals hold or not a job position with social interaction. In this section, I work with the definition of social interactive occupations provided by the ONET (under the USDOL/ETA). Therefore, from the overall output of the decomposition analysis I observe that the mean log-hourly wage of non-obese men is 2.606 while for the obese men it is equal to 2.541 and their wage gap is shown to be 0.0647. The increase of wages for obese men would be equal to 0.0411 if they had similar characteristics to non-obese men. Additionally, for the case of women which is the main sample of interest in my analysis, I find that the wage gap of obese women and non-obese women is equal to 0.0955 where more than 95% is explained be the differences on the characteristics of the two compared groups.

Table 3.14: Oaxaca Decomposition analysis' results - Overall (Prime working age individuals - Social occupations defined by ONET - 2019)

	Men	**Women**
VARIABLES	Overall	Overall
Non-obese	2.606***	2.378***
	(0.0214)	(0.0146)
Obese	2.541***	2.282***
	(0.0268)	(0.0261)
difference	0.0647*	0.0955***
	(0.0343)	(0.0299)
endowments	0.0411**	0.0912***
	(0.0201)	(0.0235)
coefficients	0.0118	0.0372
	(0.0333)	(0.0276)
interaction	0.0118	-0.0329*
	(0.0196)	(0.0200)
Observations	1,241	1,587

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

Furthermore, in Table 3.15 I provide the detailed decomposition output regarding the explanatory power of each characteristic included in my analysis. It is important to highlight that the main variable of interest (social interactive occupation) has not any explanatory power on the wage gap of obese and non-obese individuals. This finding is in line with the analysis conducted in the main part of this study and provides further evidence that the findings of my study are not sensitive to different definitions of social interactive occupations. Also, persistent is the finding that there is an

important explanatory power of whether individuals hold a university degree and, for the case of men, whether they report to have excellent health.

Additionally, I conduct similar analysis when I exclude occupations that have level two fitness requirements. The results of the corresponding analysis are presented in the Tables B.18 and B.19 (Appendix B.3). The overall decomposition output presented in the Table B.18 shows that, first for the sample of women which is the main sample of interest in my study, the increase of wages for obese women is 0.0927 when they have similar characteristics to non-obese women and that accounts for more than 97% of the wage gap of the compared groups. For the case of men the wage gap between the obese and non-obese men is equal to 0.1 from which almost 58% is explained due to differences on observed characteristics among the compared groups. Furthermore, from the results presented in the Table B.19 it is important to highlight that there is no explanatory power of the social interactive occupation on the wage gap of obese and non-obese individuals. Finally, I observe that differences on the level of education (holder of a university degree) account for an important part of the wage gap which is explained by the differences on characteristics of the compared groups. Also, for the sample men, there is persistent evidence that differences in health explain differences in wages for obese and non-obese individuals.

TABLE 3.15: Oaxaca Decomposition analysis' results - Endowments (Prime working age individuals - Social occupations defined by ONET - 2019)

	Men	**Women**
VARIABLES	Endowments	Endowments
Social Interactive Occupation	0.000446	-0.00110
	(0.00144)	(0.00181)
Age group: 35 - 44	-0.00341	-0.00769
	(0.00575)	(0.00542)
Age group: 45 - 54	-0.0111	-0.00970
	(0.00756)	(0.00724)
Marital status: Single	-0.00406	0.000924
	(0.00435)	(0.00567)
Education: University degree or equivalent	0.0245**	0.0527***
	(0.00967)	(0.0141)
North East	9.10e-06	0.000602
	(0.000570)	(0.00189)
North West	-0.00267	-0.000584
	(0.00345)	(0.00150)
Yorkshire and the Humber	-0.000376	0.00190
	(0.00352)	(0.00250)
East Midlands	0.000514	0.00351
	(0.00307)	(0.00346)
West Midlands	0.000303	-0.000532
	(0.00314)	(0.00132)
East of England	0.00336	-0.000842
	(0.00399)	(0.00314)
London	0.00794	0.000975
	(0.00722)	(0.00372)
South East	0.00152	0.00923
	(0.00269)	(0.00648)
South West	0.000546	-1.85e-05
	(0.00153)	(0.000700)
Wales	6.81e-05	0.00147
	(0.000839)	(0.00214)
Excellent	0.0426**	0.0298
	(0.0206)	(0.0317)
Very good	0.0236	0.00249
	(0.0151)	(0.00870)
Good	-0.0207	-0.00733
	(0.0136)	(0.0241)
Fair	-0.0255	0.0124
	(0.0166)	(0.0160)
Long-standing illness	0.00216	0.00108
	(0.00413)	(0.00453)
Private Sector	0.0113	0.00189
	(0.0169)	(0.00259)
Public Sector	-0.00994	
	(0.0160)	
Observations	1,241	1,587

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

3.5.3.2 The impact of social interactive occupations on the hourly wage of the prime working age individuals

In this section, I present and discuss the results of the empirical analysis regarding the impact of social interactive occupations on the hourly wage of the prime working age individuals. More specifically, I provide supportive evidence that the explanatory power of being in a social interactive occupation is not important to explain individuals' hourly wage. This finding provides supportive evidence that the main analysis of the Oaxaca decomposition is valid as it does not identify any explanatory power of the information regarding holding or not a social interactive occupation on the wage gap of obese and non-obese individuals. Hence, I present the results of the empirical analysis regarding the impact of social interactive occupation on the hourly wage of prime working age men on Table 3.16. Additionally, Table 3.17 showcases the results of the analysis regarding the impact of social interactive occupations on the hourly wage of the prime working age women.

Additionally, I conduct the analysis regarding the impact of social interactive occupations on individuals' hourly wage by working with the definition of the social interactive occupations provided by Barbieri (2018). I present the results of the corresponding analysis on Tables B.20 and B.21 (Appendix B.3). The results provide supportive evidence that being in a social interactive occupation does not determines the hourly wage of prime working age individuals. Thus, the results provide supportive evidence that Oaxaca decomposition analysis provides valid findings regarding the explanatory power of social interactive occupations on the wage gap of obese and non-obese individuals when the social interactive occupations are identified according to Barbieri (2018).

Furthermore, I estimate the impact of social interactive occupations on the hourly wages of both prime working age men and women by relying on the definition of social interactive occupations provided by the ONET (classification of 2019). The results are showcased on the Tables B.22 and B.23 (Appendix B.3). Based on the findings of the analysis I conclude that being in a job position that involves social interaction does not impact individuals' hourly wage. Hence, for both men and women of the prime working group social interactive occupation is not a determinant of their hourly wage when the definition of the social interactive occupations is provided by ONET and the list with the corresponding occupations is based on the classification of the year 2019. Therefore, the findings of the Oaxaca decomposition analysis are confirmed with the third definition of social interactive occupations as well.

TABLE 3.16: The impact of social interactive occupations on individuals' hourly wage - Men (Prime working age individuals)

Men	(1)	(2)	(3)	(4)
BMI	-0.00464	-0.00778	-0.00578	-0.00559
	(0.00726)	(0.00673)	(0.00674)	(0.00674)
Social Interactive Occupation	-0.0866	-0.233	-0.319	-0.309
	(0.272)	(0.250)	(0.249)	(0.250)
Social Interactive Occupation*BMI	0.00403	0.00742	0.0102	0.0104
	(0.00969)	(0.00892)	(0.00889)	(0.00890)
Age group: 35 - 44		0.0815*	0.104**	0.108**
		(0.0456)	(0.0458)	(0.0459)
Age group: 45 - 54		0.166***	0.198***	0.202***
		(0.0481)	(0.0484)	(0.0485)
Marital status: Single		-0.225***	-0.216***	-0.216***
		(0.0419)	(0.0417)	(0.0417)
Education: University degree or equivalent		0.350***	0.329***	0.336***
		(0.0366)	(0.0371)	(0.0374)
North East		-0.0766	-0.0648	-0.0625
		(0.0998)	(0.0994)	(0.0993)
North West		-0.0234	-0.0208	-0.0187
		(0.0783)	(0.0778)	(0.0778)
Yorkshire and the Humber		0.0305	0.0547	0.0545
		(0.0820)	(0.0818)	(0.0817)
East Midlands		-0.0240	-0.0201	-0.0201
		(0.0804)	(0.0798)	(0.0797)
West Midlands		0.0642	0.0568	0.0546
		(0.0855)	(0.0848)	(0.0848)
East of England		0.130	0.129	0.128
		(0.0811)	(0.0805)	(0.0804)
London		0.325***	0.329***	0.327***
		(0.0768)	(0.0764)	(0.0763)
South East		0.144**	0.131*	0.127*
		(0.0730)	(0.0725)	(0.0725)
South West		0.0503	0.0492	0.0501
		(0.0850)	(0.0846)	(0.0846)
Wales		-0.0118	0.00111	0.0114
		(0.101)	(0.101)	(0.101)
Excellent			0.404***	0.402***
			(0.153)	(0.153)
Very good			0.331**	0.328**
			(0.148)	(0.149)
Good			0.304**	0.301**
			(0.149)	(0.149)
Fair			0.234	0.231
			(0.154)	(0.154)
Long-standing illness			-0.101**	-0.0951**
			(0.0472)	(0.0473)
Private Sector				0.0634
				(0.0428)
No- Sector				-0.385
				(0.535)
Constant	2.737***	2.606***	2.239***	2.173***
	(0.204)	(0.204)	(0.252)	(0.256)
Observations	1,004	1,004	1,004	1,004
R-squared	0.001	0.179	0.197	0.199

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI and social interactive occupations, Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability. In case social interactive occupation the third model includes the control for the number of children under age 15. Model (4): Includes the additional controls for sector.

Table 3.17: The impact of social interactive occupations on individuals' hourly wage - Women (Prime working age individuals)

Women	(1)	(2)	(3)	(4)
BMI	-0.0132**	-0.00456	-0.00150	-0.00209
	(0.00595)	(0.00547)	(0.00547)	(0.00543)
Social Interactive Occupation	-0.0337	0.0241	0.0385	0.00233
	(0.186)	(0.170)	(0.169)	(0.168)
Social Interactive Occupation*BMI	0.00299	-0.000901	-0.00163	-0.00101
	(0.00669)	(0.00611)	(0.00608)	(0.00604)
Age group: 35 - 44		0.145***	0.155***	0.147***
		(0.0324)	(0.0322)	(0.0320)
Age group: 45 - 54		0.109***	0.128***	0.106***
		(0.0327)	(0.0327)	(0.0327)
Marital status: Single		-0.00214	0.00256	0.00938
		(0.0287)	(0.0285)	(0.0283)
Education: University degree or equivalent		0.412***	0.394***	0.364***
		(0.0243)	(0.0243)	(0.0248)
North East		-0.0506	-0.0379	-0.0314
		(0.0619)	(0.0613)	(0.0609)
North West		-0.0292	-0.0256	-0.0232
		(0.0519)	(0.0516)	(0.0512)
Yorkshire and the Humber		-0.0389	-0.0304	-0.0265
		(0.0547)	(0.0542)	(0.0538)
East Midlands		-0.0479	-0.0457	-0.0488
		(0.0566)	(0.0561)	(0.0557)
West Midlands		0.0176	0.0344	0.0334
		(0.0566)	(0.0562)	(0.0558)
East of England		-0.00548	0.00121	0.00311
		(0.0546)	(0.0542)	(0.0538)
London		0.104*	0.109*	0.110*
		(0.0573)	(0.0569)	(0.0565)
South East		0.0937*	0.105**	0.111**
		(0.0506)	(0.0503)	(0.0500)
South West		-0.0474	-0.0433	-0.0348
		(0.0551)	(0.0546)	(0.0543)
Wales		-0.0728	-0.0570	-0.0562
		(0.0612)	(0.0607)	(0.0602)
Excellent			0.226**	0.211**
			(0.104)	(0.103)
Very good			0.161	0.145
			(0.102)	(0.101)
Good			0.136	0.127
			(0.102)	(0.101)
Fair			-0.0569	-0.0647
			(0.106)	(0.105)
Long-standing illness			0.00799	0.00630
			(0.0300)	(0.0298)
Private Sector				-0.121***
				(0.0243)
No- Sector				-0.333
				(0.536)
Constant	2.674***	2.199***	1.960***	2.088***
	(0.166)	(0.161)	(0.190)	(0.190)
Observations	1,550	1,550	1,550	1,550
R-squared	0.012	0.191	0.211	0.224

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI and social interactive occupations, Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability. In case social interactive occupation the third model includes the control for the number of children under age 15. Model (4): Includes the additional controls for sector.

3.6 Discussion and conclusions

In this chapter, I estimate the impact of BMI on the probability of individuals to work in a social interactive occupation. Additionally, I provide evidence regarding the explanatory power of social interactive occupations on the wage gap of obese and non-obese individuals. I rely on the data of Understanding Society: Waves 2-3 Nurse Health Assessment, 2010-2012" and Understanding Society: Waves 1-10, 2009-2019 and Harmonised BHPS: Waves 1-18, 1991-2009: Special Licence Access" to conduct my analysis. Regarding the main variable of interest, I divide the occupations (UK SOC-2000) into social interactive and non-social interactive based on the level of interaction that they involve mainly with customers and employers. The group of individuals that I am studying in this analysis includes men and women of age 25-54 years old (prime working age individuals) since this is the most attached age group to the labour market.

Towards studying the impact of individuals' BMI, with regards to social interactive occupations, I solve the endogeneity issue, that arises when the impact of BMI/obesity on individuals' labour market is estimated, by working with a genetic IV of BMI (use of BMI-related polygenic score as an IV). Based on the findings of my analysis, an increase of individuals' BMI by one unit results in a decrease of the probability of individuals to be occupied in a social interactive positions by approximately 2%. The impact is statistically different from zero only for the case of women. I exclude from the sample of my analysis occupations with high fitness requirements (level 2) in order to create a sample where subjective criteria regarding certain body strength cannot determine the composition of the sample (obese, non-obese). After performing the same analysis method to this new data sample, I conclude that the new findings further support that an increasing BMI does not have an important impact on the probability of men to be in a social interactive occupation. Moreover, the probability of women to be in a social interactive occupation decreases by around 2% with an increase of their BMI by one unit.

Additionally, I provide evidence regarding the explanatory power of social interactive occupations on the wage gap of prime working age men and women. More specifically, I rely on the Oaxaca decomposition method to decompose the explained and unexplained difference of wages between obese and non-obese prime working age men and women. I find that the observed characteristics, included in my analysis, explain very high proportion of the differences between the hourly wage of obese and non-obese of both working age men and women. Regarding the explanatory power of social interactive occupations, it is shown that it is not an important factor for the wage differences between obese and non-obese individuals. Hence, for both men and women being in a social interactive occupation cannot explain any part of the wage differences between obese and non-obese in both groups. Also, I conduct the analysis

on the sample where occupations with level two fitness requirements are excluded. The findings are similar as in analysis results of the total sample. Thus, the observed characteristics included as controls in the models explain an important part of the wage differences for both men and women. Moreover, being in a social interactive occupation is not an important factor of wage differences between obese and non-obese individuals.

In order to ensure that my findings are robust, I conduct the same empirical analysis regarding the factors that explain the wage gap for obese and non-obese individuals by relying on two different definitions of social interactive occupations. More specifically, I work with the definition of social interactive occupations as provided by Barbieri (2018). Based on my analysis, the results indicate that social interactive occupation has no explanatory power regarding the wage gap of obese and non-obese individuals for both men and women. The coefficient of the control is not statistically important and the magnitude is very small. I rely on the definition of the ONET in order to identify the occupations that involve social interaction with customers, co-workers and/or with employers and I conduct a similar analysis to further investigate the explanatory power of social interactive occupations on the wage gap of obese and non-obese individuals. The results support my main analysis as well as the results based on the definition provided by Barbieri (2018). More specifically, I find that social interactive occupations do not explain the wage differences of obese and non-obese prime working age men and women.

I provide supportive evidence regarding the impact of social interactive occupations on individuals' hourly wage in order to verify the results of the Oaxaca decomposition analysis. More specifically, I estimate the log-linear models regarding the impact of observed characteristics on individuals' hourly wage for both men and women. The main part of the analysis contains the results regarding the impact of social interactive occupation on hourly wage based on the definition of the social interactive occupations that I construct. The findings suggest that social interactive occupation have not statistically important explanatory power on individuals' hourly wages for both men and women. Similarly, when I rely on the definition of Barbieri (2018) and ONET to identify the social interactive occupations, the results of the analysis support my main findings suggesting no power of this factor on the prediction of the hourly wage of the prime working age men and women. Hence, I conclude that the findings from the Oaxaca decomposition are robust as I cannot find a statistical important relationship of social interactive occupations and hourly wage for the prime working age men and women.

My study contributes in the research area with regards to the impact of individuals' BMI on their probability to hold a job position in certain occupations. More specifically, I provide for the first time, to the best of my knowledge, causal estimates (polygenic score as BMI's IV) regarding the extent that individuals' weight determines

the probability of the prime working age men and women to be in a social interactive occupation. Additionally, by classifying the occupations based on the level of fitness and the required physical activity I am able to construct a sample where only occupations with formal skills hold by individuals independently of their BMI (no high physical strength is required) are included. Hence, my analysis on this new sample provides important evidence whether individuals are disadvantaged by being excluded from certain occupations not because they do not meet the formal requirements but because their BMI is treated as a sign of lower productivity based on the existing social beliefs.

Another important contribution of my study is in the area of the channels that individuals with higher BMI are disadvantaged. More specifically, I provide important insights with regards to the explanatory power of being in a social interactive occupation on the observed differences in wages between obese and non-obese individuals. This aspect of my analysis is important to explore whether a potential discrimination of obese individuals from certain occupations impacts further their labour market outcomes and their life as they may earn less since they may be excluded from high paid jobs due to beliefs in the society that they are less productive. My findings support that the explanatory power of being in a social interactive occupation on the wage differences for obese and non-obese individuals is zero. This finding is more important for the case of women where my study has shown that an increasing BMI decreases their probability to be in a social interactive occupation. Furthermore, the interpretation of this finding should be based on the fact that the wage differences on social interactive occupations and non-social interactive occupations are not very large (based on the descriptive statistics) and at the same time the negative impact of an increasing BMI on the probability of women to be in a social interactive occupation is also small. Hence, my study contributes by providing evidence that the negative impact of an increasing BMI on the probability of women to be in a social interactive occupation, even when certain fitness requirements are not an obstacle for the potential employees, does not lead to lower wages and does not lead to further disadvantaging of obese women in the labour market.

Chapter 4

The impact of austerity on individuals' mental health in the UK

Acknowledgment: *This chapter is a jointly work with Professor Corrado Giulietti (University of Southampton, UK) and Professor Michael Vlassopoulos (University of Southampton, UK). The initial idea and an early-stage approach of the study design was introduced by Professor Corrado Giulietti and Professor Michael Vlassopoulos. The model of the study, the literature review, the data access, and the data analysis/empirical analysis is conducted by me (Alexandra Nazerai). Moreover, during the project I have received important feedback related to the output of the analysis and the challenges that I encountered. Also, the identification of new directions of the study at different stages is a jointly work. The chapter is written by me (Alexandra Nazerai).*

4.1 Introduction

The United Kingdom (UK) government introduced a number of austerity measures from 2010 to 2015 in order to reduce the budget deficit relative to its national income Innes and Tetlow (2015) and Barr et al. (2015). One of the major reforms introduced was the Welfare Reform Act in 2012. The welfare reforms led to a number of cuts on social benefits for working age individual which impacted a large part of the society. For example, the abolishment of the Council Tax Benefit (CTB) impacted approximately 2.45 million households. An even larger financial loss was found to affect the recipients of the Employment and Support Allowance or incapacity benefit and the recipients of the Disability Living Allowance (DLA) where it is expected that the same individuals would be impacted from the reforms related to both benefits Beatty and Fothergill (2013). Also, the introduction of the Bedroom Tax (BT) imposed a reduction of the Housing Benefit (HB), for individuals who rent house from the social housing sector, by 14% for those found to have one spare bedroom and by 25%

for those with two or more under-occupied bedrooms, according to government's definition. Thus, it is important to evaluate the impact of the welfare reforms on individuals' mental health for the case of the UK which lead to important reductions on the unearned income of individuals for low income groups of the society. An in-depth understanding of the impact of austerity on mental health and well-being will provide important insights regarding the consequences of these policies to the most vulnerable groups of the society.

Studies suggest that the economic environment, and negative economic or financial shocks deteriorate the mental health and well-being of people through the reduction of labour earned income (Murphy and Athanasou (1999), Riumallo-Herl et al. (2014), Drydakis (2015), and Economou et al. (2016)), and wealth (Schwandt (2018), Engelberg and Parsons (2016), and McInerney et al. (2013)). Additionally, economic crisis and welfare reforms, which lead to a decrease on the unearned income (e.g. social benefits) and reduction on public funding, are shown to have deterministic impact on physical health, mental health and well-being of the population (Arcà et al. (2020), Stuckler et al. (2017), Barr et al. (2016a), Barr et al. (2016a), and Wickham et al. (2020)). The existing literature highlights the importance to study the impact of the welfare reforms on the individuals' mental health and well-being. This is important for many societal groups in the UK and seems especially interesting for the more vulnerable parts of the society.

Hence, in this study, I estimate the causal effect of austerity on individuals' mental health. This is the first study, to the best of my knowledge, to provide evidence regarding the impact of financial loses, due to the implementation of the Welfare Reform Act in 2012, on the mental health of the affected individuals. I work with the data of the UK representative longitudinal household study "Understanding Society" which provides rich information regarding the source of the unearned income of individuals/households and variables regrading individuals' mental health status. I provide evidence regarding the impact of the abolishment of the CTB, the introduction of the BT and the replacement of the DLA by the Personal Independence Payments (PIP) on individuals' mental health. I find a negative but not statistically important effect on the mental health of the impacted individuals due to the implementation of the welfare reforms.

For the estimation of the causal effect of austerity on individuals' mental health, I work with the reversed General Health Questionnaire (GHQ) (GHQ-12 item) index which is provided on the data of Understanding Society. Additionally, since the introduction of the welfare reforms was exogenous to the individuals, I apply the Difference in Differences (DiD) methodology to conduct my analysis. In order to apply the DiD, I rely on the assumption of parallel trends of the treatment group and the control group with regards to the outcome of interest. I conduct the empirical analysis by estimating pooled DiD models and include multiple fixed effects.

In addition to the main empirical analysis, I estimate the dynamic impact of austerity on individuals' mental health. More specifically, I conduct panel event study analysis where I confirm that the assumption of parallel trends among the treatment groups and the corresponding control groups before the implementation of the reforms are similar. Therefore, I provide supportive evidence regarding the robustness of the findings of my main analysis. Additionally, the dynamic analysis of the impact of the implemented welfare reforms provides further evidence regarding the way that individuals are impacted over time after they experience the above austerity measures.

Furthermore, to provide additional supportive evidence regarding the validity of the findings of my main analysis, I conduct a placebo falsification test. This is a common strategy when researchers apply the DiD method in their studies and I aim to provide evidence that the estimations of the analysis have a causal interpretation. Therefore, I limit my sample to the data observed before the implementation of the welfare reforms (2009Q1 - 2013Q1) and I conduct a DiD analysis by setting a false treatment time in the middle of the new sample (2011Q1). The output of the analysis suggest no statistically important impact of the welfare reforms on the mental health of individuals. Thus, I provide additional evidence that the findings of my main analysis are solid and that there is not a threat on the parallel trend hypothesis, thus the treatment groups and the corresponding control groups are comparable.

Moreover, I explore the heterogeneity impact of the welfare reforms for groups with different characteristics that may differ in their mental health as well. Therefore, I provide evidence whether the implementation of the above austerity measures impact differently people with different characteristics and whether such differences are masked in the main analysis of my study. Hence, I conduct the analysis for men and women separately. Also, I split the sample in two smaller samples to include younger working age individuals (16-43 years old) in the first and the older working age individuals (44 - 64 years old) in the second. Additionally, I conduct the empirical analysis separately for the sample of individuals who live in less deprived areas and the sample of individuals who live in more deprived areas. The heterogeneity analysis provides evidence that, in general, there are no heterogeneous effects of the implemented austerity measures in individuals' mental health as the results are in line with the findings of the main analysis.

The structure of the paper is organised as follows: In Section 4.1, I presented and discussed the motivation, aims and objectives of this study. In Section 4.2, I present and analyse the findings provided on existing work in the literature of the research area. In Section 4.3, I present the data sets and the variables that I use to conduct my analysis and I showcase and analyse the descriptive statics regarding the samples included in my study. In Section 4.4, I present the econometric methods that I use to conduct my empirical analysis. Additionally, I describe the robustness checks that I include in my study to support the findings of the main analysis. In Section 4.5, I

exhibit and discuss the results of the empirical analysis. Finally, in Section 4.7, I present the discussion and conclusions based on the findings of my analysis.

4.2 Literature Review

Studies suggest that labour market outcomes affect the mental health and well-being of individuals. More specifically, in their report Cooper and Stewart (2015), the authors summarize the findings of the studies regarding the causal effect of income on individuals' outcomes. The authors conclude that based on the findings of studies which rely on different methodologies, higher income improves individuals' well-being and mental health outcomes. Although, there are studies which suggest that an increase on individuals' income may not lead to an improvement of his/her well-being or mental health status but this is observed for groups with higher income where the effect is found to be the effect of the relative income. Thus, although the income of individuals may increase, if their expectations regarding their income are not met or if the income of comparable groups have increased more (i.e. peers with same level of education, live in same/similar neighborhood etc.), it will not be followed by an improvement of their well-being or mental health status. One of the main finding agreed upon multiple scientific papers and presented on the review paper Cooper and Stewart (2015), which is regarding the impact of income on individuals' well-being and mental health, is that an increase on labour earned income or unearned income (lottery, social benefits) has a positive effect on the outcomes of interest for low income groups.

Additionally, the impact of unemployment on individuals' well-being and mental health has been investigated by many researchers. Thus, in their review study, Murphy and Athanasou (1999) examine the findings of multiple research papers regarding the impact of unemployment on individuals' mental health when the outcome is measured by standardised psychological tests (General Health Questionnaire, and Hopkins Symptom Checklist). The authors present two groups of studies. The first group includes the findings from studies that estimate the causal effect of moving from unemployment to employment while the second group provides estimates regarding the way that individuals' mental health is affected if employed people become unemployed. Although the authors highlight the concern regarding the selection bias when studies compare outcomes of individuals in employment and individuals in unemployment (i.e. more fit individuals may find themselves in employment more easily that less fit individuals), the findings of the majority of the studies, as reviewed by Murphy and Athanasou (1999), suggest that losing employment worsen individuals' mental health and gaining employment have a positive impact on their well-being and mental health. The positive impact on mental health, as caused by gaining employment, is found to be higher than the negative

impact of losing employment on the same outcome. Finally, the authors analyse the findings of studies that provide evidence regarding the role of the labour market conditions in the area that individuals live to the impact of unemployment on individuals' mental health. These findings suggest that whether an individual lives in a labour market with high/low unemployment rate it determines how the flow from employment to unemployment impacts his/her mental health. If individuals live in areas with low unemployment rate, then losing their job position lead to less severe impact on their mental health compared to the case when they lose their job position in a situation where the unemployment rate in labour market is high.

Furthermore, more recent studies provide evidence (based on data sets of different countries) that, due to the economic crisis of 2008, unemployment is one of the most important factors that increases more the risk of mental health conditions (Stuckler et al. (2017), Economou et al. (2016), Drydakis (2015), and Riumallo-Herl et al. (2014)). According to Curtis et al. (2019), labour market's conditions affect not only the health outcomes, mental health, and well-being of directly impacted individuals but they may determine the same outcomes for others who share the same neighbourhood/area of residence. The authors report that individuals who live in districts where the unemployment rate is high have worse mental health outcomes. Additionally, individuals who live in areas that labour market conditions changed and unemployment rate increased (due to the recent global economic crisis in 2008), their mental health deteriorated even if they were not directly impacted.

Additionally, in their study, Riumallo-Herl et al. (2014) estimate the impact of being unemployed due to an economic crisis for elder individuals. The authors work with data from European countries and United States of America (USA) to estimate the impact of unemployment due to the recent economic crisis of 2008 on mental health for older workers as they experienced a high increase on unemployment rate. Hence, the study's findings suggest that a flow to unemployment deteriorates older workers' mental health both in Europe and in USA. It is important to highlight that the authors provide evidence regarding the way that transition to unemployment impacts individuals based on their wealth. More specifically, the findings suggest that, for the case of the US, older workers with higher wealth experience less negative impact on their mental health compare to individuals who have less wealth before they lose their job position. This is not the case for the European countries where more generous unemployment schemes and social benefit programs are available to vulnerable parts of the society. Thus, the main finding of this study contributes on the importance of policies related to social schemes which aim to support members of the society to mitigate the impact of unemployment/lose of labour earned income.

Also, in their study, Economou et al. (2016) estimate the impact of the recent economic crisis of 2008 on the prevalence of major depression by relying on the Structural Clinical Interview (SCID) and suicide thoughts and attempts in Greece. According to

the authors' findings, the prolonged economic recession in the country deteriorated populations' mental health by increasing the proportion of individuals identified to suffer from major depression and increased the rates of individuals reporting suicidal thoughts or attempts. The main risk factors for the reported negative impact on mental health are identified to be unemployment where there is found a heterogeneity of the impact based on individuals' gender (i.e. women are more impacted than men) and whether individuals live in rural areas or not. Also, it is important to highlight the authors' conclusion regarding the necessity of implementing social policies to protect the vulnerable parts of the society to alleviate the consequences of an economic downturn.

Additionally, in the study of Drydakis (2015), the author estimates the impact of unemployment on individuals' health and mental health before and after the recent economic crisis of 2007 for the case of Greece. The author verifies the findings from the existing literature that unemployment have a negative effect on individuals' health and mental health. Additionally, the study provides supportive evidence regarding the suggestion of the existing literature that unemployment impacts further the individuals' mental health when the rate of unemployment in labour market is high. Thus, based on the paper's findings, individuals' mental health declines during the years of economic crisis, due to unemployment. Also, women are identified to have poorer mental health due to unemployment than men.

Furthermore, evidence suggest that shocks on individuals' wealth impact their physical and mental health. More specifically, in the study of Schwandt (2018), the author provides evidence regarding the impact of fluctuations on retired individuals' wealth in the USA. The author predicts wealth's fluctuation by examining the fluctuations in stock market combined with the level of individuals' stock holdings and finds that a negative shock worsen individuals' physical health, mental health, and their probability to be alive two years after the event. Also, McInerney et al. (2013) provide evidence that a decrease on older individuals' wealth in the USA, due the the financial crisis of 2008, have a negative effect on their mental health outcomes as measured by self reported measures. Additionally, in a similar direction, Engelberg and Parsons (2016) provide evidence that fluctuations in stock market may have an immediate effect for the investors' well-being and mental health conditions by increasing their hospitalisation. More specifically, the authors find that a decrease in stock prices worsen individuals' physical health while the impact is higher with a more immediate response on their mental health and well-being outcomes.

Additionally, Ratcliffe and Taylor (2015) use data from the UK and provide supportive evidence that individuals' mental health is impacted by fluctuations on stock market due to a corresponding fluctuation on wealth for the investors and due to the interpretation of the event as a signal regarding the performance of the economy for the non-investors. Also, Frijters et al. (2015) find that better performance of stock

market improves the level of satisfaction and mental health for young men depending on the level of exposure to the financial market. Furthermore, Deaton (2012) finds that the crash of the financial market in 2008 and the fluctuations which followed on the marked affected individuals' well-being not only through the wealth channel (investors) but because they were interpreted as signals of economic perspectives (non-investors). Findings on a different direction are provided by CHRISTOPHER J. RUHM (2000) who suggest that economic recessions improve individuals' physical health in short run although continued economic growth improves health in long run while unemployment increases suicides.

It is important to discuss the findings of the existing literature regarding the impact of unearned income loss from social benefits which aim to support vulnerable groups of our society. Thus, after the economic crisis of 2008, many European countries implemented austerity policies to balance the budget deficit of their national income. In their study, Arcà et al. (2020) estimate the impact of cuts on health care funding in selected regions of south Italy after the implementation of the scheme Piano di Rientro (PdR). The authors find that, contrary to the suggestion that cuts on health care funding in rich countries impact only the quality of life, reductions in health care expenditures increase mortality as the number of avoidable deaths increases. Additionally, Stuckler et al. (2017) provide evidence that austerity measures across the European countries worsen the health outcomes of people and contributed to causing negative mental health outcomes in addition to the impact of economic crisis. Thus, although economies may recovered from the economic crisis of 2008, austerity measures is shown to lead to continuous poor mental health outcomes.

Turning the attention to the literature related to the impact of the welfare reforms introduced in the UK after the economic crisis of 2008 with Welfare Reform Act 2012, I identify an increasing interest regarding a range of outcomes for the society. More specifically, Fetzer (2019) finds that austerity had a causal effect on political preferences leading to an increase of the support for the UK Independence Party and support for "Leave" vote on the EU referendum in 2016. Additionally, Giulietti and McConnell (2020) study the impact of the welfare reforms on crime and find that it led the more disadvantaged districts to suffer from higher rates of crime and higher crime concentration.

There is evidence, based on data from England, that austerity measures introduced in the UK led to prolonged negative impact on mental health outcomes (as shown by Barr et al. (2016a)), at the local authority level, following the deterioration of mental health caused by the consequences of the current economic crisis of 2008 (as highlighted by Barr et al. (2015)). More specifically, the welfare reforms introduced in the UK after the economic crisis of 2008 lead to income/benefit loses for certain parts of the society. Thus, in their study, Barr et al. (2016a) estimate the impact of the replacement of the incapacity social benefit by the Employment and Support Allowance (ESA) where the

transition was accompanied by the evaluation of fit for Work Capability Assessment. This reform lead a number of individuals from inactivity to labour market where it is found that people who lost their disability benefit found themselves on unemployment and their probability to be employed did not increase (as shown by Barr et al. (2016b)). Hence, after the implementation of the reform, Barr et al. (2016a) find that reassessment of recipients of the old benefit is associated with higher suicide rate and antidepressant prescriptions with the most deprived areas being impacted more. Additionally, Friebel et al. (2022) provide evidence that UK's government budget reductions on the local authorities worsen the opioid abuse of the population of the country as vulnerable individuals (exposed to the increase of unemployment due to the economic crisis) saw a decline on the government's support.

In their study Brewer et al. (2022), explore the difference of the impact of entering unemployment when the Universal Credit (UC) benefit system is implemented compared to the impact of entering unemployment under the previews system where separate benefits where provided for different needs (that includes the six benefits replaced by the UC) on individuals' mental health. The authors rely on the data set of the UK Household Longitudinal Study (UKHLS) to conduct their analysis. Also, Brewer et al. (2022) rely on the exogenous roll-out of the UC across regions to estimate panel data models where they include time, region, and individuals' fixed effects. Furthermore, the authors explore the channels through which the new benefit system (i.e. UC) may impact the mental health of unemployed differently than the predecessor system. More specifically, the authors explain that they expect the UC system may impact differently (positively or negatively) the mental health of unemployed individuals due to the fact that it simplified the administrative process (six benefits can be claimed with one application), it impacted the social benefit income received, impacted households' income, led to problems with payments of bills, impacted the satisfaction with leisure time as its aim was to increase the job searching activity, and led to exiting the benefit system due to difficulties of submitting successfully the application (IT issues) or not meeting the new criteria (time of job searching and less than a certain amount of savings). Based on their analysis, the authors find that the UC differs on the impact of unemployed individuals' mental health based on their households' composition. More specifically, lone parents' mental health is 13.9% of a standard deviation lower if they enter unemployment under UC. Also, less is the effect of the UC to mitigate the negative impact of unemployment for single adults who experience lower mental health by 8.4% of standard deviation. Finally, for the households with further support, as it is the spouse's income, UC either had no different effect on individuals' mental health or it was found to be a better system on mitigating the negative impact of unemployment. Thus, for couples without children there is not a different effect on mental health when individuals enter unemployment under UC while for couples with children their mental health is improved when they enter unemployment under the new benefit system compared to its predecessor.

Furthermore, in their study, Wickham et al. (2020) estimate the causal effect of Universal Credit (UC) on mental health and they find that it increases the psychological distress by 6.57% for the case of unemployed individuals. The authors rely on the gradually implementation of the first phase of the UC ("Live Service") in Great Britain (GB) (i.e. from April 2013 to Spring 2016) and use the data set provided by Understanding Society (UK Longitudinal Study). Additionally, the authors use the time that the UC was introduced in each Local Authority District (LAD) which is identified based on the time that claims (≥ 1) for UC are registered per LAD. Furthermore, evidence in the same direction regarding the impact of the UC on the mental health of its claimants is provided by the quality study by Cheetham et al. (2019). According to the authors the claimants of the benefit find the experience with the new system to be inconvenient and not well organised making the process complicated and causing delays on payments. The authors report that the new system has impacted negatively the physical and mental health of vulnerable people of society in some of the most deprived areas of England.

In this study, I contribute on the existing literature as it is the first time, to the best of my knowledge, to provide evidence regarding the impact of austerity measures in the UK on individuals' mental health. Thus, my study adds on the literature regarding the impact of a reduction on income, in that case unearned income, on mental health and well-being at an individual level. Also, I contribute on the literature regarding the impact of welfare reforms on the mental health of vulnerable groups of the society. Furthermore, I provide evidence regarding the impact of a number of welfare reforms (CTB, BT, and DLA/PIP) which impacted a high proportion of the population in the Great Britain (GB).

4.3 Data

To conduct my empirical analysis, I rely on the data set provided by the nationally representative longitudinal household study "Understanding Society: Waves 1-10, 2009-2019 and Harmonised BHPS: Waves 1-18, 1991-2009". More specifically, I work with the first seven waves of Understanding Society (US) for the time period 2009-2015 to conduct my analysis. I do not include observations after 2015 since the Universal Credit (UC) was introduced in most areas from that year onward and it replaced the following six means-tested benefits for working-age households: Jobseeker's Allowance, Income Support, Housing Benefit, Employment and Support Allowance, Working Tax Credit and Child Tax Credit. Additionally, I conduct the analysis for Great Britain (GB) since in Northern Ireland the welfare reforms were implemented in different time such as the BT that was implemented on 20 February 2017 (after the implementation of the UC and beyond the time period of my study) and also the scheme of the CTB was different between these two cases. Furthermore, I limit my

sample to working age individuals as the welfare reforms introduced with Welfare Reform Act in 2012 were impacting almost exclusively this group of people. Moreover, I limit the sample only to individuals who report to receive social benefits. More specifically, I identify the social benefit recipients as those individuals who report to receive one of the provided social benefits Severe Disablement Allowance, Industrial Injury Disablement Allowance, Disability Living Allowance, Attendance Allowance, Carer's Allowance (formerly Invalid Care Allowance), War Disablement Pension, Incapacity Benefit, Income Support, Job Seeker's Allowance, National Insurance Credits, Child Benefit (including Lone-Parent Child Benefit payments), Child Tax Credit, Working Tax Credit (includes Disabled Person's Tax Credit), Maternity Allowance, Housing Benefit, Council Tax Benefit, Educational Grant (not Student Loan or Tuition Fee Loan), Rent Rebate, Employment and Support Allowance, Return to Work Credit, Sickness and Accident Insurance, In-Work Credit for Lone Parents, Other Disability Related Benefit or Payment, Any other state benefit, Universal Credit, Personal Independence Payments.

This data set provides a number of advantages towards conducting my analysis. Firstly, individuals are surveyed every year enabling me to create a panel data where I can follow the same persons across time. Thus, I will be able to apply panel data methods (e.g. fixed effects). Furthermore, the data set contains the module "Unearned Income and State Benefits module". This module provides the information regarding the social benefits that individuals receive across time. Finally, the adult individuals provide the information regarding their mental health outcomes.

More specifically, the main outcome in my analysis is the GHQ which is available on file "indresp" of the data set. The self-reported GHQ with 12 items is preferred compared to information related to diagnosed mental health condition (for convenience, Appendix C.1 provides the questions included in GHQ). This is considered more appropriate measure due to potential underestimation of the effects (treatments) since some mental health problems are not reported and diagnosed. In my analysis, I work with the reversed scale of the GHQ in order to provide estimates which will be interpreted in line with the existing literature (i.e the higher the reversed GHQ the better the mental health of individuals). Thus, I limit the sample of my analysis to those individuals who report the GHQ.

Additionally, I will work similarly to Fetzer (2019) and I will estimate the impact of austerity as the impact of the three welfare reforms (CTB, DLA, and Bedroom Tax (BT)) since they affect a high proportion of individuals and the affected groups can be identified on my data. The file "income" of Understanding Society (US) contains the module "Unearned Income and State Benefits module" where information regarding the source and the amount of the social benefit income is collected. More specifically, the participants report the source of the social benefit income, the amount of money that they receive per source as well as the time that the reported payment covers. The

information regarding the personal income from social benefits is provided on file "income" of US. Thus, the variable **"ficode: Income receipt code"** provides the codes regarding the source of the income (social benefit) that individuals receive. For example, the benefits of interest CTB, HB, and DLA/PIP corresponds to the "ficode" codes 23, 22, 10/41, respectively. Additionally, the variable **"frmnth_dv: computed monthly income received from source"** and the variable **"frmnthimp_dv: Total income from source, including imputed"** provide the information regarding individuals' income per corresponding source reported on the variable "ficode". Based on the information provided on the "6614 waves1_to_10_user_guide" of US, the variables "frmnth_dv" and "frmnthimp_dv" report the total amount of money that an individual receives per unearned income source. For example, an individual may receive multiple pensions from a previous employer, thus multiple entries of the same individual to report the different payments from the same source will appear as different entries on the variable "frval". The variables "frmnth_dv" and "frmnthimp_dv" report in one entry the total sum of all the receipts from the same source and for the other entries that the same source is reported (on the variable "frval") a value of zero corresponds to these income variables. For the case of the benefits of interest (CTB, HB, DLA/PIP), there are no multiple receipts for an individual from the same social benefit source on the same time period (wave).

In the study Fetzer (2019), the author identifies the recipients of the DLA based on the information of the variables "bendis" and "pbnft3". More specifically, in the case of the DLA/PIP, the variable "bendis: Income: Disability benefits" asks participants to answer the question "Are you currently receiving any of these payments ,either just yourself or jointly if hhsize > 1 and (livesp = 1 or livewith = 1) ?". The option five (bendis5) corresponds to the DLA and the answer twelve (bendis12) to the PIP. More specifically, the variable "bendis5: Disability Living Allowance" is available for all the waves of US and the variable "bendis12: Personal Independence Payments" is available from wave 3 onward of US as PIP replaced DLA after the year 2013. Additionally, for the case of proxy interviews, the corresponding information regarding the DLA for all the waves of US is provided on the variable "pbnft3: Disability Living Allowance". Additionally, Fetzer (2019) identifies individuals who are impacted from the introduction of the BT as those who live continuously on social rented house and, according to the government's definition, have a spare room at the time of the implementation of the reform (April 2013). Finally, individuals who receive the CTB are defined to be those individuals who report to receive the corresponding social income.

Regarding the treatment group for each of the welfare reforms included in my analysis, I firstly work similarly to Fetzer (2019) and then I define the treatment groups based on information provided on the variable "ficode" presented above. Hence, according to Fetzer (2019), individuals that are impacted from the replacement of the

DLA by PIP are considered those individuals who never stop receiving one of the two benefits and are identified as those individuals who report to receive the benefit through the variable "bendis" every time that they are observed on the survey. Based on the information provided on the variable "ficode", treated by the replacement of the DLA from the PIP are those individuals who report the corresponding code (10 or 41) every time that they are observed on the survey. The requirement that the treated of the DLA/PIP should be those individuals that continue to receive the benefit after its reform relies on the assumption that those individuals should be the most affected group of the reform as even after the strongest requirements to receive the benefit they meet them.

Additionally, according to Fetzer (2019), affected by the introduction of the BT are individuals who always live in social rented house before the implementation of the reform and have a spare bedroom at the time of the implementation of the reform. Alternative definition by relying on the information provided on the variable "ficode" requires that individuals should report to receive the Housing Benefit (HB). Thus, a more conservative definition would require that individuals live always in social rented house, at least one member of the household reports to receive the HB (code of "ficode" equals to 22), and have a spare bedroom at the time of the implementation of the reform. A household is identified to have a spare bedroom based on the provided definition by government (more information can be found on the website Bedroom Tax. On the sample, the size of the household and the number of bedrooms of house are provided by the variables "hhsize" and "hsbeds", respectively. Both variables are available on the file "hhresp". Since the variable "ficode" reports the source of social income, I work with the information of the variable of "ficode" where the missing values on the corresponding social income variable are imputed ("frmnthimp").

Furthermore, the impacted individuals by the CTB are identified as those individuals who report to receive the benefit (code of "ficode" equals to 23) every time that they are observed on the survey before the abolishment of the benefit on April 2013. Additionally, similarly to Fetzer (2019), I construct a fourth treatment group which includes individuals affected by at least one of the three reforms.

Finally, I conduct the analysis on the sample of individuals that are observed at least once before and once after the implementation of the reforms. Additionally, to ensure that I do not work with a contaminated control group, I exclude from the sample individuals who report to receive any of the benefits of interest (CTB, BT, and DLA/PIP) but are not identified as treated individuals. Moreover, I exclude from the sample individuals who may have been impacted by other welfare reforms introduced with the Welfare Reform Act in 2012. More specifically, I identify and exclude individuals who report to ever receive the Incapacity Benefit and the Employment and Support Allowance. Also, I identify and exclude those who report to ever receive before 2013 the Child benefit, the Child Tax Credit, and the Working Tax Credit.

Furthermore, I excluded from my sample those few individuals who report to receive the newly introduced Universal Credit.

4.3.1 Operational roll out of the reforms Council tax benefit abolishment, Disability Living Allowance, and Bedroom tax

In this section, I provide information regarding the operational roll out of the welfare reforms of interest that are included in my analysis to estimate the impact of austerity measures on individuals' mental health.

4.3.1.1 Council tax benefit

According to the Department for Work and Pensions 1, 2, and Stuart Adam and James Browne (2012), the Council Tax Benefit (CTB) was abolished from 1 April 2013 as part of the reforms introduced by the Welfare Reform Act 2012. More specifically, the abolished benefit was to be replaced by policies designed by local authorities in England based on their needs. Additionally, the Scottish and Welsh governments were asked to design their own policies based on their criteria. The reform let the abolishment of the CTB and the reduction by 10% of the available funding for the new schemes which aimed to replace it. Although, the system of local taxation in Northern Ireland is different and did not change it was also affected by the 10% reduction in the fund provided by the UK government for this scheme.

4.3.1.2 Disability Living Allowance

The Welfare Reform Act 2012 introduced the replacement of the Disability Living Allowance (DLA) by the Personal Independence Payments (PIP) for working age individuals. The Department of Work and Pensions (DWP) started the replacement of the DLA by the PIP on April 2013. More specifically, from 8 April 2013 new claimants were registered in few areas of the North West and the North East of England. Additionally, from 10 June 2013 new claimants could claim the benefit across the Great Britain (and entirely the UK). Furthermore, individuals who were receiving the DWP were asked replace it with PIP, if they met the criteria from 28 October 2013. More information can be found in Personal Independence Payment: April 2013 to October 2020.

4.3.1.3 Bedroom tax

Individuals who live in a rented house, by any registered social landlord (e.g. local authority), and receive Housing Benefit (and later those who receive UC) were

impacted by the reduction of the benefit based on the criteria that defined a house under-occupied. The reform was introduced by the Welfare Reform Act 2012 and started to be implemented from 1 April 2013 to working age social tenants. According to Wendy Wilson (2019) the rules and the reforms related to the Housing Benefit (HB) generally apply to England, Wales and Scotland. In Scotland, the government have said that it will abolish the reform (Bedroom Tax) but until that time all impacted by the reform can be compensated by applying for a Discretionary Housing Payment. Finally, the Northern Ireland started the implementation of the measure on 20 February 2017.

4.3.2 Descriptive statistics

In this section, I present and discuss the descriptive statistics regarding the samples of the treatment groups and control groups for each welfare reform. More specifically, I present the mean, the standard deviation, and the number of observation of the sample per case of welfare reform for individuals that are observed on the data at least once before and once after the implementation of the reforms. Furthermore, on Table 4.1 I present the above descriptive statistics of the total sample and on Appendix C.2.1, Table C.1 I present the same statistical analysis where I apply the survey's cross sectional weights.

Based on the information showcased on Table 4.1, individuals who report to receive the CTB every time that they are interviewed on the survey correspond to almost almost 40% of the total sample (the corresponding standard deviation is 0.49). This is the highest proportion of treated individuals for the welfare reforms that I include in my analysis and it is in line with the fact that the claimants of the CTB are more than the claimants of any of the other benefits. Thus, the impacted individuals from the abolishment of the CTB correspond to an important size group in the society and the micro-data of the study that includes only recipients of any social benefit. Additionally, when the sample is based on the definition of treated individuals according to Fetzer (2019) then the corresponding proportion of the treated individuals is equal to 40% as well. Furthermore, as it is shown on Table C.1, the corresponding proportion of treated individuals by the CTB, when I work with the survey's cross sectional weights, is 38.2% for my definition (based on the information provided by the variable "ficode") and 38.6% when I work similarly to Fetzer (2019).

Additionally, the treatment group for the DLA/PIP corresponds to almost 33% (the corresponding standard deviation is equal to 0.47) of the sample. In that case, individuals who are treated are considered to be those who report to always receive the benefit before and after its replacement. Similarly to Fetzer (2019), I identify treated individuals by the replacement of DLA by PIP to be those who always meet the requirements to receive the benefit as it is difficult to separate individuals on the data

set who do not report to receive the benefit after its replacement due to the new policy or because they themselves decide that they do not need this support. In that case, it is expected that I do not identify all the treated by the reform and that the individuals that I identify probably did not experience a financial lose but had to cope with the new procedure introduced by the replacement of DLA by PIP. Also, in Table 4.1, it is exhibited that the proportion of the treatment group when I work similarly to Fetzer (2019) corresponds to almost 23%. Quality checks on the sample show that all individuals who are considered to be treated when I work similarly to Fetzer (2019) are included on the treatment group that I construct based on the information provided on the variable "ficode" as well. Additionally, the proportion of treated individuals by the DLA/PIP, when I conduct the statistical analysis by working with the survey's cross sectional weights (C.1), is 33% (0.47 SD) for the definition of the treated individuals based on the information provided on the variable "ficde" and almost 23% when I work similarly to Fetzer (2019) towards identifying the treated individuals by the DLA/PIP.

Furthermore, regarding the BT, it is relevant to individuals/households who rent in the social housing sector. According to Fetzer (2019), the impacted individuals are identified as those who live always in social rented house and have a spare bedroom in line with the definition of government based on which the BT was introduced ((for more information, please visit the website: Removal of the spare room subsidy). Based on that definition, the treatment group corresponds to almost 39% of the sample when the control group includes everyone considered to be not treated by the reform (as shown in Table 4.1). Although, the impacted individuals by the BT are those who rent from the social housing sector, there are additional requirements for the recipients of the HB to be eligible (e.g limit of savings). Thus, I construct a different treatment group for the case of the BT. I include in the treatment group individuals who always live in social rented house, have a spare bedroom at the time of the implementation of the reform and additionally live in a household where at least one member report to receive the HB. This definition of the treatment group includes almost 36% of the total sample when everyone else belongs to the control group. Additionally, similar statistics are presented in Table C.1 where the cross sectional weights of the survey apply on the analysis. Hence, it is shown that close to 40% of the sample is treated by the introduction of the BT.

I construct a treatment group which includes individuals that are treated by at least one of the three welfare reforms of interest. Thus, in Table 4.1, it is shown that when the treated individuals are identified based on the information provided by the variable "ficode' and the control group includes everyone else the treatment group by at least one reform corresponds to 71% (the corresponding Standard deviation is equal to 0.45) of the sample. When the treated individuals are identified similarly to Fetzer (2019) and in the control group is everyone else then the corresponding proportion of the sample is equal to 65.6% (SD equals 0.48). Additionally, when the cross sectional

weights of the survey apply on the statistical analysis then the corresponding proportions are 71% and 65% respectively (C.1). It is important to highlight that the empirical analysis is conducted for the case that individuals are impacted by at least one of the welfare reforms of interest.

Moreover, I conduct the same statistical analysis for all the sub-samples based on the characteristics that I include in the heterogeneous empirical analysis of my study and I present the results on Appendix C.2.1. More specifically, I provide the sample mean, the corresponding standard deviation, and the number of observations for the sub-samples identified by individuals' sex, their age group, and level of deprivation in the area that individuals live. Table C.2 showcase the statistical analysis per individuals' sex. It is important to highlight that the results of the two panels presented on C.2 support that it is more likely to find a treated woman on the sample than a treated man. Also, the highest disproportion of treated individuals by sex is observed on the case of individuals impacted by the CTB welfare reform. The proportion of treated women is shown to be more than 10 percentage points higher than the proportion of the treated men when the welfare reform of interest is the CTB. This observation is supported by both definitions of the impacted individuals of the CTB whether it is based on the information provided on the variable "ficode" (my definition) or when I work similarly to Fetzer (2019).

I construct two age groups of individuals in order to classify younger individuals and older individuals in groups with similar potential outcomes (health, employment, etc.) as they may differ only due to returns based on individuals' age category. More specifically, since I include in my analysis only working age individuals, I identify the group of younger individuals those who are less than 44 years old and the group of older individuals includes people of 44 years old and older. The results of the statistical analysis regarding the sample per welfare reform and per age group is provided on Table C.3. Based on the results presented on Table C.3, I observe that the highest proportion of treated individuals by at least one welfare reform is found on the sample of older individuals but a more detailed analysis per welfare reform provides supportive evidence that older individuals are primary more likely to be affected by the BT and the DLA/PIP compared to the group of the younger individuals. The above observation may be in line with the expectations that, for the case of the BT, it may be more relevant to older individuals as they may be more likely to have old children who may decided to live the common household which may explain why they now are found to have a spare space/room according to the government's definition. Additionally, regarding the welfare reforms related to the DLA/PIP, the higher proportion of the impacted individuals on the group of older people may be in line with the expectation that the health of older individuals is not better than the health of the individuals on the group of younger people.

Finally, I explore in my empirical analysis the impact of austerity on individuals' mental health by working separately for people who live in more deprived areas and people who live in less deprived areas. More specifically, I work with a definition based on the Twonsend score to identify more deprived and less deprived areas in which individuals live. Hence, I identify the most deprived areas (consequently the individuals who report to live in these areas) those on the fifth quintile of the score as the most deprived areas while those on the first quintile as the least deprived areas. I present the statistical analysis for the two groups in Table C.4. From the results of the statistical analysis it is shown that the proportions of the treated individuals by CTB the BT are higher on the sample of the most deprived areas compared to the sample of the least deprived areas. This finding may be in line with the fact that the CTB used to support unemployed and low income individuals who may be more likely to be found on the group of the individuals who live in more deprived areas. Similarly, the same logic may apply on the case of the BT. For the case of the DLA/PIP the sample with the higher proportion of the treated individuals belongs to the sample with least deprived areas.

TABLE 4.1: Summary descriptive statistics of the groups of treated individuals by the different welfare reforms

Total Sample			
	Fstats		
	Mean	SD	Observations
CTB	0.399	0.490	6245
BT	0.361	0.480	6245
Any Treatment	0.712	0.453	6245
CTB - F	0.403	0.491	6245
BT - F	0.394	0.489	6245
Any Treatment - F	0.656	0.475	6245
DLA	0.327	0.469	6384
DLA - F	0.229	0.421	6384

The corresponding results when I work with the survey's cross-section weights are presented on Table C.1.

In this part of the statistical analysis I present the plots of the average reversed-GHQ for the time period included in my analysis. More specifically, I present the plot of the average reversed-GHQ per quarter of the year for the years 2009-2015. The plot of the average reversed-GHQ for the case that individuals are impacted by at least one of the three welfare reforms is provided on Figure 4.1. Additionally, I detrend the data in order to remove any potential underling trends and to more easily see any cyclical trend that may be exhibited on the plot of the data over time. Hence, I work towards removing the potential trends of my data by fitting a model where I control for time (the quarter of the year), squared time and year fixed effects. The plots of the detrended data, where I present the difference of the observed values and the predicted values (plots of residuals), for the individuals impacted by at least one of the welfare reforms and the untreated individuals are presented in Figure 4.2 and Figure 4.3.

Based on the information exhibited in Figure 4.1, the mean of the reversed GHQ overtime is higher for the control group compared to the treatment group. Thus, on average not impacted individuals have better mental health than the impacted individuals even before the implementation of the reforms. This observation is not unexpected as individuals who rely on social benefits for their needs may have worse mental health status than those who do not need the additional help from the society to cover their needs. It is important to mention that the sample of the study includes working age individuals who are eligible to receive the CTB and the HB mainly based on their income. Thus, benefited individuals is expected to be low paid or even unemployed individuals who, in general, may have worse mental health level. Additionally, for the case of the impacted individuals from the DLA/PIP, who have the lowest average of the reversed GHQ on the sample, they are working age individuals who may be out of the labour marked due to their health condition. As a result, it is expected that those individuals may be in worsen mental health status on average. Taking all the above into account, the difference of the level of the reversed GHQ between the treatment groups and the control groups is not a concern to compare those groups in the analysis as long as they exhibit similar trends before the implementation of the reforms. Thus, the groups are comparable although they are not similar.

Additionally, it is important to highlight that in Figure 4.1 we observe a decrease of the reversed GHQ at the time of the implementation of the reforms for the impacted individuals while for the non-impacted individuals the change during that quarter is not important and is upwards instead of downwards. Also, based on the graphs of the detrended data, for the average of the reversed GHQ, the decrease on the treated individuals' mental health during the quarter that the reforms are implemented is confirmed as it is shown in Figure 4.2. Moreover, in Figure 4.3 the detrended data of the average reversed-GHQ (residuals' plot) for the control group, on the study where

the treated are individuals impacted by at least one of the reforms of interest, confirms that there is a smaller decrease on individuals' mental health during the quarter of the implementation of the reforms for this group as well.

Furthermore, I explore the plot of the average reversed-GHQ during the time of my study per case of welfare reform, when I identify the treated individuals based on the information provided on the variable "ficode" and when I work similarly to Fetzer (2019), for both treated and untreated individuals. I explore the corresponding trends only for the treatment group per case as for my empirical analysis I work only with the case that individuals are treated by at least one of the welfare reforms and the control group includes individuals who are not impacted by any of the three welfare reforms of interest. Also, I presented the detrended plots of the average reversed-GHQ as well (residuals' plot of models where I control for time (quarter of the year), squared time and year fixed effects). I present the results of the statistical analysis regarding the quarter average of the reversed-GHQ per case of welfare reform in the Appendix C.2.2, Figures C.1 - C.18.

In Figure C.1 I present the trends of the average reversed-GHQ for the treated individuals by the CBT (when I rely on the variable "ficode" to identify the recipients of the social benefits). The exhibited trends for the case of the CTB are in line with the trends presented on this section in Figure 4.1. More specifically, I observe that the treated individuals experience a decrease on their reversed-GHQ during the quarter of the implementation of the CTB reform. Additionally, the detrended plots of the same data (residuals' plots of the models that I control for time, square time and years' fixed effects) confirm that individuals have worse mental health outcomes during the time of the implementation of the reform (Figure C.2 and Figure C.3). Finally, it is worth discussing that the trends exhibited on the case where I include impacted individuals by the CTB and the case where I work with the sample that individuals are impacted by at least one welfare reform are similar as the highest proportion of welfare recipients and impacted individuals is related to the CTB since this social benefit is more relevant to more individuals in the welfare system.

Additionally, in Figure C.4 I present the trend of the average reversed-GHQ for the individuals that were impacted by the introduction of the B. The detrended plots for the treated and the untreated individuals are presented in Figure C.5 and Figure C.6 respectively. Based on the exhibited trends on the above graphs it is important to highlight that for the case of this welfare reform I observe that, in terms of descriptive statistics, there is a small decrease on the treated and untreated individuals' mental health index during the quarter of the implementation of the reforms. Similarly for the case of the DLA/PIP welfare reform, the detrended plots support that individuals experience an worsening on their mental health during the quarter of the implementation of the reforms (Figure C.7, Figure C.8 and Figure C.9)

Finally, I explore the change of the average reversed-GHQ per quarter of the year, for the time period of my study, for the treated and the untreated individuals per welfare reform and for the case that individuals are impacted by at least one of the welfare reforms by working similarly to Fetzer (2019) as well. Hence, I present the corresponding results of the statistical analysis for all the graphs of the average reversed-GHQ and the residuals' plots when I present the detrended data in the Appendix C.2.2 and the Figures C.10 - C.18. It is worth discussing that the statistical analysis of the average reversed-GHQ when the treated individuals by each welfare reforms are identifying by working similarly to Fetzer (2019) confirm the results presented and analysed above where the treated individuals were identified based on the information provided on the variable "ficode" regarding the recipients of each social benefit.

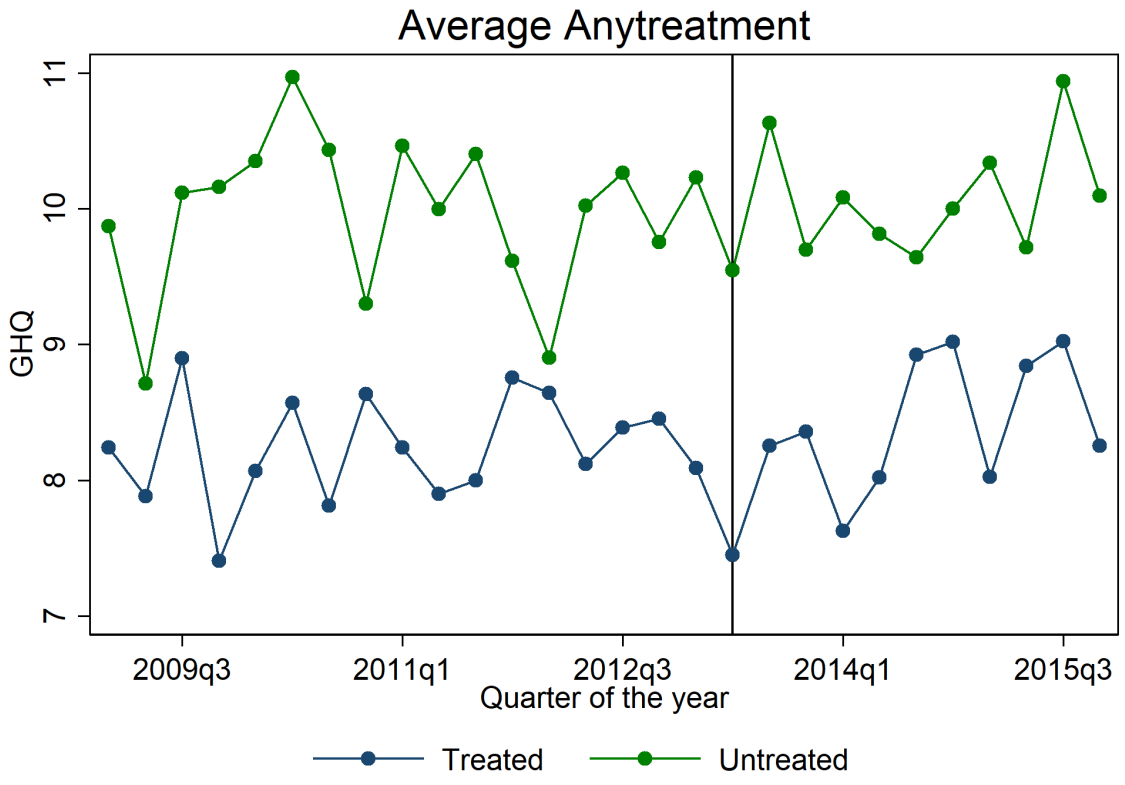

FIGURE 4.1: Mean of GHQ when the treated of Any treatment are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms)

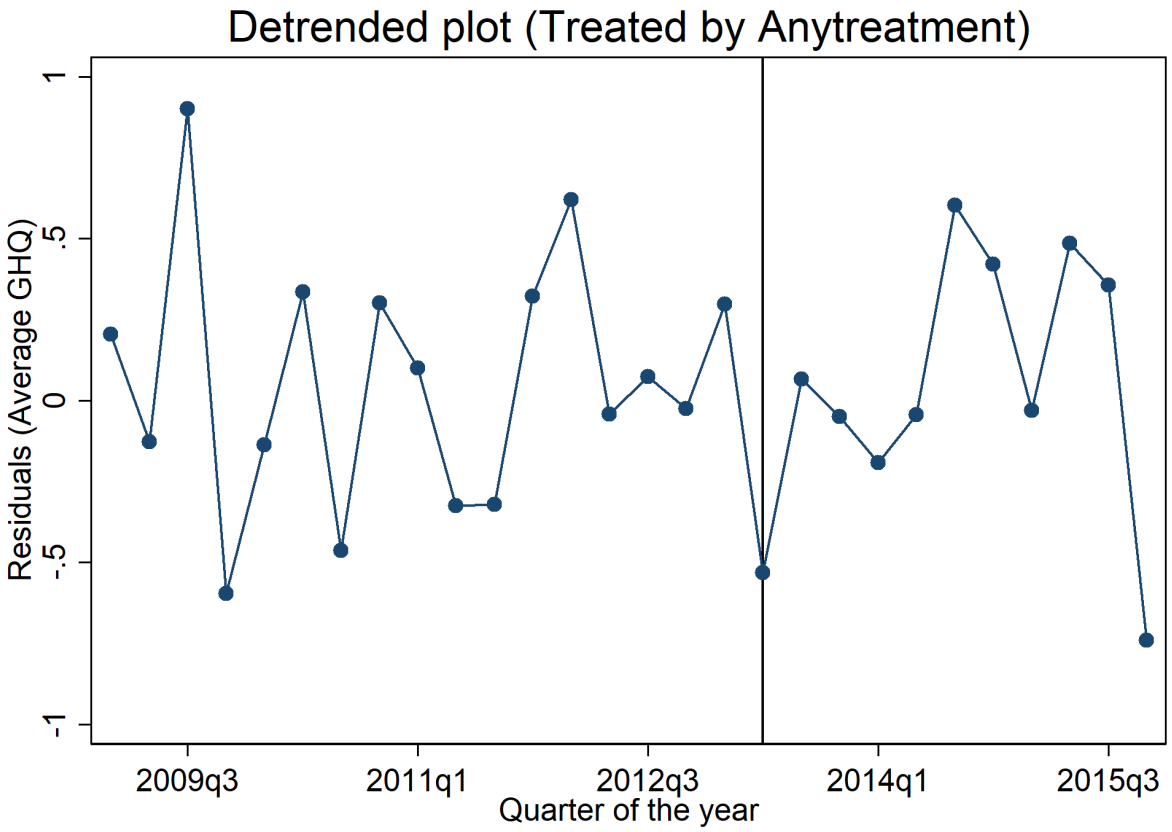

FIGURE 4.2: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of Any treatment are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms - treated individuals)

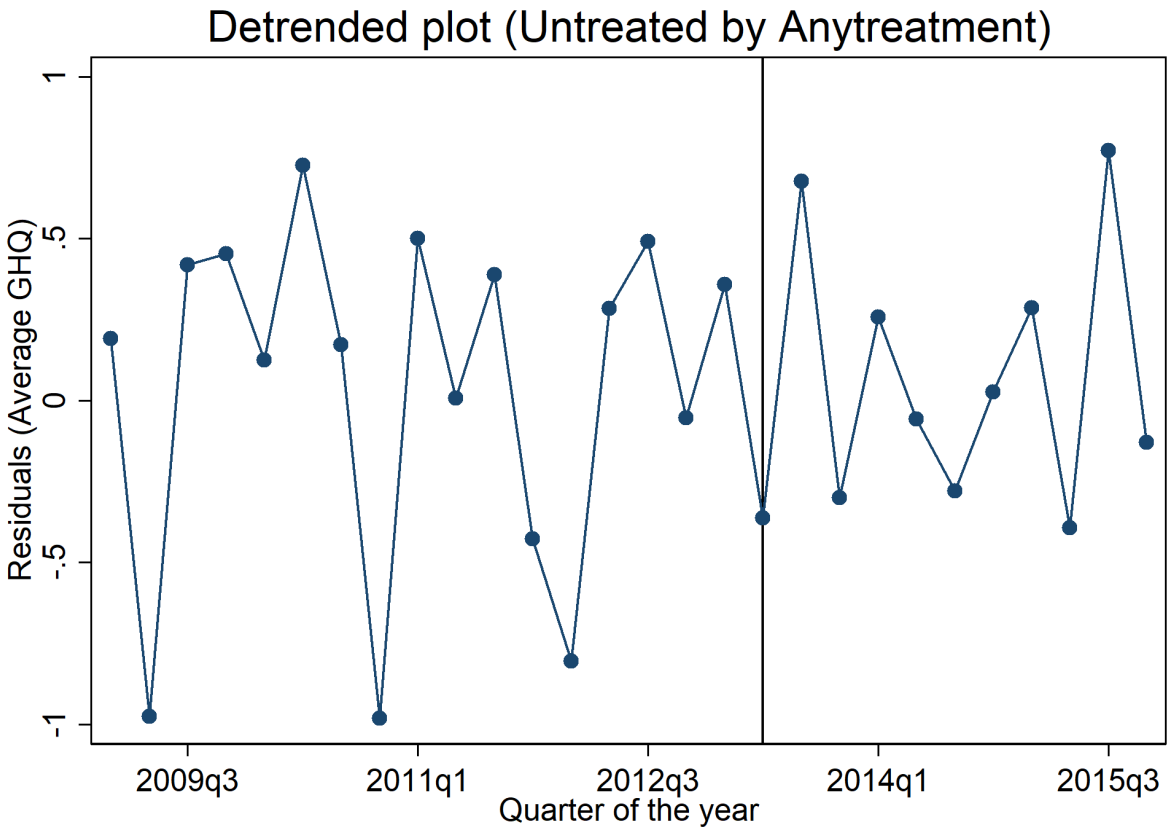

FIGURE 4.3: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of Any treatment are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms- untreated individuals)

4.4 Empirical methods

4.4.1 Pooled Difference in Differences analysis

I estimate the impact of austerity on individuals' mental health by relying on the Difference in Differences (DiD) method and estimating models that include multiple fixed effects. The main identification assumption is that there are two groups, treated and untreated, which do not differ systematically and prior to the examined welfare reforms they have parallel trends with regards to the outcome of interest.

- Structure of the empirical specification:

$$Y_{i,j,t} = \alpha_i + \beta_t + \gamma(Post_{i,j,t} * Reform_{i,j}) + \epsilon_{i,j,t} \tag{4.1}$$

  - $Y_{i,t}$: General Health Questionnaire (GHQ)
  - α_i: individual fixed effect
  - β: time fixed effect
  - γ: the causal effect of the reform j
  - i: refers to the individual
  - j: refers to one of the welfare reforms of interest CTB, DLA/PIP, or BT. Additionally, it refers to the case were at least one of the reforms affects the individual i

4.4.2 Event study analysis (Robustness check)

I explore further the dynamic impact of austerity on mental health by conducting event study analysis. More specifically, I estimate a panel event study model as it is developed on Clarke and Schythe (2020). The method provides evidence regarding the trends of the treatment group and control group before the implementation of the reforms. Also, the point estimates provide evidence regarding the impact of the reforms overtime. Thus, I include all the lag periods (i.e. the time periods before the implementation of the reforms), and all the lead periods (i.e. the time periods after the implementation of the reform). Additionally, the reference period is set on the model to be the time period immediately before the time of the implementation of the reforms (i.e. -1). The main assumption of the model is that the occurrence of the event (welfare reform) for the treatment group is not systematically related to changes that will occur in the future.

- Structure of the panel event study specification:

$$Y_{i,t} = \alpha_i + \beta_{area,t} + \sum_{k=1}^{K} \gamma_k (Lag_k)_{it} + \sum_{l=1}^{L} \lambda_l (Lead_l)_{it} + \epsilon_{i,d,t} \tag{4.2}$$

- Number of lags: k ($k \in [1, ..., K-1]$)
- Number of leads: l ($l \in [1, ..., L-1]$)

4.5 Results

4.5.1 The impact of austerity on individuals' mental health

In this section, I discuss the results of the empirical analysis regarding the impact of the welfare reforms on individuals' mental health. More specifically, I estimate the impact of being impacted by at least of one of the welfare reforms CTB, DLA/PIP, and BT on the reversed GHQ. Therefore, in Table 4.2, I present the results of the empirical analysis regarding the impact of austerity on individuals' mental health measured by the reversed GHQ. In my analysis I control for individuals' fixed effect, thus I exploit the within individual variation. Also, I control for time fixed effects (time variable: quarter of the year). Additionally, the time of the implementation of the reforms is the second quarter of the year 2013. Moreover, the sample of my analysis includes only social benefit recipients and I exclude from the sample individuals who report to receive any of the benefits of interest (CTB, BT, and DLA/PIP) but are not identified as treated individuals. Moreover, I exclude from the sample individuals who may have been impacted by other welfare reforms introduced with the Welfare Reform Act in 2012. More specifically, I identify and exclude individuals who report to ever receive the Incapacity Benefit and the Employment and Support Allowance. Also, I identify and exclude those who report to ever receive before 2013 the Child benefit, the Child Tax Credit, and the Working Tax Credit. Furthermore, I exclude from my sample those few individuals who report to receive the newly introduced Universal Credit.

According to the findings of the empirical analysis presented in the Table 4.2, when I work with my definition of the treatment group (unearned income source), I find that the introduced austerity measures, related to the welfare reforms included in my study, do not have a causal effect on the mental health of the impacted individuals. More specifically, I observe that individuals who are impacted by at least one of the welfare reforms of interest experience a negative impact almost 0.03 but this impact is small and it is not statistically important. Furthermore, I conduct the empirical analysis by relying on the definitions of the treated individuals, by the welfare reforms related to the CTB, BT, and DLA/PIP, as they are provided by Fetzer (2019). Therefore, in the second column of the Table 4.2 I present the findings regarding the welfare reforms on individuals' mental health when I work with second set of definitions for the treated individuals. It is important to highlight that the results provide supportive evidence that the welfare reforms did not cause a deterioration on individuals' mental health. More specifically, I find that the coefficient of interest is negative but it is small and it is not statistically different from zero (-0.055), thus it do not indicate any important causal impact.

Additionally, I include in my analysis controls for survey's wave specific fixed effect in addition to individuals' fixed effect and time fixed effect (time period: the quarter of

year). The results of the DiD analysis when I control for individuals' fixed effect, wave and time fixed effect, when the treated individuals are identified based on the information provided on the variable "ficode" and on the study Fetzer (2019), are provided in the Table C.5 (Appendix C.3). The findings are in line with the findings presented in Table 4.2. Therefore I find that, according to my definition of the treated individuals, impacted by at least one of the welfare reforms of interest experience a negative impact on their mental health (reversed GHQ score) equal to 0.033 but this impact is small and it is statistically insignificant. Also, I find that individuals who are impacted by at least one of the welfare reforms, when the treated individuals are identified according to Fetzer (2019), do not have worse mental due to the implemented reforms as it shown on the second column of Table C.5 (Appendix C.3).

TABLE 4.2: The Impact of the welfare reforms on individuals' mental health

	Any	Any - F
Dependent Variable: GHQ		
Post × Reform	-0.0318	-0.0553
	(0.167)	(0.161)
Mean of Dependent Variable	8.73	8.73
PIDP	1622	1622
Number of Observations	6245	6245
Individual FE & Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for time fixed effect (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

Furthermore, I provide evidence regarding the impact of the welfare reforms on the mental health of individuals depending on the level of the social benefit income reduction that they experience. More specifically, Figure C.19 and Figure C.20 on Appendix C.2.3 show that the social benefit of the impacted individuals declines after the implementation of the welfare reforms. The above graphs plot the results of the analysis where I regress the log-social benefit income of individuals on an interaction term between the treatment status and the time variable (quarter of the year). Also, I control for individuals' fixed effect and survey's wave by time fixed effect (survey's wave x quarter of the year). Based on the above evidence, I identify all the impacted individuals who experience an overall reduction on their social benefit income in the post welfare reforms period compared to the pre-intervention period. I conduct the empirical analysis separately for those impacted individuals who saw a heavily decline in their social benefit income (first quintile) and on the rest of the impacted individuals who experience a mildly reduction on their social benefit income. I include controls for individuals' fixed effect and survey's wave by time fixed effect as well.

The results of the empirical analysis for the case of the heavily impacted individuals are presented on Table C.6 and Table C.7 (Appendix C.3). As it is shown on the above tables, although those impacted individuals, experience important reductions on their social benefit income additionally to the institutional change on the welfare benefit system that they have to deal with, there is no supportive evidence to indicate an important impact on their mental health. More specifically, the empirical analysis provide supportive evidence that the most impacted individuals in terms of social benefit reduction experience a negative impact in their mental health between 0.25 - 0.3 but this impact is not statistically different from zero. The results do not differ in significance level independently of the definition of the treatment group that I work with (column 1 and column 2). Additionally, on Table C.8 and Table C.9 (Appendix C.3) I provide the results of the same empirical analysis on the sample of the mildly impacted individuals. It is important to highlight that on this sample the impact is even smaller, thus negative coefficients but very small in magnitude or even positive coefficients while none of the coefficients indicate a statistically important impact as they are insignificant.

4.6 Results from robustness checks

4.6.1 Results from the event study analysis

In this section I showcase and discuss the results of the panel event study analysis. More specifically, I estimate the impact of the austerity measures related to the welfare reforms, CTB, BT and the DLA/PIP, on the mental health of the impacted individuals over time and I provide evidence regarding the trends of the compared groups (treatment group and control group) before the implementation of the reforms. The time variable in my analysis is the quarter of the year and the value zero in my analysis corresponds to quarter of the implementation of the reform. Therefore, the time zero corresponds to the second quarter of the year 2013. Also, the reference period in my event study analysis analysis, is the quarter before the implementation of the reforms (-1), thus the first quarter of the year 2013. The confidence level is 95% and I present the output of 10 pre-event periods and 10 post-event periods. Finally, I include in my analysis individuals' fixed effect and time fixed effects.

Figure 4.4 plots the results of the panel event study analysis for the case that individuals are impacted by at least one of the welfare reforms. Also, I identify the treated individuals by working with the information available in my data (variable "ficode") related to the source per social benefit received by individuals. The sample is the same sample as in the main analysis and I include social benefit recipients, working age who are observed at least once before and once after the implementation of the welfare reforms. Based on the output of the panel event study analysis I observe that there is no statistically significant point estimate before the implementation of the welfare reforms. This finding indicates that there is no evidence of an effect in the time period that should not be there as the implementation of the welfare reforms do take place later. Therefore, this finding provides supportive evidence that the treatment group and the control group are comparable as their trends do not differ systematically, before the implementation of the welfare reforms, with regards to the outcome of interest (reversed GHQ). Furthermore, it is important to highlight that the event study analysis not only provides evidence regarding the parallel trend assumption, an essential requirement to ensure that the DiD analysis provides causal estimates, it also provides evidence regarding the impact of the intervention over time. Therefore, from Figure 4.4 I identify a small but important impact of the implementation of the welfare reforms on the mental health of the impacted individuals during the first two quarters in the post treatment period. Also, over the next time periods included in my study, I find that the negative impacts disappears as the point coefficients are not statistically different from zero.

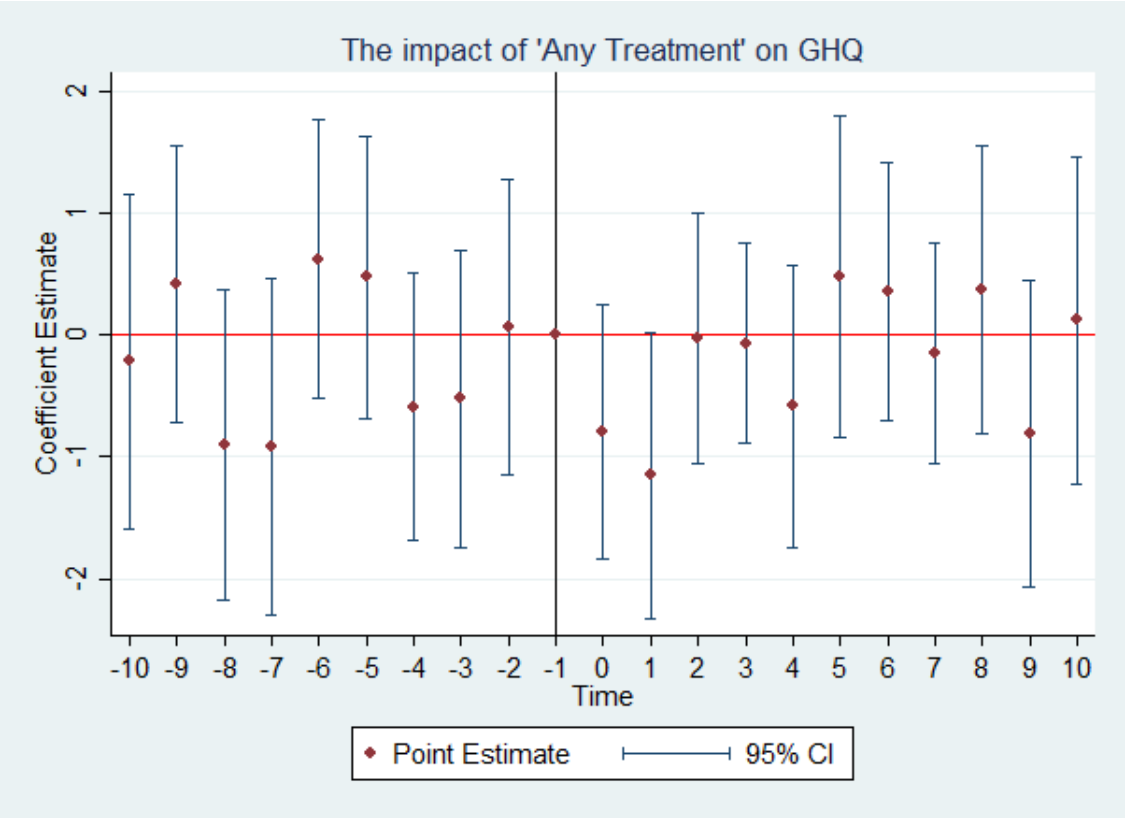

FIGURE 4.4: Event Study Analysis when treated of Any treatment are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms, Controls: individuals' fixed effect and time fixed effects)

Additionally, I conduct panel event study analysis for the case that I control for individuals' fixed effect, survey's wave and time fixed effect (survey's wave by quarter of the year). Therefore, I provide evidence regarding the impact of the welfare reforms on the mental health of individuals who are impacted by at least one of the reforms of interest (abolishment of the CTB, introduction of the BT, replacement of the DLA by the PIP) over time. By working similarly to my analysis above, I showcase the output when I add the additional control for survey's wave on Figure C.21 (Appendix C.4). It is important to discuss that the findings support that there is no evidence against the parallel trend assumption with regards to the control group and the treatment group with respect to the outcome of interest (reversed GHQ). Hence, all the point estimates before the implementation of the welfare reforms are not statistically different from zero providing supportive evidence regarding the validity of my main analysis and the causal interpretation of my findings. Additionally, as for the impact of the implementation of the welfare reforms on the mental health of those impacted by at least one of the reforms during the time period after the implementation of the welfare reforms I confirm that there is a small but important effect the first two quarters but that effect does not persist over time. Therefore, after the last quarter of the year 2013

there is no impact on the mental health of the individuals who had to adjust to the changes related to at least one of the social benefits of interest (CTB, HB, DLA/PIP).

Furthermore, it is important to highlight that the most important challenge when researchers apply the DiD methodology is to provide supportive evidence regarding the validity of their findings and the confidence that the provided findings can have a causal interpretation. Therefore, it is important to provide supportive evidence in favour of the parallel trend assumption among the treatment group and the control group before the studied intervention with regards to the outcome of interest as there is no formal test of that assumption. In this section I explain that I work on that direction and I am able to present and to discuss the supportive evidence regarding the validity of the findings of my main analysis based on the results of the event study analysis above. To further ensure that I conduct the appropriate empirical analysis towards providing supportive evidence of the parallel trends assumption on my specification I also work similarly to Autor (2003) who provides a similar analysis to the event study analysis that I present on that section. Therefore, by working similarly to Autor (2003) I work with leads and lags where I include, this time, all the times before and after the implementation of the welfare reforms included in my study and I design the analysis manually step by step. Additionally, my time variable is the quarter of the year. Also, the reference time period which is excluded is the quarter before the implementation of the welfare reforms otherwise I cannot avoid having a perfect multicollinearity problem. Moreover, as in my main analysis the sample includes working age social benefit recipients who are observed at least once before and once after the implementation of the welfare reforms.

I present the results of the empirical where I work similarly to Autor (2003), towards providing evidence regarding the impact of the welfare reforms on the mental health of the impacted individuals over time and the parallel trends assumption, on Figure C.22 (Appendix C.4). It is important to highlight that output of the analysis that I conduct manually step by step confirm the event study analysis above. Therefore, I find that there is no evidence of anticipation effect as none of the point estimates before the implementation of the welfare reforms is statistically different from zero. Most importantly, this finding confirms that the treatment group and the control are comparable as there is no threat regarding their parallel trends assumption before the implementation of the reforms with respect the outcome of interest (reversed GHQ). Additionally, I find that impacted individuals by at least on of the implemented welfare reforms experience a small but statistically important negative impact in their mental health the first two quarter in the post treatment period. This impact is not maintained overtime as all the rest of the point estimates are not statistically different from zero.

4.6.2 Placebo falsification test regarding the validity of the DiD analysis

In this section I conduct a placebo falsification analysis to provide supportive evidence regarding the validity of the findings of my main analysis. More specifically, I limit the data of the analysis on the time period before the implementation of the welfare reforms to explore whether a similar analysis, to the main analysis, on that sample indicates that there is an impact of the implementation of the welfare reforms at a time that they were not implemented yet. Such a finding would be an indication against the validity of the findings of my main analysis while a zero impact would indicate that there is not an incorrectly captured impact and that there is no anticipation effect of the welfare reforms before their actual implementation. Therefore, I conduct DiD analysis for the case that individuals are impacted by at least one of the welfare reforms of interest (CTB, BT, and DLA/PIP) where I include only the sample that corresponds to the period time of 2009Q1 - 2013Q1. In that way I limit the time period of my analysis to all the years and quarters before the implementation of the welfare reforms. My sample continuous to include only individuals who are observed at least once before and once after the implementation of the reforms in order to be a constructed sample that comes from the sample of the main analysis. Also, as in the main analysis, I control for individuals' fixed effect and the time fixed effect. Most importantly I set the false time of the implementation of the welfare reforms to be the first quarter of the year 2011 (2011Q1).

The results of the placebo falsification analysis provide supportive evidence in favour of the parallel trend assumption on my main DiD specification. More specifically, I rely on the identification of the impacted individuals based on my definitions which are constructed based on the information provided on the variable "ficode" on my data. Also, I identify the treatment group according to the study by Fetzer (2019). Based on the findings of my analysis, presented on Table 4.3 I do not identify any impact due to the implementation of the welfare reforms on the mental health of the treated individuals on the false time period of my analysis. Therefore when individuals are treated by at least one of the welfare reforms, based on both definitions of the treatment groups, I find a positive and statistically zero effect of the implementation of the welfare reforms on the false time period of the data. I include the same controls as in the main specification of my analysis. Thus, I control for individuals' fixed effect and for time fixed effects (quarter of the year). Additionally, as I do in the main analysis, I estimate the impact of austerity measures on individuals' mental health with a second specification where I include the control for the survey's wave control. Hence, the controls include the individuals' effect, survey's wave by time fixed effects. The results of this second specification are in line with main findings and provide supportive evidence that there is no violation of the parallel trend assumption on the main DiD analysis as no evidence is identified on the false time period of the study. The results are showcased on Table C.10 (Appendix C.5).

Taking all the above into account, I find that, on the placebo falsification, the coefficient of the interaction term of treatment status and the false post treatment term is small and statistically insignificant which provides supportive evidence that the trends of the treatment group and the control group are similar, with regards to the outcome of interest, before the implementation of the reforms.

TABLE 4.3: The Impact of austerity on individuals' mental health (placebo falsification)

	Any	Any - F
Dependent Variable: GHQ		
Post × Reform	0.326	0.207
	(0.304)	(0.286)
Mean of Dependent Variable	8.67	8.67
PIDP	1622	1622
Number of Observations	3399	3399
Individual FE & Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The false time of the implementation of the reforms is the first quarter of the year 2011.The analysis includes the data of the years 2009Q1-2013Q1. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

4.6.3 Results from the heterogeneous analysis

In this section I present and discuss the results of the empirical analysis regarding the impact of the welfare reforms on the mental health of different groups of individuals. More specifically, I am interested to explore whether the welfare reforms exhibit heterogeneous impact for groups with different characteristics which could be masked

in the total sample. Therefore, I estimate the impact of the implementation of the welfare reforms CTB, BT and DLA/PIP separately for men and for women as the mental health may be impacted differently for the two groups. Additionally, I am concerned that economic and institutional shocks, associated with the welfare reforms that I include in my analysis, may impact individuals differently depending in their time of life, thus depending on their age group. For that reason I conduct the empirical analysis for two sample based on participants' age. The first sample includes younger individuals from the age group of 16-43 years old and the second sample includes older working age adults from the age group of 44-64 years old. Additionally, I conduct the empirical analysis by splitting the sample based on the deprivation level of the area that individuals live. More specifically, I identify as the least deprived areas those districts that have a Townsend index score less or equal to zero and the more deprived areas those that have a corresponding score more than zero. Therefore, I identify the individuals who live in a less deprived area as those who report to live in areas where the Townsend index score is less than the median of the Townsend index score (in the total sample) and those who live in more deprived areas are individuals who report to live in areas with Townsend index score higher than the median. I am interested to provide evidence whether there is heterogeneity on the impact of the austerity measures on individuals' mental health based on the level of deprivation in the area that they live as people in more deprived areas are individuals with worse mental health and they are also the most impacted groups by the majority of the welfare reforms. I present the output of the DiD analysis in the next parts of this section. Therefore, in Section 4.6.3.1 I provide the results and the analysis for the heterogeneity by sex, in Section 4.6.3.2 I present the analysis based on individuals' age group, and in the Section 4.6.3.3 I showcase the output of the empirical analysis for individuals who live in less deprived and more deprived areas (separately).

4.6.3.1 Results from the heterogeneous analysis - By sex

Table 4.4 showcases the DiD analysis by sex when I identify the treated individuals per welfare reform based on both definitions that I use in my study. More specifically, the first panel of the table (Panel A) provides the output of the empirical analysis regarding the impact of the welfare reforms on the mental health of men. Based on the results of the analysis, when I work with my definition of the treatment groups (based on the information of the unearned income source), there is a small negative impact on the mental health men when they are impacted by at least one of the welfare reforms of interest (CTB, BT, DLA/PIP) which is close to 0.05 but this impact is not statistically important. Additionally, when I work with the second definition of the treatment groups I find a small positive impact of the welfare reforms on the mental health of the impacted men when they are impacted by at least one of the reforms. It is important to highlight that this impact is statistically insignificant as well.

Additionally, in Panel B of the Table 4.4 I provide the results of the empirical analysis regarding the impact of welfare reforms on the mental health of women. I find that women that are impacted by at least one of the welfare reforms of interest (the abolishment of the CTB, the introduction of the BT, and the replacement of the DLA PIP) is shown to experience a negative impact on their mental health. More specifically, when I rely on the first definition of the treatment groups, I find that women that are impacted by at least one welfare reforms experience a reduction on their reversed GHQ score close to 0.03. Also, when I rely on the second definition of the treatment groups the negative impact that women see on their mental health is larger and close to 0.1. It is important to highlight that the negative impact of the implementation of the welfare reforms on the mental health of women is persistent but it is not statistically different from zero.

Furthermore, the results that I present on Table 4.4 includes the same controls that I include on the main analysis of my study. Therefore, I control for individuals' fixed effect and time fixed effect (quarter of the year). Additionally, I conduct the same empirical analysis where I control for individuals' fixed effect, survey's wave by time fixed effects (wave x quarter of the year). The corresponding results are showcased on Table C.11 (Appendix C.6). Based on the findings of my analysis I confirm that when men are impacted by at least one of the welfare reforms of interest they experience a small impact on their mental health but it is not statistically important. Also, in the case of women I confirm the persistent negative impact on the welfare reforms on the mental health of the impacted women but this is statistically insignificant.

Table 4.4: The Impact of austerity on individuals' mental health (GHQ score)

	Any	Any - F
Panel A: ***Men***		
Post × Reform	-0.0508	0.104
	(0.239)	(0.232)
Mean of Dependent Variable	9.19	9.19
PIDP	671	671
Number of Observations	2485	2485
Individual FE & Time FE	Yes	Yes
Panel B: ***Women***		
Post × Reform	-0.0318	-0.110
	(0.239)	(0.219)
Mean of Dependent Variable	8.43	8.43
PIDP	951	951
Number of Observations	3760	3760
Individual FE & Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

4.6.3.2 Results from the heterogeneous analysis - By age group

In this section I present the results of the empirical analysis regarding the impact of the austerity measures related to the welfare of interest (CTB, BT, and DLA/PIP) on the mental health of individuals based on their age group. More specifically, Table 4.5 showcases the results of the DiD analysis for younger working age individuals of 16-43 years old (Panel A) and older working age individuals of 44-64 years old. The heterogeneous analysis for different age groups is important as the mental status of

individuals is not independent of their age group, thus it is important to explore whether economic and institutional changes affect the two groups differently in the case of my study where I explore the impact of welfare reforms on individuals' mental health. Additionally, in my analysis I include the same controls as in the main analysis. Therefore, I control for individuals' fixed effect and time fixed effect (quarter of the year). The results provided on the first column of the Panel A of the Table 4.5, where I work with the first definition of the treatment groups (based on the information of the unearned income "ficode"), provide evidence that the implementation of the welfare reforms did not worse the mental health of younger individuals. More specifically, I find that younger working age individuals (16-43 years old) who are treated by at least one of the welfare reforms of interest (CTB, BT, DLA/PIP) it is shown to have even an improvement on their mental health after the reforms although the coefficient is small and not statistically important. The absent of an impact due to the implementation of the welfare reforms on the mental health of individuals of age 16-43 years old is confirmed by the findings exhibited on the second column of Panel A where I rely on the second definition of the treatment groups.

Additionally, the second panel (Panel B) of the Table 4.5 showcases the results regarding the impact of the welfare reforms of interest on the mental health of older working age individuals (44-64 years old). I present the results of the analysis when I work with the first definition of the treatment groups on the first column of Panel B. Based on my findings the implementation of the welfare reforms deteriorated the mental health of the older working age individuals. More specifically, I find that the older working age individuals who are impacted by at least one of the welfare reforms of interest (the abolishment of the CTB, the introduction of the BT, and the replacement of the DLA by the PIP) experience a reduction close to 0.55 of their reversed GHQ scale and this impact is statistically significant. When I rely on the second way of identifying the treatment groups, as it is shown on the second column of Panel B, the negative impact is persistent but the impact is smaller and it is not statistically important.

Finally, on Table C.12 (Appendix C.6) I present the results of the heterogeneity analysis with regards to the age groups of the working age individuals when the controls include the individuals' fixed effect, survey's wave and time fixed effect (wave by quarter of the year). The findings are in line with the findings presented and discussed above (Table 4.5). More specifically, based on the results presented on Panel A of the Table C.12 (Appendix C.6) it is confirmed that, based on the results of both definitions of the treatment groups, younger working age individuals (16-43 years old) who are impacted by at least one of the welfare reforms of interest do not experience any statistically important effect on their mental health. Additionally, I confirm that older working age individuals (44-64 years old) exhibit a persistent negative impact due to the implementation of the welfare reforms. More specifically, based on the findings presented on Panel B of the Table C.12 (Appendix C.6) the older working age

individuals who are impacted by at least one of the welfare reforms of interest experience a reduction on their reversed GHQ scale between 0.2-0.5 and that impact is statistically important only when I identify the treatment groups based on the information related to the source of the unearned income that social benefit recipients receive.

TABLE 4.5: The Impact of austerity on individuals' mental health (GHQ score)

	Any	Any - F
Panel A: ***Younger individuals***		
Post × Reform	0.243	0.130
	(0.221)	(0.224)
Mean of Dependent Variable	9.25	9.25
PIDP	823	823
Number of Observations	2882	2882
Individual FE & Time FE	Yes	Yes
Panel B: ***Older individuals***		
Post × Reform	-0.546*	-0.192
	(0.307)	(0.249)
Mean of Dependent Variable	8.29	8.29
PIDP	799	799
Number of Observations	3363	3363
Individual FE & Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

4.6.3.3 Results from the heterogeneous analysis - Deprivation level of the area that individuals live

In this section I present and analyse the results of the last heterogeneity analysis that I conduct. More specifically, I provide evidence regarding the way that the abolishment of the CTB, the introduction of the BT and the replacement of the DLA by the PIP impact individuals' mental health depending on the deprivation level of the area that they live (local authority district). I present the results of the DiD analysis in Table 4.6 where the first panel (Panel A) showcases the output of the analysis for the individuals who are impacted by at least one of the welfare reforms of interest and live in the fifth of the country that is least deprived based on the distribution of the Townsend index score (first quintile). According to the findings of my analysis the implantation of the welfare reforms did not worsen the mental health of the impacted individuals as the corresponding coefficients are positive and not statistically important. The estimated models include the same controls as the main specification of my study where I control for individuals' fixed effect and time fixed effect (quarter of the year). Also, I conduct the same empirical analysis by adding the control of survey's wave. The results are presented on Table C.13 (Appendix C.6) and provide supportive evidence that individuals who are impacted by at least one of the welfare reforms of interest and live in the least deprived areas of the country did not experience a deterioration in the mental health.

Additionally, I present the results of the empirical analysis with regards to the impact of the welfare reforms on the mental health of the impacted individuals who live in the most deprived areas of the country (fifth quintile of the Townsend index score) on the second part (Panel B) of Table 4.6. My findings suggest that, by working with both ways of identifying the treatment groups, there is a persistent negative impact of the abolishment of the CTB, the introduction of the BT and the replacement of the DLA by the PIP for those individuals who are impacted by at least one of the above reforms and live in the most deprived districts of the country. Therefore, I find that the reversed GHQ index of the impacted individuals declines by $0.1 - 0.3$ but this impact is not statistically significant. The results are confirmed when I add on the model the additional control for the survey's wave. More specifically, I find that, when I control for individuals' fixed effect and survey's wave by time fixed effects (wave by the quarter of the year) the implementation of the welfare reforms on the impacted individuals who live in areas that belong on the fifth most deprived districts experience a reduction on their mental health index between $0.2 - 0.3$ but this impact is not statistically different from zero (Panel B, Table C.13, Appendix C.6).

Table 4.6: The Impact of austerity on individuals' mental health (GHQ score)

	Any	Any - F
Panel A: ***The (first) quintile that represents the least deprived***		
Post × Reform	0.152	0.262
	(0.361)	(0.335)
Mean of Dependent Variable	8.89	8.89
PIDP	370	370
Number of Observations	1315	1315
Individual FE & Time FE	Yes	Yes
Panel B: ***The (fifth) quintile that represents the most deprived***		
Post × Reform	-0.282	-0.115
	(0.344)	(0.336)
Mean of Dependent Variable	8.74	8.74
PIDP	453	453
Number of Observations	1530	1530
Individual FE & Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age individuals who are observed at least once before and once after the implementation of the reforms. The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

Moreover, I provide further evidence regarding the impact of the implementation of the welfare reforms on the mental health of the impacted individuals depending on the deprivation level of the area that they live by working with a second classification based on the Townsend index score. More specifically, I identify as the least deprived areas those districts that have a Townsend index score less or equal to zero and the more deprived areas those that have a corresponding score more than zero. Therefore, I conduct a similar empirical analysis to the main analysis of my study where I control for the individuals' fixed effect and the time fixed effects (quarter of the year). I present the output of the analysis on Table 4.7. Based on the results showcased on the Panel A of Table 4.7 I observe that the implementation of the welfare reforms of interest (CTB, BT, DLA/PIP) did not impact the mental health of the affected individuals who report

to live in the least deprived areas of the country. Thus, when I work with the first definition of the impacted individuals, based on the source of the unearned income of the social benefit recipients ("ficode"), I find that individuals that are identified to be affected by at least one of the welfare reforms of interest seems to have even a positive impact on their mental health although this impact is not statistically important (Panel A, first column). Additionally, the same direction of the impact of the implementation of the welfare reforms on the mental health of the same sample is found when I work similarly to Fetzer (2019) to identify the impacted individuals where again no statistically important impact is uncovered (Panel A, second column). Also, it is important to discuss that I conduct a similar empirical analysis where I control for individuals' fixed effect, and survey's wave by time (wave by quarter of the year). I showcase the results of that part of the analysis on Table C.14 (Appendix C.6). Based on the findings presented on Panel A of Table C.14 (Appendix C.6) I confirm that there is no statistically significant impact on the mental health of the individuals who are impacted by at least one of the welfare reforms of interest and report to live in the least deprived areas of the country.

Furthermore, Panel B of Table 4.7 exhibits the results of the empirical analysis regarding the impact of the implementation of the welfare reforms "abolishment of the CTB", "introduction of the BT" and the "replacement of the DLA by the PIP" on the mental health of the affected individuals who live in areas of the country that are considered to experience a higher level of deprivation. Based on the output of the above empirical analysis I find that individuals who report to live in areas of higher level of deprivation and are impacted by at least one of the welfare reforms of interest experience a very small decline on their mental health score. More specifically, I find that being impacted by one of the welfare reforms of interest, for those who live in deprived areas, decreases the reversed GHQ score by only 0.07. That impact is found to be much smaller when I rely on the second definition of the treatment groups on my study. Most importantly, I find that the small negative impact in magnitude is not statistically important. Finally, the results of Panel B of Table C.14 (Appendix C.6) where I add the control for the survey's wave confirm that there is no important impact of the implementation of the welfare reforms on the mental health of the affected individuals who report to live in the more deprived districts of the country.

Table 4.7: The Impact of austerity on individuals' mental health (GHQ score)

	Any	Any - F
Panel A: ***Individuals who live in a less deprived area***		
Post × Reform	0.0519	0.0191
	(0.293)	(0.285)
Mean of Dependent Variable	8.75	8.75
PIDP	592	592
Number of Observations	2140	2140
Individual FE & Time FE	Yes	Yes
Panel B: ***Individuals who live in a more deprived area***		
Post × Reform	-0.0703	-0.00715
	(0.216)	(0.208)
Mean of Dependent Variable	8.74	8.74
PIDP	1097	1097
Number of Observations	3985	3985
Individual FE & Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

4.6.3.4 Replication analysis and impact of austerity on mental health (same sample)

In this section, I present the results from the replication analysis of the main outcome of interest on the study by Fetzer (2019). More specifically, since Fetzer (2019) relies on the same welfare reforms (CTB, DLA/PIP, and BT) to estimate the impact of austerity on the support for the UK Independence Party (UKIP) and works with the data of Understanding Society, I replicated the paper's findings on a sample where both the information regarding political preferences and mental health are available. Thus, in the sample of my study (working age individuals who report the GHQ, receive social benefits and are observed at least once before and once after the implementation of the welfare reforms) I constructed the main outcome of the paper Fetzer (2019) based on

the variables "vote3: party which would vote for tomorrow" and "vote4: which political party closest to" available on the data. Additionally, I work with both definitions of treated individuals introduced in my analysis. Thus, firstly I work with the treatment groups that are identified based on the information provided on the variable "ficode" related to the source of individuals' social income and then I conduct the analysis with the treatment groups being identified similarly to Fetzer (2019) as well. My work in this section should be compared to the reported results of Panel A, Table 2 of Fetzer (2019). Therefore, I control for district fixed effect, region and wave and time fixed effects and I cluster at the local authority level (LAD) to work similarly to the work presented in the paper by Fetzer (2019).

In Table 4.8, Panel A, I present the results of the replication analysis where I estimate the impact of the welfare reforms on the support for UKIP. I find that individuals who are impacted by at least one of the welfare reforms of interest show an important increase on their support of the UKIP. Therefore, my findings confirm the positive impact of the introduced and implemented welfare reforms on the political preferences of the impacted individuals with regards to the UKIP which is shown in the study by Fetzer (2019). When I conduct the empirical analysis regarding the impact of the welfare reforms (CTB, BT, DLA/PIP) on the outcome of interest of my study (reversed GHQ) on the same sample I find that its magnitude is almost zero and that it is not statistically different from zero. I present the output of the empirical analysis regarding the outcome of interest of my study on Panel B of Table 4.8. In this specification I control for individuals' fixed effect and time fixed effects (quarter of the year) as I do on my main analysis of the study. Additionally, on Panel C of Table 4.8 I showcase the results of the analysis when I add the control for the survey's wave. The results confirm that the impacted individuals by at least of one welfare reform do not experience a negative impact on their mental health as the coefficients are close to zero and not statistically significant.

TABLE 4.8: The Impact of austerity on support for UKIP and individuals' mental health (GHQ score)

	Any	Any - F
Panel A: Dependent Variable: Support UKIP		
Post × Reform	0.0613***	0.0611***
	(0.0170)	(0.0162)
Mean of Dependent Variable	.0765	.0765
PIDP	326	326
Number of Observations	4142	4142
District FE & Region x Wave x Time FE	Yes	Yes
Panel B:Dependent Variable: GHQ (reversed score)		
Post × Reform	-0.00990	0.00353
	(0.278)	(0.271)
Mean of Dependent Variable	8.72	8.72
PIDP	326	326
Number of Observations	4142	4142
Individual FE & Time FE	Yes	Yes
Panel C:Dependent Variable: GHQ (reversed score)		
Post × Reform	0.00858	0.00938
	(0.282)	(0.274)
Mean of Dependent Variable	8.72	8.72
PIDP	326	326
Number of Observations	4142	4142
Individual FE & Wave x Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms. Panel A, presents the results of the analysis for the main outcome of interest of the study Fetzer (2019) (Support UKIP). The controls for District by Region x Wave x Time Fixed Effects are included to be in line with Panel A of Table 2 of Fetzer (2019) and exploits the within district (between individual variation) variation and within region variation (between district variation). Panel B, presents the results of the analysis regarding the outcome of interest of my study (GHQ). The controls for individual Time Fixed Effects are included. Panel C, presents the results of the analysis regarding the outcome of interest of my study (GHQ) when I add the control for the survey's wave. The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. Standard errors clustered at the Local Government Authority District Level are presented in parentheses.

4.7 Conclusions and Discussion

In this chapter, I estimate the impact of austerity on individuals' mental health. This is the first time, to the best of my knowledge, that the impact of the social benefit reforms, introduced in the UK with the Welfare Reform Act in 2012 and led to financial loses, on individuals' mental health are investigated. More specifically, I estimate the impact of the abolishment of the CTB, the replacement of DLA by the PIP, and the introduction of the BT on the mental health of the impacted individuals.

Firstly, I apply the DiD method to estimate the causal impact of austerity measures related to the above welfare reforms on individuals' mental health measured by the reversed GHQ score. I estimate linear specifications where I control for individuals' fixed effect and time fixed effect. The findings suggest that the individuals do not experience an important impact on their mental health as for all the welfare reforms investigated in my analysis, thus for individuals who are impacted by at least one of the above welfare reforms, the estimated coefficients are not statistically important. Furthermore, the findings are consistent when I include in my analysis the additional control for the survey wave. Therefore, my study provides evidence that the welfare reforms associated with unearned income reduction and institutional change did not lead the impacted individuals to worse mental health status.

Additionally, in order to capture the dynamic impact of the welfare reforms on individuals' mental health, I conduct panel event study analysis for the case that individuals are impacted by at least one of the welfare reforms of interest. The event studies provide supportive evidence regarding the validity of the findings of the main analysis as it is shown that the trends of the treatment groups and the corresponding control groups are similar before the reforms with regards to the outcome of interest. Also, the output of the panel event studies analysis confirms that there is no long term impact, in general, of the welfare reforms on individuals' mental health. The investigation regarding the dynamic impact of austerity on individuals' mental health exhibits a consistent pattern regarding the finding that there is a negative impact on individuals' reversed GHQ score the first and the second quarters after the implementation of the welfare reforms but that impact is not large.

Furthermore, I conduct a placebo falsification test analysis in order to provide further evidence of the robustness of the findings of my main analysis. More specifically, I limit the sample to the time period before the implementation of the reforms (2009Q1 - 2013Q1) and I set as a false treatment time the first quarter of the year 2011 (2011Q1). I conduct the empirical analysis firstly by controlling for individuals' fixed effect and time fixed effect and then I conduct the same analysis when the additional control for the survey wave is added. Based on the findings of the analysis the treatment group and the control group are comparable as there is not evidence that the trends of the reversed GHQ score differ among those two groups in the placebo falsification test.

Therefore, I provide additional supportive evidence that the findings of my main analysis are solid and have a causal interpretation.

Moreover, I explore the impact of the welfare reforms on the mental health of different groups in order to provide evidence whether groups with different characterises experience the austerity measures with regards to their mental health differently. Therefore, I conduct the empirical analysis separately for men and for women. Also, I split the sample in two different samples based on the age group of individuals. I include younger working age individuals of 16-43 years old on the first sample while the second sample includes older working age individuals of 44-64 years old. Furthermore, I explore whether the impact of the welfare reforms was different to impacted individuals who live in less deprived areas from those who report to live in more deprived areas. The overall output of the above heterogeneity analysis provides evidence that the analysis in the total sample does not mask any impact that may be found in a certain group of individuals. Therefore, I find that the austerity measures related to the welfare reforms included in my study, in general, do not impact the mental health of individuals.

Also, I provide supportive evidence regarding the correct choice of sample to conduct my analysis by conducting a replication analysis on the main outcome of interest of the study by Fetzer (2019) which relies on the same welfare reforms to estimate the impact of austerity at an individual level and uses the same source of data. Additionally, I conduct the analysis for my outcome (reversed GHQ) on the exact same sample. The findings I showcase in this work are in line with the findings reported by Fetzer (2019). Also, I show that the impact of austerity on political preferences is not mirrored on the individuals' mental health.

Through my findings, I contribute to the literature as, to the best of my knowledge, this is the first study that provides evidence regarding the impact of austerity measures in the UK on individuals' mental health. Hence, my study adds on the research area regarding the impact of a reduction on income, in that case unearned income, on mental health at an individual level. Additionally, I further contribute to this research area by providing evidence regarding the impact of social benefits reforms on the mental health of vulnerable groups of individuals in the society even if it introduces changes regarding the provided scheme and non financial changes are implemented. Furthermore, I provide evidence regarding the impact of a number of welfare reforms (CTB, BT, and DLA/PIP) which impacted a high proportion of the population in the Great Britain (GB).

Chapter 5

Conclusions

My thesis centres in applied research that aims at providing evidence regarding health conditions (physical and mental) and how they may impact economic aspects of individuals' lives (impact of BMI on individuals' labour market outcomes) or how individuals' health may be impacted by economic policies (impact of welfare reforms on the mental health of the impacted individuals). In Chapter 2 and Chapter 3 of this thesis, I explore the impact of an increasing BMI on the labour market outcomes of men and women in the UK. More specifically, in Chapter 2, I estimate the causal effect of individuals' BMI on their probability to be in employment and their hourly wage. In this chapter I provide updated evidence regarding the extent that BMI may impact two of the main labour outcomes of individuals. In Chapter 3, I provide causal estimates regarding the way that individuals' BMI determines their probability to hold a social interactive occupation. Also, I explore the explanatory power of being in a social interactive occupation on the wage gap of obese and non-obese individuals. In Chapter 4, I study the impact of the welfare reforms, introduced in the UK with the Welfare Reform Act in 2012, on the mental health of the impacted individuals.

The increase of the average BMI across countries and the continuously increase of the prevalence of obesity on the population has raised an alarm about the consequences of this health condition on individuals' health but also on different aspects of the life of the impacted individuals and the society. Therefore, there is a high interest from health and labour economists to study this phenomenon and to provide evidence with regards to the extent that the obesity epidemic impacts our lives. With regards to the impact of an increasing BMI on the labour market outcomes, researchers provide supportive evidence that it may lead to poorer labour market outcomes. For example there are studies which support that higher BMI may impact negatively the labour income of individuals (Cawley (2004), Brunello and D'Hombres (2007)) or it may reduce their probability to be in employment (Rooth (2009), Garcia Jaume and Quintana-Domeque Climent (2006)). Since an increasing number of members of our society are classified as obese and the average BMI per country increases, it motivates

researchers to conduct further studies in order to provide insights regarding the extent at which individuals are impacted with regards to their labour market outcomes and if there are evidence that society updates the way that it treats its impacted members. I contribute on the above research area by providing causal estimates regarding the impact of BMI on the main labour market outcomes of individuals (hourly wage and employment) as well as on their probability to hold a social interactive occupation. Also, I further explore the explanatory power of being in a social interactive occupation on the hourly wage of obese and non-obese individuals.

In the first research chapter of this thesis (Chapter 2), I provide evidence regarding the impact of an increasing BMI on individuals' hourly wage and their probability of employment. More specifically, the sample of interest in my study includes prime working age individuals (i.e. 25-54 years old) since this age group includes the most attached individuals with regards to the labour market. I consider younger individuals to be people with shorter work experience, thus they may have different labour market outcomes compared to more experienced workers. Also, working age individuals older than 54 years old are closer to their retirement, thus their behaviours in labour market may differ compared to younger working age individuals. Additionally, I conduct my analysis separately for men and women as those two groups of individuals differ with regards to their outcomes in the labour market. I work with the UK nationally representative data set of the UK Household Longitudinal Survey (UKHLS) "Understanding Society" which I link to the data of the supplementary study "Nurse Health Assessment". Also, I add to the data of my study epigenic information related to individuals' BMI which I obtained with a separate application to the Genetics Team of Understanding Society.

Furthermore, I estimate the impact of individuals' BMI on their probability on employment by estimating linear probability models with the OLS method. Also, I estimate log-linear models with the OLS method when I explore the impact of BMI on the hourly wage of individuals. Researchers who conduct research in this area encounter the issue of endogeneity that arises due to a potential reverse causality or omitted variable problem between individuals' BMI and their labour market outcomes (Cawley (2004), Lindeboom et al. (2010), Morris (2007), Mora (2010), etc.). Therefore, in order to provide causal estimates regarding the impact of individuals' BMI on their labour market outcomes I follow an IV approach. More specifically, I use the most updated method of estimating the impact of BMI on individuals' labour market outcomes as I work with a polygenic score which is highly related to individuals' BMI and it provides a valid IV as it impacts the labour market outcomes of interest only through the endogenous variable (BMI).

Based on my analysis, I find that individuals' BMI does not impact the probability of the working age men and women to hold a job position. More specifically, for the case of the prime working age men, I find that the impact of an increasing BMI is zero. This

finding is in line with the distribution of the obese and non-obese working age men based on their employment status. As it is shown on the descriptive statistics the proportion of obese prime working age men in employment is not importantly lower than the proportion of the non-obese prime working age men. Additionally, when I account for the endogeneity issue that arises due to the potential reverse causality or a potential omitted variable problem between individuals' BMI and their employment status, I confirm that there is no causal effect of BMI on the probability of the prime working age men to be in employment as I find a negative effect which is not statistically different from zero. Furthermore, for the case of the prime working age women, the analysis of the impact of an increasing BMI on their probability to be in employment shows that there is a negative effect. More specifically, when I do not account for the endogeneity issue the impact is small but statistically important. This finding confirms the observation on the descriptive statistics that the proportion of obese prime working age women in employment is lower than the proportion of the non-obese prime working age women in employment. However, when I work with the IV of individuals' BMI I find that the causal effect of BMI on the probability of the prime working age women to hold a job position is statistically insignificant. Hence, the outcome of my empirical analysis provides evidence that when I do not account for the endogeneity issue then the impact of BMI on the probability of women to be in employment is overestimated.

Moreover, according to the findings of my analysis regarding the impact of individuals' BMI on their hourly wage, I find a negative and significant impact only for the case of the prime working age women. More specifically, when I account for the endogeneity issue that arises from the reverse causality of individuals' BMI and their labour income, I find that the impact, for the case of men, is not statistically different from zero. For the case of the prime working age women, I find an increase of their BMI by one unit decreases their hourly wage by approximately 3%. Furthermore, I provide supportive evidence regarding the validity of the findings of the main analysis of this chapter. More specifically, I conduct a similar analysis where I estimate the impact of an increasing BMI on the probability of men and women to be in employment and on their hourly wage but now I include in the sample all the working age individuals. Therefore, I provide supportive evidence that independently of the sample, individuals' BMI does not impact the probability of working age men and women to be in employment. Additionally, I confirm that and an increasing BMI has a negative and statistically important impact on the hourly wage of the working age women while I do not find any impact on the sample of the working men.

In Chapter 3, I work with the same data sets and the same samples as for the analysis exhibited in Chapter 2 to conduct a by-gender analysis, regarding the impact of individuals' BMI on their probability to be in a social interactive occupation. Also, I classify the occupations at the unit level of the SOC2000 to socially interactive and

non-social interactive. In this part of my study, I define the non-social interactive occupations those occupations that have very low interaction/or no interaction with customers and a very limited interaction with employers (those who have hired them). Additionally, I discuss the sources of the discrimination that individuals with higher BMI may encounter in labour market. Hence, individuals with higher BMI may have lower probability to be in job positions with certain level of fitness requirements as the potential employers may expect lower productivity due to individuals' excess weight. The second source of discrimination of individuals with higher BMI I expect to be related to the social norms and the beliefs is that individuals may be lazier and less productive. Therefore, I classify the occupations based on their fitness requirements to be able to provide some evidence regarding the way that individuals' BMI impacts their labour market outcomes even when I include in my sample only occupations that do not require certain level of fitness.

The findings of my empirical analysis, when I account for the endogeneity problem due to potential omitted variables that may impact individuals' BMI and their probability to be in a social interactive occupation, provide supportive evidence that an increase on individuals' BMI decreases the probability of the prime working age women to be in a social interactive occupation by around 2%. For the case of the prime working age men, I do not find a causal and statistically important effect. Furthermore, I exclude from my sample the occupations with fitness requirements of level two and I conduct the empirical analysis regarding the impact of BMI on the hourly wage of the prime working age men and women and their probability to be in a social interactive occupation. The findings are consistent indicating a decrease on the hourly wage of the prime working age women by around 3% for an increase of their BMI by one unit while the corresponding impact for men is zero. Also, the probability of the prime working age women to be in a social interactive occupation decreases by more than 2% when their BMI increases by one unit while for men I do not find a statistically important causal effect. Therefore, my findings suggest that as the BMI of women increases women are disadvantaged in the labour market although the sample may not include occupations that have certain fitness requirements. Thus, I provide supportive evidence that women may have worse labour outcomes not because they are less qualified (as I exclude occupations that require higher physical strength) but probably because they face a discrimination due to social norms and beliefs that individuals with excess weight may be less productive.

Moreover, the above findings motivates my empirical analysis to explore the explanatory power of being in a social interactive occupation on the hourly wage gap of obese and non-obese individuals. More specifically, I show that the social interactive occupations pay more on average (higher hourly wage) compared to the non-social interactive occupations for both the sample of the prime working age men and women. I considered worth investigating whether being in a social interactive

occupation could explain part of the wage gap of individuals with excess weight and individuals with a non unhealthy weight. The analysis is more important for the case of women as the findings have suggested that their probability to hold a social interactive occupation decreases as their BMI increases. Similarly, the hourly wage of women is negatively impacted by their BMI. Hence, my aim is to provide evidence whether women with higher BMI earn less due to the fact that they are less likely to be in a social interactive occupation that pays more. For this part of my analysis I conduct my analysis by working with the Blinder-Oaxaca decomposition method. Based on the findings of my analysis being in a social interactive occupation does not explain the wage gap of obese and non-obese individuals. The results are consistent on the sample where I exclude the occupations that have a fitness requirement of level two.

Furthermore, I provide supportive evidence regarding the validity of my main analysis about the explanatory power of being in a social interactive occupation on the hourly wage gap of obese and non-obese individuals by working with different proposed definitions of social interactive occupations. Firstly, I conduct my analysis by working with the definition of the social interactive occupations provided by Barbieri (2018) where the classification of the occupations to social and non social is conducted at the minor group level (three digits) of the SOC2000. Secondly, I work with an official classification of occupations to social and non-social interactive which is provided by the ONET (developed under the sponsorship of the USDOL/ETA). The results of the analysis with both classifications of the occupations to social and non-social interactive confirm that holding a job position that involves social interaction cannot explain (part) of the wage gap of obese and non-obese individuals. To further enhance the confidence regarding the findings of the main analysis I conduct an empirical analysis regarding the impact of being in a social interactive occupation on the hourly wage of men and women. The output of the analysis suggest that being in as social interactive occupation has not a statistically important impact on the hourly wage of the prime working age men and women. The findings are consistent when I work the classification of occupations to socially interactive according to Barbieri (2018) and according to the ONET. My findings are important as they suggest that we cannot explain the wage gap of obese and non-obese when we know whether they hold a social interactive occupation. My findings does not disprove that women with an increasing BMI are discriminated in the labour market. Instead, the findings only provide evidence that a valid potential channel which could be expected to explain the wage differences of obese and non-obese women is not supported by the output of my analysis. Hence, it is important in future research to rely on that knowledge and explore other potential channels towards providing evidence on the channels that explain the wage differences among obese and non-obese individuals.

In Chapter 4, I explore the impact of the welfare reforms, that were introduced in the UK with the Welfare Reform Act in 2012, on the mental health of the impacted

individuals. For my study, I work with the data set of the first five waves of the UKHLS, "Understanding Society". More specifically, I estimate the impact of the CTB, BT and the replacement of the DLA by the PIP on the mental health of the impacted working age individuals. The information regarding individuals' mental health, in my sample, is provided by the self reported GHQ (12 items) as this is a measure frequently used in the literature. The time period of my analysis is limited to 2009-2015 since after the 2015 the Universal Credit was introduced in most areas. This new welfare reform impacted working age individuals for whom it replaced six of the existing social benefits (Jobseeker's Allowance, Income Support, Housing Benefit, Employment and Support Allowance, Working Tax Credit and Child Tax Credit). Furthermore, I exclude from the sample of my study observations that report to live in the Northern Ireland as the welfare reforms differ in their time of implementation and/or the new social benefits introduced were different. For example the BT was implemented in the Northern Ireland from 20 February 2017. Also, the new scheme of the old CTB was different compared to the Great Britain. To conduct my empirical analysis I apply the DiD method. Moreover, I limit the sample to social benefit recipients. Additionally, to ensure that I do not work with a contaminated control group, I exclude from the sample individuals who report to receive any of the benefits of interest (CTB, BT, and DLA/PIP) but are not identified as treated individuals. Also, I exclude individuals who report to receive other social benefits that were also impacted by the Welfare Reform Act in 2012. I estimate linear specifications where I control for individuals' fixed effect and time fixed effects.

According to the findings of my analysis, the implementation of the welfare reforms did not have an important impact on the mental health of the impacted individuals. More specifically, the empirical analysis provides small and not statistically important coefficients on individuals' reverse GHQ score for the case where I explore the impact of being impacted by at least one of the reforms. The findings are consistent when I include in my models controls for the survey wave additionally to the individuals' fixed effect and time fixed effect. Additionally, in order to provide supportive evidence regarding the validity of the main findings of my study and to capture the dynamic impact of the welfare reforms on individuals' mental health I conduct panel event study analysis per specification. The output of this further analysis provides supportive evidence that the treatment groups share similar trends, with regards to the outcome of interest, with the corresponding control groups before the implementation of the reforms as there is no statistically important coefficient before the time of the implementation of the reforms to indicate a violation of the parallel trend assumption needed for the validity of the DiD analysis. Therefore, I provide supportive evidence that the main analysis (DiD) provides causal estimates regarding the impact of the welfare reforms on individuals' mental health. With regards to the dynamic impact of the welfare reforms on individuals' mental health it is important to highlight that in general it is confirmed that there is no identified impact but I observe

an consistent finding which indicates a small but negative and statistically significant impact during the first two quarters after the implementation of the welfare reforms which is not maintained over time.

Additionally, I provide further robustness analysis regarding the findings of my main analysis. For example, I construct a placebo falsification setting to conduct my analysis. More specifically, I limit the sample of my analysis to the time period before the implementation of the reforms (2009Q1 - 2013Q1). Also, I set a false time of treatment the first quarter of the 2011 as it is in the middle of the time period of the placebo setting. I conduct the DiD analysis for the models that I control for individuals' fixed and time fixed effect as well as for the models that I include the additional control of survey wave. The findings provide supportive evidence regarding the validity of the main analysis as no impact on the placebo falsification is identified. Hence, this analysis provides further evidence that the hypothesis of the parallel trends, before the implementation of the reforms, for the treatment group and the control group, with regards to individuals' self-reported reversed GHQ score, holds.

Furthermore, I conduct heterogeneous analysis to explore whether the impact of the welfare reforms on the mental health of the effected individuals differ based on their characteristics. Firstly, I explore the impact of the austerity measures on the mental health of men and women separately to provide insights whether those two groups react differently on income reduction (unearned income) and institutional changes. Additionally, given that the average mental health of younger individuals is better than the average mental health of older individuals, I explore whether the implementation of the welfare reforms have different consequences for the mental health of the younger working age individuals (16-43 years old) than for the older working age individuals (44-64 years old). Furthermore, I investigate whether there are heterogeneous effects of the implemented austerity measures on the mental health of individuals based on the deprived level of the area that they live. Therefore, since the mental health of individuals who live in more deprived areas is worse compared to the mental health of people who live in less deprived areas I conduct the DiD analysis separately for those two groups. The results of the heterogeneous analysis provides supportive evidence that there is a homogeneous response of individuals to the implementation of the welfare reforms and that their mental health is not impacted overall. Finally, I conduct a replication analysis with regards to the main outcome of the study by Fetzer (2019) as the author works with the same welfare reforms that I include my analysis. Also, on the same sub-sample I conduct again the main analysis of my study. Therefore, I confirm the findings of the above study and I confirm the findings of my analysis. Thus, I provide supportive evidence that the sample that I use to answer my research question is appropriate.

The findings of my study support that the reduction of the unearned income and the institutional changes introduced with the implementation of the CTB, BT and the

replacement of the DLA by the PIP did not impact the mental health of the affected individuals. My study is the first study, to the best of my knowledge, that investigates the impact of the austerity measures in the UK on individuals' mental health. Therefore, my study contributes to the literature regarding the impact of reduction of income, in that case unearned income from social benefits, on individuals' mental health. Also, I contribute on the research area related to the impact of an institutional reform on the social benefit system even if the goal is not an income reduction of the eligible individuals. Additionally, my analysis provides supportive evidence with regards to the extent that a number of welfare reforms (CTB, BT, and DLA/PIP) impacted the mental health of a high proportion of people in the country.

Appendix A

Chapter II

A.1 Descriptive statistics

Table A.1: Classification of BMI's categories and occupations' categories

BMI categories	
Underweight	less than 18.5
Healthy weight	$18.5 \leq BMI \leq 24.9$
Overweight	$25 \leq BMI \leq 29.9$
Obese	$30 \leq BMI \leq 39.9$
Occupation	
Professional	employers large, employers small, professional, self-employed and professional employed
Manager	managers large, managers small, int. non-manual foreman, and foreman manual
Skilled	skilled manual workers
Semi-skilled	int. non manual work, junior non-manual personal service worker, semiskilled manual workers and own account workers
Unskilled/Other	unskilled manual workers, farmers employer, agricultural workers, farmers on won account and members of armed forces

A.2 Empirical analysis

TABLE A.2: The impact of BMI on the probability of employment for the prime working age men and women

Employment	Men		Women	
	(1)	(2)	(1)	(2)
Age group: 35 - 44	-0.0378	-0.0157	0.0673**	0.0716***
	(0.0239)	(0.0226)	(0.0270)	(0.0252)
Age group: 45 - 54	-0.0951***	-0.0514**	0.0763***	-0.0159
	(0.0240)	(0.0222)	(0.0272)	(0.0263)
Marital status: Single	-0.133***	-0.115***	0.0229	-0.0472**
	(0.0187)	(0.0184)	(0.0216)	(0.0210)
Education: University degree or equivalent	0.0688***	0.0489***	0.177***	0.129***
	(0.0165)	(0.0154)	(0.0224)	(0.0198)
North East	-0.112**	-0.0626	0.0244	0.0510
	(0.0452)	(0.0434)	(0.0467)	(0.0437)
North West	-0.0618*	-0.0287	0.0489	0.0339
	(0.0354)	(0.0334)	(0.0392)	(0.0365)
Yorkshire and the Humber	-0.0328	-0.00673	0.0504	0.0408
	(0.0395)	(0.0375)	(0.0415)	(0.0386)
East Midlands	0.0337	0.0544	0.0609	0.0627
	(0.0364)	(0.0342)	(0.0438)	(0.0411)
West Midlands	-0.0654*	-0.0591	0.0265	0.0183
	(0.0385)	(0.0363)	(0.0424)	(0.0400)
East of England	-0.00502	0.0161	0.0407	0.0403
	(0.0393)	(0.0373)	(0.0411)	(0.0383)
London	0.0391	0.0443	-0.0370	-0.0306
	(0.0373)	(0.0353)	(0.0455)	(0.0430)
South East	0.00900	0.00525	0.0476	0.0525
	(0.0339)	(0.0318)	(0.0413)	(0.0396)
South West	-0.00988	0.00745	0.125***	0.0995**
	(0.0403)	(0.0377)	(0.0434)	(0.0405)
Wales	0.0350	0.0353	0.166***	0.115***
	(0.0470)	(0.0442)	(0.0475)	(0.0443)
Excellent		0.417***		0.552***
		(0.0556)		(0.0560)
Very good		0.467***		0.542***
		(0.0489)		(0.0479)
Good		0.449***		0.486***
		(0.0445)		(0.0440)
Fair		0.331***		0.314***
		(0.0441)		(0.0457)
Long-standing illness		-0.0711***		-0.0542**
		(0.0192)		(0.0223)
Number of children		-0.148**		-0.113***
		(0.0697)		(0.00938)
Constant	1.172***	0.730**	0.678**	0.113
	(0.299)	(0.328)	(0.274)	(0.306)
Observations	1,641	1,641	2,220	2,220

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability and number of children.

TABLE A.3: The impact of BMI on the hourly wage of the prime working age men and women

Hourly wage	**Men**		**Women**	
	(1)	(2)	(1)	(2)
Age group: 35 - 44	0.0888*	0.0699	0.165***	0.145***
	(0.0456)	(0.0465)	(0.0351)	(0.0338)
Age group: 45 - 54	0.142***	0.118**	0.135***	0.109***
	(0.0483)	(0.0476)	(0.0362)	(0.0345)
Marital status: Single	-0.219***	-0.188***	-0.0213	-0.0230
	(0.0364)	(0.0370)	(0.0292)	(0.0283)
Education: University degree or equivalent	0.368***	0.311***	0.384***	0.300***
	(0.0327)	(0.0349)	(0.0273)	(0.0265)
North East	-0.0605	0.0393	-0.0589	-0.0452
	(0.0888)	(0.0903)	(0.0622)	(0.0597)
North West	-0.00166	0.0317	-0.0438	-0.0496
	(0.0704)	(0.0704)	(0.0525)	(0.0505)
Yorkshire and the Humber	0.0449	0.139	-0.0475	-0.0339
	(0.0846)	(0.0863)	(0.0550)	(0.0525)
East Midlands	0.0138	0.0586	-0.0643	-0.0908*
	(0.0723)	(0.0721)	(0.0571)	(0.0551)
West Midlands	0.0699	0.105	-0.00160	-0.00311
	(0.0740)	(0.0737)	(0.0572)	(0.0555)
East of England	0.138*	0.223***	-0.0245	-0.0609
	(0.0803)	(0.0815)	(0.0554)	(0.0537)
London	0.347***	0.409***	0.0683	0.0585
	(0.0765)	(0.0771)	(0.0599)	(0.0577)
South East	0.120*	0.146**	0.0416	0.0413
	(0.0669)	(0.0662)	(0.0549)	(0.0546)
South West	0.0317	0.0833	-0.0832	-0.0663
	(0.0821)	(0.0817)	(0.0574)	(0.0563)
Wales	0.000723	0.0875	-0.0929	-0.0711
	(0.0954)	(0.0953)	(0.0614)	(0.0592)
Excellent		0.454***		0.162
		(0.153)		(0.102)
Very good		0.346**		0.143
		(0.140)		(0.101)
Good		0.294**		0.145
		(0.133)		(0.103)
Fair		0.242*		-0.0207
		(0.132)		(0.107)
Long-standing illness		-0.0381		0.0177
		(0.0410)		(0.0301)
Professional		0.381***		0.650***
		(0.109)		(0.0951)
Manager		0.551***		0.327***
		(0.0802)		(0.0781)
Skilled		0.340***		0.187
		(0.0867)		(0.143)
Semi-skilled		0.339***		0.189**
		(0.0792)		(0.0739)
Private Sector		0.0221		-0.136***
		(0.0390)		(0.0237)
Constant	2.158***	0.502	2.919***	2.560***
	(0.617)	(0.779)	(0.333)	(0.380)
Observations	1,243	1,243	1,589	1,589

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability, occupation and sector.

Appendix B

Chapter III

B.1 Classification of the Standard Occupational Classification 2000 (SOC2000) to socially interactive and non-socially interactive occupations

Table B.1: Social interactive occupations and fitness requirement - A (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
1111 Senior officials in national government	Yes	0
1112 Directors and chief executives of major organisations	Yes	0
1113 Senior officials in local government	Yes	0
1114 Senior officials of special interest organisations	Yes	0
1121 Production, works and maintenance managers	No	0
1122 Managers in construction	No	0
1123 Managers in mining and energy	No	0
1131 Financial managers and chartered secretaries	Yes	0
1132 Marketing and sales managers	Yes	0
1133 Purchasing managers	No	0
1134 Advertising and public relations managers	Yes	0
1135 Personnel, training and industrial relations managers	Yes	0
1136 Information and communication technology managers	Yes	0
1137 Research and development managers	No	0
1141 Quality assurance managers	No	0
1142 Customer care managers	Yes	0
1151 Financial institution managers	Yes	0
1152 Office managers	Yes	0
1161 Transport and distribution managers	No	0
1162 Storage and warehouse managers	No	0
1163 Retail and wholesale managers	No	0
1171 Officers in armed forces	No	2
1172 Police officers (inspectors and above)	No	2
1173 Senior officers in fire, ambulance, prison and related services	Yes	2
1174 Security managers	No	2
1181 Hospital and health service managers	Yes	0
1182 Pharmacy managers	Yes	0
1183 Healthcare practice managers	Yes	0
1184 Social services managers	No	0
1185 Residential and day care managers	No	0

TABLE B.2: Social interactive occupations and fitness requirement - B (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
1211 Farm managers	Yes	0
1212 Natural environment and conservation managers	Yes	0
1219 Managers in animal husbandry, forestry and fishing n.e.c.	Yes	0
1221 Hotel and accommodation managers	Yes	0
1222 Conference and exhibition managers	Yes	0
1223 Restaurant and catering managers	Yes	0
1224 Publicans and managers of licensed premises	Yes	0
1225 Leisure and sports managers	Yes	0
1226 Travel agency managers	Yes	0
1231 Property, housing and land managers	Yes	0
1232 Garage managers and proprietors	No	0
1233 Hairdressing and beauty salon managers and proprietors	Yes	0
1234 Shopkeepers and wholesale/retail dealers	No	0
1235 Recycling and refuse disposal managers	No	0
1239 Managers and proprietors in other services n.e.c.	No	0
2111 Chemists	No	0
2112 Biological scientists and biochemists	No	0
2113 Physicists, geologists and meteorologists	No	0
2121 Civil engineers	Yes	0
2122 Mechanical engineers	Yes	0
2123 Electrical engineers	Yes	0
2124 Electronics engineers	Yes	1
2125 Chemical engineers	No	0
2126 Design and development engineers	No	0
2127 Production and process engineers	Yes	0
2128 Planning and quality control engineers	No	0
2129 Engineering professionals n.e.c	Yes	0
2131 IT strategy and planning professionals	No	0
2132 Software professionals	No	0

TABLE B.3: Social interactive occupations and fitness requirement - C (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
2211 Medical practitioners	Yes	0
2212 Psychologists	Yes	0
2213 Pharmacists/pharmacologists	Yes	0
2214 Ophthalmic opticians	Yes	0
2215 Dental practitioners	Yes	0
2216 Veterinarians	Yes	0
2311 Higher education teaching professionals	Yes	0
2312 Further education teaching professionals	Yes	0
2313 Education officers, school inspectors	Yes	0
2314 Secondary education teaching professionals	Yes	0
2315 Primary and nursery education teaching professionals	Yes	0
2316 Special needs education teaching professionals	Yes	0
2317 Registrars and senior administrators of educational establishments	Yes	0
2319 Teaching professionals n.e.c.	Yes	0
2321 Scientific researchers	Yes	0
2322 Social science researchers	Yes	0
2329 Researchers n.e.c.	Yes	0
2411 Solicitors and lawyers, judges and coroners	Yes	0
2419 Legal professionals n.e.c.	Yes	0
2421 Chartered and certified accountants	Yes	0
2422 Management accountants	Yes	0
2423 Management consultants, actuaries, economists and statisticians	Yes	0
2431 Architects	Yes	0
2432 Town planners	Yes	0
2433 Quantity surveyors	Yes	0
2434 Chartered surveyors (not quantity surveyors)*	No	1
2441 Public service administrative professionals	No	0
2442 Social workers	Yes	0
2443 Probation officers	Yes	0
2444 Clergy	Yes	0
2451 Librarians	Yes	0
2452 Archivists and curators	No	0
3111 Laboratory technicians	No	0
3112 Electrical/electronics technicians	Yes	1
3113 Engineering technicians	Yes	1
3114 Building and civil engineering technicians	No	1
3115 Quality assurance technicians	No	1
3119 Science and engineering technicians n.e.c.	No	0
3121 Architectural technologists and town planning technicians	No	0
3122 Draughtspersons	No	0
3123 Building inspectors	No	0
3131 IT operations technicians	No	0
3132 IT user support technicians	Yes	0

TABLE B.4: Social interactive occupations and fitness requirement - D (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
3211 Nurses	Yes	1
3212 Midwives	Yes	1
3213 Paramedics	Yes	1
3214 Medical radiographers	Yes	1
3215 Chiropodists	Yes	1
3216 Dispensing opticians	Yes	0
3217 Pharmaceutical dispensers	Yes	1
3218 Medical and dental technicians	No	0
3221 Physiotherapists	Yes	2
3222 Occupational therapists	Yes	1
3223 Speech and language therapists	Yes	0
3229 Therapists n.e.c.	Yes	0
3231 Youth and community workers	Yes	0
3232 Housing and welfare officers	Yes	0
3311 NCOs and other ranks	No	2
3312 Police officers (sergeant and below)	Yes	2
3313 Fire service officers (leading fire officer and below)	Yes	2
3314 Prison service officers (below principal officer)	Yes	2
3319 Protective service associate professionals n.e.c.	Yes	2
3411 Artists	Yes	0
3412 Authors, writers	No	0
3413 Actors, entertainers	Yes	0
3414 Dancers and choreographers	Yes	2
3415 Musicians	Yes	0
3416 Arts officers, producers and directors	Yes	0
3421 Graphic designers	No	0
3422 Product, clothing and related designers	No	0
3431 Journalists, newspaper and periodical editors	Yes	0
3432 Broadcasting associate professionals	Yes	0
3433 Public relations officers	Yes	0
3434 Photographers and audio-visual equipment operators	Yes	0
3441 Sports players	Yes	2
3442 Sports coaches, instructors and officials	Yes	1
3443 Fitness instructors	Yes	0
3449 Sports and fitness occupations n.e.c.	Yes	2
3511 Air traffic controllers	No	0
3512 Aircraft pilots and flight engineers	No	1
3513 Ship and hovercraft officers	No	1
3514 Train drivers	No	0

TABLE B.5: Social interactive occupations and fitness requirement - E (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
3520 Legal associate professionals	Yes	0
3531 Estimators, valuers and assessors	No	0
3532 Brokers	Yes	0
3533 Insurance underwriters	Yes	0
3534 Finance and investment analysts/advisers	Yes	0
3535 Taxation experts	No	0
3536 Importers, exporters	Yes	0
3537 Financial and accounting technicians	No	0
3539 Business and related associate professionals n.e.c.	Yes	0
3541 Buyers and purchasing office	Yes	0
3542 Sales representati	Yes	0
3543 Marketing associate professionals	Yes	0
3544 Estate agents, auctioneers	Yes	0
3551 Conservation and environmental protection officers	Yes	0
3552 Countryside and park rangers	No	0
3561 Public service associate professionals	Yes	0
3562 Personnel and industrial relations officers	Yes	0
3563 Vocational and industrial trainers and instructors	Yes	0
3564 Careers advisers and vocational guidance specialists	Yes	0
3565 Inspectors of factories, utilities and trading standards	No	0
3566 Statutory examiners	Yes	0
3567 Occupational hygienists and safety officers (health and safety)	Yes	0
3568 Environmental health officers	Yes	0
4111 Civil Service executive officers	Yes	0
4112 Civil Service administrative officers and assista	Yes	0
4113 Local government clerical officers and assistants	Yes	0
4114 Officers of non-governmental organisations	Yes	0
4121 Credit controllers	No	0
4122 Accounts and wages clerks, book-keepers, other financial clerks	No	0
4123 Counter clerks	Yes	0
4131 Filing and other records assistants/clerks	No	0
4132 Pensions and insurance clerks	Yes	0
4133 Stock control clerks	Yes	0
4134 Transport and distribution clerks	Yes	0
4135 Library assistants/clerks	No	0
4136 Database assistants/clerks	No	0
4137 Market research interviewers	Yes	0
4141 Telephonists	No	0
4142 Communication operators	No	0
4150 General office assistants/clerks	Yes	0

TABLE B.6: Social interactive occupations and fitness requirement - F (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
4211 Medical secretaries	Yes	0
4212 Legal secretaries	Yes	0
4213 School secretaries	Yes	0
4214 Company secretaries	Yes	0
4215 Personal assistants and other secretaries	Yes	0
4216 Receptionists	Yes	0
4217 Typists	No	0
5111 Farmers	No	2
5112 Horticultural trades	No	2
5113 Gardeners and groundsmen/groundswomen	No	2
5119 Agricultural and fishing trades n.e.c.	No	2
5211 Smiths and forge workers	No	2
5212 Moulders, core makers, die casters	No	2
5213 Sheet metal workers	No	2
5214 Metal plate workers, shipwrights, riveters	No	2
5215 Welding trades	No	2
5216 Pipe fitters	No	2
5221 Metal machining setters and setter-operators	No	2
5222 Tool makers, tool fitters and markers-out	No	2
5223 Metal working production and maintenance fitters	No	2
5224 Precision instrument makers and repairers	No	2
5231 Motor mechanics, auto engineers	Yes	2
5232 Vehicle body builders and repairers	No	2
5233 Auto electricians	Yes	2
5234 Vehicle spray painters	No	1
5241 Electricians, electrical fitters	Yes	1
5242 Telecommunications engineers	Yes	1
5243 Lines repairers and cable jointers	No	1
5244 TV, video and audio engineers	Yes	1
5245 Computer engineers, installation and maintenanc	Yes	1
5249 Electrical/electronics engineers n.e.c.	No	1

TABLE B.7: Social interactive occupations and fitness requirement - G (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
5311 Steel erectors	No	2
5312 Bricklayers, masons	Yes	2
5313 Roofers, roof tilers and slaters	Yes	2
5314 Plumbers, heating and ventilating engineers	Yes	2
5315 Carpenters and joiners	Yes	2
5316 Glaziers, window fabricators and fitters	Yes	2
5319 Construction trades n.e.c.	No	2
5321 Plasterers	No	1
5322 Floorers and wall tilers	Yes	1
5323 Painters and decorators	Yes	1
5411 Weavers and knitters	No	1
5412 Upholsterers	No	1
5413 Leather and related trades	No	1
5414 Tailors and dressmakers	Yes	1
5419 Textiles, garments and related trades n.e.c.	No	1
5421 Originators, compositors and print preparers	No	0
5422 Printers	Yes	0
5423 Bookbinders and print finishers	Yes	0
5424 Screen printers	Yes	0
5431 Butchers, meat cutters	Yes	1
5432 Bakers, flour confectioners	Yes	1
5433 Fishmongers, poultry dressers	No	1
5434 Chefs, cooks	No	1
5491 Glass and ceramics makers, decorators and finishers	Yes	1
5492 Furniture makers, other craft woodworkers	No	1
5493 Pattern makers (moulds)	No	1
5494 Musical instrument makers and tuners	Yes	1
5495 Goldsmiths, silversmiths, precious stone workers	No	1
5496 Floral arrangers, florists	Yes	1
5499 Hand craft occupations n.e.c.	No	1
6111 Nursing auxiliaries and assistants	Yes	1
6112 Ambulance staff (excluding paramedics)	Yes	2
6113 Dental nurses	Yes	0
6114 Houseparents and residential wardens	Yes	1
6115 Care assistants and home carers	Yes	1
6121 Nursery nurses	Yes	1
6122 Childminders and related occupations	Yes	1
6123 Playgroup leaders/assistants	Yes	1
6124 Educational assistants	Yes	0
6131 Veterinary nurses and assistants	Yes	1
6139 Animal care occupations n.e.c.	Yes	1

TABLE B.8: Social interactive occupations and fitness requirement - H (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
6211 Sports and leisure assistants	Yes	1
6212 Travel agents	Yes	0
6213 Travel and tour guides	Yes	0
6214 Air travel assistants	Yes	0
6215 Rail travel assistants	Yes	0
6219 Leisure and travel service occupations n.e.c.	Yes	0
6221 Hairdressers, barbers	Yes	0
6222 Beauticians and related occupations	Yes	0
6231 Housekeepers and related occupations	Yes	1
6232 Caretakers	No	1
6291 Undertakers and mortuary assistants	Yes	1
6292 Pest control officers	Yes	1
7111 Sales and retail assistants	Yes	1
7112 Retail cashiers and check-out operators	Yes	0
7113 Telephone salespersons	No	0
7121 Collector salespersons and credit agents	Yes	0
7122 Debt, rent and other cash collectors	Yes	0
7123 Roundsmen/women and van salespersons	Yes	1
7124 Market and street traders and assistants	Yes	1
7125 Merchandisers and window dressers	Yes	1
7129 Sales related occupations n.e.c.	Yes	0
7211 Call centre agents/operators	No	0
7212 Customer care occupations	Yes	0
8111 Food, drink and tobacco process operatives	No	1
8112 Glass and ceramics process operatives	No	1
8113 Textile process operatives	No	1
8114 Chemical and related process operatives	No	1
8115 Rubber process operatives	No	1
8116 Plastics process operatives	No	1
8117 Metal making and treating process operatives	No	1
8118 Electroplaters	No	2
8119 Process operatives n.e.c.	No	1
8121 Paper and wood machine operatives	No	2
8122 Coal mine operatives	No	2
8123 Quarry workers and related operatives	No	2
8124 Energy plant operatives	No	1
8125 Metal working machine operatives	No	2
8126 Water and sewerage plant operatives	No	1
8129 Plant and machine operatives n.e.c.	No	2

TABLE B.9: Social interactive occupations and fitness requirement - I (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
8131 Assemblers (electrical products)	No	2
8132 Assemblers (vehicles and metal goods)	No	2
8133 Routine inspectors and testers	No	0
8134 Weighers, graders, sorters	No	1
8135 Tyre, exhaust and windscreen fitters	No	2
8136 Clothing cutters	No	1
8137 Sewing machinists	No	1
8138 Routine laboratory testers	No	0
8139 Assemblers and routine operatives n.e.c.	No	1
8141 Scaffolders, stagers, riggers	No	2
8142 Road construction operatives	No	2
8143 Rail construction and maintenance operatives	No	2
8149 Construction operatives n.e.c.	No	2
8211 Heavy goods vehicle drivers	No	1
8212 Van drivers	No	1
8213 Bus and coach drivers	Yes	0
8214 Taxi, cab drivers and chauffeurs	Yes	0
8215 Driving instructors	Yes	0
8216 Rail transport operatives	No	0
8217 Seafarers (merchant navy); barge, lighter and boat operatives	No	2
8218 Air transport operatives	No	2
8219 Transport operatives n.e.c.	No	1
8221 Crane drivers	No	1
8222 Fork-lift truck drivers	No	0
8223 Agricultural machinery drivers	No	1
8229 Mobile machine drivers and operatives n.e.c.	No	1
9111 Farm workers	No	2
9112 Forestry workers	No	2
9119 Fishing and agriculture related occupations n.e.c.	No	2
9121 Labourers in building and woodworking trades	No	2
9129 Labourers in other construction trades n.e.c.	No	2
9131 Labourers in foundries	No	2
9132 Industrial cleaning process occupations	No	2
9133 Printing machine minders and assistants	No	1
9134 Packers, bottlers, canners, fillers	No	1
9139 Labourers in process and plant operations n.e.c.	No	2

TABLE B.10: Social interactive occupations and fitness requirement - J (UK SOC-2000)

SOC2000 - Unit Group	Social Interactive	Fitness requirement
9141 Stevedores, dockers and slingers	No	2
9149 Other goods handling and storage occupations n.e.c.	No	2
9211 Postal workers, mail sorters, messengers, couriers	Yes	1
9219 Elementary office occupations n.e.c.	Yes	0
9221 Hospital porters	Yes	2
9222 Hotel porters	Yes	1
9223 Kitchen and catering assistants	Yes	1
9224 Waiters, Waitresses	Yes	1
9225 Bar staff	Yes	1
9226 Leisure and theme park attendants	Yes	1
9229 Elementary personal services occupations n.e.c.	Yes	1
9231 Window cleaners	No	1
9232 Road sweepers	No	1
9233 Cleaners, domestics	No	1
9234 Launderers, dry cleaners, pressers	No	1
9235 Refuse and salvage occupations	No	1
9239 Elementary cleaning occupations n.e.c.	No	1
9241 Security guards and related occupations	Yes	2
9242 Traffic wardens	Yes	0
9243 School crossing patrol attendants	Yes	0
9244 School mid-day assistants	Yes	0
9245 Car park attendants	Yes	0
9249 Elementary security occupations n.e.c.	Yes	1
9251 Shelf fillers	No	1
9259 Elementary sales occupations n.e.c.	Yes	1

B.2 Social interactive occupations based on ONET-2019 classification

Table B.11: Social interactive occupations based on ONET-2019 classification: A (UK SOC-2000)

Standard Occupational Classification 2000 (SOC2000) - Unit Group
Adult Literacy, Remedial Education, and GED Teachers and Instructors
Agricultural Sciences Teachers, Postsecondary
Ambulance Drivers and Attendants, Except Emergency Medical Technicians
Anthropology and Archeology Teachers, Postsecondary
Arbitrators, Mediators, and Conciliators
Architecture Teachers, Postsecondary
Area, Ethnic, and Cultural Studies Teachers, Postsecondary
Art, Drama, and Music Teachers, Postsecondary
Athletic Trainers
Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary
Biological Science Teachers, Postsecondary
Bus Drivers, Transit and Intercity
Business Teachers, Postsecondary
Chemistry Teachers, Postsecondary
Child Care Workers
Child, Family, and School Social Workers
Chiropractors
Clergy
Coaches and Scouts
Combined Food Preparation and Serving Workers, Including Fast Food
Communications Teachers, Postsecondary
Computer Science Teachers, Postsecondary
Computer Systems Analysts
Conservation Scientists
Counter Attendants, Cafeteria, Food Concession, and Coffee Shop
Criminal Justice and Law Enforcement Teachers, Postsecondary
Crossing Guards
Customer Service Representatives
Dental Hygienists
Dietetic Technicians
Dining Room and Cafeteria Attendants and Bartender Helpers
Economics Teachers, Postsecondary
Education Administrators, Preschool and Child Care Center/Program
Education Teachers, Postsecondary
Educational, Vocational, and School Counselors
Elementary School Teachers, Except Special Education
Eligibility Interviewers, Government Programs
Emergency Management Specialists
Engineering Teachers, Postsecondary
English Language and Literature Teachers, Postsecondary
Environmental Science Teachers, Postsecondary
Equal Opportunity Representatives and Officers
Farm and Home Management Advisors
Fitness Trainers and Aerobics Instructors
Flight Attendants
Food Servers, Nonrestaurant
Foreign Language and Literature Teachers, Postsecondary
Forestry and Conservation Science Teachers, Postsecondary
Funeral Attendants
Geography Teachers, Postsecondary

Table B.12: Social interactive occupations based on ONET-2019 classification: B (UK SOC-2000)

Standard Occupational Classification 2000 (SOC2000) - Unit Group
Graduate Teaching Assistants
Health Diagnosing and Treating Practitioners, All Other
Health Educators
Health Specialties Teachers, Postsecondary
Health Technologists and Technicians, All Other
Healthcare Practitioners and Technical Workers, All Other
Healthcare Support Workers, All Other
History Teachers, Postsecondary
Home Economics Teachers, Postsecondary
Home Health Aides
Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop
Instructional Coordinators
Kindergarten Teachers, Except Special Education
Law Teachers, Postsecondary
Library Science Teachers, Postsecondary
Licensed Practical and Licensed Vocational Nurses
Lifeguards, Ski Patrol, and Other Recreational Protective Service Workers
Locker Room, Coatroom, and Dressing Room Attendants
Marriage and Family Therapists
Massage Therapists
Mathematical Science Teachers, Postsecondary
Medical and Public Health Social Workers
Medical Assistants
Mental Health and Substance Abuse Social Workers
Mental Health Counselors
Middle School Teachers, Except Special and Vocational Education
Nursing Aides, Orderlies, and Attendants
Nursing Aides, Orderlies, and Attendants
Nursing Instructors and Teachers, Postsecondary
Occupational Therapist Aides
Occupational Therapist Assistants
Occupational Therapists
Orthotists and Prosthetists
Personal and Home Care Aides
Philosophy and Religion Teachers, Postsecondary
Physical Therapist Aides
Physical Therapist Assistants
Physical Therapists
Physician Assistants
Physicians and Surgeons, All Other
Physics Teachers, Postsecondary
Political Science Teachers, Postsecondary
Preschool Teachers, Except Special Education
Probation Officers and Correctional Treatment Specialists
Psychiatric Aides
Psychiatric Technicians
Psychology Teachers, Postsecondary
Radiation Therapists
Recreation and Fitness Studies Teachers, Postsecondary
Recreation Workers

TABLE B.13: Social interactive occupations based on ONET-2019 classification: C (UK SOC-2000)

Standard Occupational Classification 2000 (SOC2000) - Unit Group
Recreational Therapists
Registered Nurses
Rehabilitation Counselors
Residential Advisors
Respiratory Therapists
Secondary School Teachers, Except Special and Vocational Education
Self-Enrichment Education Teachers
Social Work Teachers, Postsecondary
Sociology Teachers, Postsecondary
Special Education Teachers, All Other
Special Education Teachers, Middle School
Special Education Teachers, Preschool, Kindergarten, and Elementary School
Special Education Teachers, Secondary School
Speech-Language Pathologists
Substance Abuse and Behavioral Disorder Counselors
Teachers and Instructors, All Other
Therapists, All Other
Tour Guides and Escorts
Training and Development Specialists
Ushers, Lobby Attendants, and Ticket Takers
Veterinary Assistants and Laboratory Animal Caretakers
Vocational Education Teachers, Middle School
Vocational Education Teachers, Postsecondary
Vocational Education Teachers, Secondary School
Waiters and Waitresses

B.3 Empirical analysis

TABLE B.14: Oaxaca Decomposition analysis' results - Overall (Prime working age individuals - Occupations with fitness level 2 are excluded from the sample)

	Men	**Women**
VARIABLES	Overall	Overall
Non-obese	2.651***	2.378***
	(0.0242)	(0.0149)
Obese	2.550***	2.283***
	(0.0309)	(0.0266)
difference	0.100**	0.0956***
	(0.0392)	(0.0305)
endowments	0.0574**	0.0935***
	(0.0240)	(0.0237)
coefficients	0.0442	0.0365
	(0.0383)	(0.0281)
interaction	-0.00120	-0.0344*
	(0.0237)	(0.0199)
Observations	1,004	1,550

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

TABLE B.15: Oaxaca Decomposition analysis' results - Endowments (Prime working age individuals - Occupations with fitness level 2 are excluded from the sample)

	Men	**Women**
VARIABLES	Endowments	Endowments
Social Interactive Occupation	-0.000129	-0.000366
	(0.00350)	(0.00155)
Age group: 35 - 44	-0.00556	-0.00832
	(0.00627)	(0.00568)
Age group: 45 - 54	-0.00614	-0.0102
	(0.00817)	(0.00740)
Marital status: Single	-0.00377	0.00148
	(0.00501)	(0.00560)
Education: University degree or equivalent	0.0289**	0.0557***
	(0.0118)	(0.0146)
North East	0.000329	0.00101
	(0.00212)	(0.00196)
North West	-0.00276	-0.000599
	(0.00468)	(0.00170)
Yorkshire and the Humber	-0.000840	0.00239
	(0.00455)	(0.00286)
East Midlands	0.00172	0.00365
	(0.00359)	(0.00349)
West Midlands	0.000257	-0.000589
	(0.00296)	(0.00141)
East of England	0.00669	-0.000929
	(0.00602)	(0.00343)
London	0.0105	0.000417
	(0.00864)	(0.00370)
South East	0.000433	0.00836
	(0.00283)	(0.00642)
South West	0.000862	7.00e-05
	(0.00310)	(0.000968)
Wales	-0.000397	0.00185
	(0.00170)	(0.00244)
Excellent	0.0449**	0.0311
	(0.0218)	(0.0314)
Very good	0.0323	0.00345
	(0.0199)	(0.00936)
Good	-0.0226	-0.00957
	(0.0168)	(0.0243)
Fair	-0.0298	0.0115
	(0.0186)	(0.0158)
Long-standing illness	0.00168	0.000864
	(0.00372)	(0.00469)
Private Sector	0.000728	0.00230
	(0.00177)	(0.00277)
Observations	1,004	1,550

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

TABLE B.16: Oaxaca Decomposition analysis' results - Overall (Prime working age individuals - Occupations with fitness level 2 are excluded from the sample - Social occupations defined by Barbieri (2018))

	Men	**Women**
VARIABLES	Overall	Overall
Non-obese	2.651***	2.378***
	(0.0242)	(0.0149)
Obese	2.550***	2.283***
	(0.0309)	(0.0266)
difference	0.100**	0.0956***
	(0.0392)	(0.0305)
endowments	0.0571**	0.0911***
	(0.0238)	(0.0243)
coefficients	0.0398	0.0393
	(0.0383)	(0.0282)
interaction	0.00356	-0.0348*
	(0.0237)	(0.0206)
Observations	1,004	1,550

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

TABLE B.17: Oaxaca Decomposition analysis' results - Endowments (Prime working age individuals - Occupations with fitness level 2 are excluded from the sample - Social occupations defined by Barbieri (2018))

	Men	**Women**
VARIABLES	Endowments	Endowments
Social Interactive Occupation	0.00153	-0.00205
	(0.00250)	(0.00392)
Age group: 35 - 44	-0.00559	-0.00830
	(0.00630)	(0.00567)
Age group: 45 - 54	-0.00602	-0.0105
	(0.00802)	(0.00746)
Marital status: Single	-0.00393	0.00129
	(0.00519)	(0.00558)
Education: University degree or equivalent	0.0270**	0.0554***
	(0.0113)	(0.0145)
North East	0.000391	0.00104
	(0.00213)	(0.00197)
North West	-0.00263	-0.000618
	(0.00448)	(0.00175)
Yorkshire and the Humber	-0.00126	0.00240
	(0.00454)	(0.00286)
East Midlands	0.00195	0.00364
	(0.00365)	(0.00348)
West Midlands	0.000244	-0.000607
	(0.00296)	(0.00144)
East of England	0.00649	-0.000943
	(0.00597)	(0.00349)
London	0.0104	0.000345
	(0.00854)	(0.00370)
South East	0.000417	0.00828
	(0.00273)	(0.00641)
South West	0.000897	6.77e-05
	(0.00322)	(0.000937)
Wales	-0.000394	0.00178
	(0.00169)	(0.00240)
Excellent	0.0439**	0.0317
	(0.0216)	(0.0314)
Very good	0.0318	0.00357
	(0.0196)	(0.00938)
Good	-0.0222	-0.00964
	(0.0166)	(0.0242)
Fair	-0.0286	0.0114
	(0.0183)	(0.0158)
Long-standing illness	0.00184	0.000633
	(0.00373)	(0.00464)
Private Sector	0.000845	0.00224
	(0.00195)	(0.00271)
Observations	1,004	1,550

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

TABLE B.18: Oaxaca Decomposition analysis' results - Overall (Prime working age individuals - Occupations with fitness level 2 are excluded from the sample - Social occupations defined by ONET - 2019)

	Men	**Women**
VARIABLES	Overall	Overall
Non-obese	2.651***	2.378***
	(0.0242)	(0.0149)
Obese	2.550***	2.283***
	(0.0309)	(0.0266)
difference	0.100**	0.0950***
	(0.0392)	(0.0305)
endowments	0.0576**	0.0927***
	(0.0239)	(0.0238)
coefficients	0.0435	0.0357
	(0.0383)	(0.0281)
interaction	-0.000652	-0.0334*
	(0.0236)	(0.0200)
Observations	1,004	1,552

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

TABLE B.19: Oaxaca Decomposition analysis' results - Endowments (Prime working age individuals - Occupations with fitness level 2 are excluded from the sample - Social occupations defined by ONET - 2019)

	Men	**Women**
VARIABLES	Endowments	Endowments
Social Interactive Occupation	0.00206	-0.000822
	(0.00317)	(0.00166)
Age group: 35 - 44	-0.00572	-0.00815
	(0.00642)	(0.00563)
Age group: 45 - 54	-0.00639	-0.0102
	(0.00848)	(0.00744)
Marital status: Single	-0.00412	0.00135
	(0.00542)	(0.00563)
Education: University degree or equivalent	0.0265**	0.0549***
	(0.0112)	(0.0145)
North East	0.000572	0.000932
	(0.00218)	(0.00194)
North West	-0.00292	-0.000604
	(0.00492)	(0.00164)
Yorkshire and the Humber	-0.000379	0.00232
	(0.00447)	(0.00282)
East Midlands	0.00187	0.00343
	(0.00362)	(0.00340)
West Midlands	-2.20e-05	-0.000539
	(0.00295)	(0.00135)
East of England	0.00710	-0.000867
	(0.00613)	(0.00337)
London	0.0109	0.000640
	(0.00889)	(0.00370)
South East	0.000500	0.00890
	(0.00326)	(0.00658)
South West	0.000856	6.92e-05
	(0.00308)	(0.000820)
Wales	-0.000568	0.00172
	(0.00178)	(0.00237)
Excellent	0.0448**	0.0290
	(0.0216)	(0.0314)
Very good	0.0334	0.00272
	(0.0203)	(0.00910)
Good	-0.0229	-0.00758
	(0.0170)	(0.0243)
Fair	-0.0306*	0.0127
	(0.0185)	(0.0160)
Long-standing illness	0.00179	0.000701
	(0.00371)	(0.00459)
Private Sector	0.000950	0.00206
	(0.00214)	(0.00260)
Public Sector		
Observations	1,004	1,552

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model Controls for age group, education, region, and marital status. Additionally, controls for self assessed health, and Long standing illness or disability.

TABLE B.20: The impact of social interactive occupations (defined by Barbieri (2018)) on individuals' hourly wage - Men (Prime working age individuals)

Men	(1)	(2)	(3)	(4)
BMI	0.00597	0.000811	0.00402	0.00492
	(0.0105)	(0.00988)	(0.00986)	(0.00986)
Social Interactive Occupation	0.593*	0.315	0.309	0.340
	(0.332)	(0.311)	(0.308)	(0.308)
Social Interactive Occupation*BMI	-0.00991	-0.00563	-0.00512	-0.00554
	(0.0118)	(0.0110)	(0.0109)	(0.0109)
Age group: 35 - 44		0.0819*	0.104**	0.106**
		(0.0453)	(0.0455)	(0.0454)
Age group: 45 - 54		0.155***	0.186***	0.192***
		(0.0480)	(0.0483)	(0.0483)
Marital status: Single		-0.228***	-0.218***	-0.215***
		(0.0414)	(0.0412)	(0.0412)
Education: University degree or equivalent		0.303***	0.278***	0.289***
		(0.0376)	(0.0382)	(0.0384)
North East		-0.0843	-0.0733	-0.0712
		(0.0993)	(0.0989)	(0.0987)
North West		-0.0259	-0.0236	-0.0211
		(0.0779)	(0.0774)	(0.0772)
Yorkshire and the Humber		0.0317	0.0550	0.0514
		(0.0814)	(0.0812)	(0.0811)
East Midlands		-0.00562	-0.000928	-0.00272
		(0.0800)	(0.0794)	(0.0793)
West Midlands		0.0773	0.0709	0.0671
		(0.0851)	(0.0844)	(0.0843)
East of England		0.126	0.124	0.122
		(0.0807)	(0.0801)	(0.0799)
London		0.316***	0.320***	0.317***
		(0.0765)	(0.0760)	(0.0759)
South East		0.144**	0.131*	0.125*
		(0.0726)	(0.0721)	(0.0720)
South West		0.0535	0.0509	0.0518
		(0.0847)	(0.0842)	(0.0840)
Wales		-0.0125	-0.00235	0.00744
		(0.101)	(0.0999)	(0.101)
Excellent			0.400***	0.391***
			(0.152)	(0.151)
Very good			0.324**	0.313**
			(0.147)	(0.147)
Good			0.296**	0.285*
			(0.148)	(0.148)
Fair			0.216	0.199
			(0.153)	(0.153)
Long-standing illness			-0.0942**	-0.0876*
			(0.0469)	(0.0469)
Private Sector				0.0994**
				(0.0416)
No- Sector				-0.227
				(0.534)
Constant	2.198***	2.248***	1.845***	1.733***
	(0.297)	(0.289)	(0.331)	(0.334)
Observations	1,004	1,004	1,004	1,004
R-squared	0.042	0.187	0.205	0.210

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI and social interactive occupations, Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability. In case social interactive occupation the third model includes the control for the number of children under age 15. Model (4): Includes the additional controls for sector.

TABLE B.21: The impact of social interactive occupations (defined by Barbieri (2018)) on individuals' hourly wage - Women (Prime working age individuals)

Women	(1)	(2)	(3)	(4)
BMI	-0.00444	0.000699	0.000943	0.00114
	(0.0168)	(0.0153)	(0.0152)	(0.0151)
Social Interactive Occupation	0.455	0.318	0.242	0.212
	(0.462)	(0.422)	(0.419)	(0.416)
Social Interactive Occupation*BMI	-0.00686	-0.00626	-0.00397	-0.00419
	(0.0170)	(0.0155)	(0.0154)	(0.0153)
Age group: 35 - 44		0.141***	0.152***	0.144***
		(0.0324)	(0.0322)	(0.0320)
Age group: 45 - 54		0.110***	0.128***	0.107***
		(0.0327)	(0.0327)	(0.0327)
Marital status: Single		-0.00195	0.00242	0.00829
		(0.0287)	(0.0284)	(0.0283)
Education: University degree or equivalent		0.407***	0.390***	0.362***
		(0.0242)	(0.0242)	(0.0248)
North East		-0.0488	-0.0361	-0.0276
		(0.0618)	(0.0612)	(0.0609)
North West		-0.0315	-0.0276	-0.0237
		(0.0519)	(0.0515)	(0.0512)
Yorkshire and the Humber		-0.0353	-0.0270	-0.0223
		(0.0546)	(0.0540)	(0.0537)
East Midlands		-0.0482	-0.0451	-0.0447
		(0.0563)	(0.0559)	(0.0555)
West Midlands		0.0152	0.0327	0.0340
		(0.0564)	(0.0561)	(0.0557)
East of England		-0.00841	-0.00130	0.00335
		(0.0545)	(0.0541)	(0.0537)
London		0.102*	0.106*	0.110*
		(0.0572)	(0.0568)	(0.0564)
South East		0.0946*	0.106**	0.113**
		(0.0505)	(0.0502)	(0.0499)
South West		-0.0484	-0.0433	-0.0326
		(0.0549)	(0.0544)	(0.0542)
Wales		-0.0709	-0.0547	-0.0530
		(0.0611)	(0.0606)	(0.0602)
Excellent			0.221**	0.206**
			(0.104)	(0.103)
Very good			0.156	0.142
			(0.102)	(0.101)
Good			0.131	0.122
			(0.102)	(0.101)
Fair			-0.0585	-0.0659
			(0.106)	(0.105)
Long-standing illness			0.00871	0.00622
			(0.0298)	(0.0297)
Private Sector				-0.114***
				(0.0242)
No- Sector				-0.336
				(0.535)
Constant	2.212***	1.916***	1.766***	1.885***
	(0.456)	(0.420)	(0.423)	(0.420)
Observations	1,550	1,550	1,550	1,550
R-squared	0.019	0.194	0.213	0.224

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI and social interactive occupations, Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability. In case social interactive occupation the third model includes the control for the number of children under age 15. Model (4): Includes the additional controls for sector.

TABLE B.22: The impact of social interactive occupations (defined by ONET) on individuals' hourly wage - Men (Prime working age individuals)

Men	(1)	(2)	(3)	(4)
BMI	-0.00858	-0.00943*	-0.00595	-0.00547
	(0.00605)	(0.00568)	(0.00572)	(0.00573)
Social Interactive Occupation	-0.454	-0.459*	-0.448*	-0.428*
	(0.279)	(0.257)	(0.255)	(0.256)
Social Interactive Occupation*BMI	0.0169*	0.0151	0.0150	0.0148
	(0.00995)	(0.00920)	(0.00914)	(0.00915)
Age group: 35 - 44		0.0891*	0.111**	0.112**
		(0.0455)	(0.0457)	(0.0457)
Age group: 45 - 54		0.169***	0.200***	0.204***
		(0.0480)	(0.0483)	(0.0485)
Marital status: Single		-0.223***	-0.214***	-0.214***
		(0.0418)	(0.0416)	(0.0416)
Education: University degree or equivalent		0.348***	0.324***	0.331***
		(0.0367)	(0.0373)	(0.0377)
North East		-0.0657	-0.0547	-0.0550
		(0.0998)	(0.0994)	(0.0994)
North West		-0.0115	-0.00900	-0.00855
		(0.0784)	(0.0780)	(0.0779)
Yorkshire and the Humber		0.0411	0.0648	0.0624
		(0.0819)	(0.0817)	(0.0817)
East Midlands		-0.0195	-0.0149	-0.0172
		(0.0801)	(0.0796)	(0.0795)
West Midlands		0.0736	0.0673	0.0642
		(0.0855)	(0.0849)	(0.0849)
East of England		0.135*	0.133*	0.131
		(0.0810)	(0.0805)	(0.0805)
London		0.332***	0.336***	0.334***
		(0.0768)	(0.0764)	(0.0763)
South East		0.153**	0.141*	0.137*
		(0.0730)	(0.0726)	(0.0726)
South West		0.0619	0.0590	0.0573
		(0.0852)	(0.0848)	(0.0847)
Wales		-0.0148	-0.00545	0.00456
		(0.101)	(0.101)	(0.101)
Excellent			0.401***	0.396***
			(0.152)	(0.152)
Very good			0.333**	0.327**
			(0.148)	(0.148)
Good			0.307**	0.300**
			(0.149)	(0.149)
Fair			0.233	0.227
			(0.153)	(0.154)
Long-standing illness			-0.0931**	-0.0895*
			(0.0472)	(0.0472)
Private Sector				0.0620
				(0.0425)
No- Sector				-0.397
				(0.535)
Constant	2.856***	2.641***	2.225***	2.162***
	(0.171)	(0.175)	(0.235)	(0.238)
Observations	1,004	1,004	1,004	1,004
R-squared	0.003	0.181	0.198	0.200

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI and social interactive occupations, Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability. In case social interactive occupation the third model includes the control for the number of children under age 15. Model (4): Includes the additional controls for sector.

TABLE B.23: The impact of social interactive occupations (defined by ONET) on individuals' hourly wage - Women (Prime working age individuals)

Women	(1)	(2)	(3)	(4)
BMI	-0.0161***	-0.00797**	-0.00533	-0.00547
	(0.00416)	(0.00386)	(0.00387)	(0.00385)
Social Interactive Occupation	-0.116	-0.0916	-0.0813	-0.116
	(0.151)	(0.138)	(0.137)	(0.136)
Social Interactive Occupation*BMI	0.00789	0.00440	0.00418	0.00458
	(0.00549)	(0.00504)	(0.00499)	(0.00495)
Age group: 35 - 44		0.142***	0.152***	0.144***
		(0.0323)	(0.0322)	(0.0320)
Age group: 45 - 54		0.108***	0.127***	0.105***
		(0.0327)	(0.0326)	(0.0327)
Marital status: Single		-0.00209	0.00297	0.00856
		(0.0287)	(0.0284)	(0.0283)
Education: University degree or equivalent		0.406***	0.386***	0.361***
		(0.0245)	(0.0245)	(0.0249)
North East		-0.0460	-0.0325	-0.0261
		(0.0618)	(0.0612)	(0.0608)
North West		-0.0285	-0.0246	-0.0226
		(0.0519)	(0.0515)	(0.0512)
Yorkshire and the Humber		-0.0351	-0.0260	-0.0225
		(0.0547)	(0.0541)	(0.0537)
East Midlands		-0.0416	-0.0377	-0.0409
		(0.0565)	(0.0560)	(0.0557)
West Midlands		0.0217	0.0398	0.0379
		(0.0565)	(0.0562)	(0.0558)
East of England		-0.00114	0.00679	0.00651
		(0.0546)	(0.0542)	(0.0539)
London		0.109*	0.114**	0.114**
		(0.0573)	(0.0568)	(0.0565)
South East		0.0987*	0.112**	0.116**
		(0.0505)	(0.0503)	(0.0500)
South West		-0.0406	-0.0353	-0.0272
		(0.0551)	(0.0546)	(0.0543)
Wales		-0.0677	-0.0507	-0.0515
		(0.0612)	(0.0607)	(0.0603)
Excellent			0.211**	0.196*
			(0.101)	(0.100)
Very good			0.146	0.131
			(0.0987)	(0.0981)
Good			0.117	0.109
			(0.0986)	(0.0979)
Fair			-0.0744	-0.0798
			(0.103)	(0.102)
Long-standing illness			0.00853	0.00716
			(0.0299)	(0.0296)
Private Sector				-0.117***
				(0.0246)
No- Sector				-0.344
				(0.536)
Constant	2.731***	2.275***	2.056***	2.166***
	(0.113)	(0.116)	(0.151)	(0.152)
Observations	1,552	1,552	1,552	1,552
R-squared	0.021	0.192	0.212	0.223

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The analysis is weighted with the cross-sectional blood person weight of Nurse health assessment (UKHLS). Model (1): BMI and social interactive occupations, Model (2): Controls for age group, education, region, and marital status. Model (3): Additional controls for self assessed health, and Long standing illness or disability. In case social interactive occupation the third model includes the control for the number of children under age 15. Model (4): Includes the additional controls for sector.

Appendix C

Chapter IV

C.1 General Health Questionnaire (12-item) (GHQ-12)

Understanding Society, the UK Household Longitudinal Survey British Household Panel Survey (UKHLS) (more information are available on the website: Understanding Society, the UK Household Longitudinal Survey British Household Panel Survey (UKHLS), Catalogue of Mental Health Measures)

Anxiety, depression: General Health Questionnaire (12-item) (GHQ-12) - Adult participants - Self-report

Reporting term Past few weeks

Questions Have you recently:

1. Been able to concentrate on whatever you're doing?
2. Lost much sleep over worry?
3. Felt that you were playing a useful part in things?
4. Capable of making decisions?
5. Felt constantly under strain?
6. Felt you couldn't overcome your difficulties?
7. Been able to enjoy your normal day-to-day activities?
8. Been able to face up to problems?
9. Been feeling unhappy or depressed?
10. Been losing confidence in yourself?

11. Been thinking of yourself as a worthless person?
12. Been feeling reasonably happy, all things considered?

Response scale

1. Not at all
2. No more than usual
3. Rather more than usual
4. Much more than usual

C.2 Descriptive statistics

C.2.1 Descriptive statistics - Welfare reforms' samples

TABLE C.1: Summary descriptive statistics of the groups of treated individuals by the different welfare reforms (Survey cross-sectional weights)

Panel A: ***Total Sample***

	Fstats		
	Mean	SD	Observations
CTB	0.382	0.486	5574
BT	0.375	0.484	5574
Any Treatment	0.709	0.454	5574
CTB - F	0.386	0.487	5574
BT - F	0.411	0.492	5574
Any Treatment - F	0.653	0.476	5574
DLA	0.329	0.470	5600
DLA - F	0.229	0.420	5600

TABLE C.2: Summary descriptive statistics of the groups of treated individuals by the different welfare reforms (by sex)

Panel A: ***Men***

	Fstats		
	Mean	SD	Observations
CTB	0.326	0.469	2485
BT	0.301	0.459	2485
Any Treatment	0.611	0.488	2485
CTB - F	0.331	0.471	2485
BT - F	0.336	0.472	2485
Any Treatment - F	0.545	0.498	2485
DLA	0.276	0.447	2498
DLA - F	0.187	0.390	2498

Panel B: ***Women***

	Fstats		
	Mean	SD	Observations
CTB	0.447	0.497	3760
BT	0.401	0.490	3760
Any Treatment	0.780	0.415	3760
CTB - F	0.451	0.498	3760
BT - F	0.433	0.496	3760
Any Treatment - F	0.692	0.462	3760
DLA	0.359	0.480	3886
DLA - F	0.257	0.437	3886

TABLE C.3: Summary descriptive statistics of the groups of treated individuals by the different welfare reforms (by age group)

Panel A: ***Younger Individuals***

	Fstats		
	Mean	SD	Observations
CTB	0.247	0.431	2882
BT	0.269	0.443	2882
Any Treatment	0.525	0.499	2882
CTB - F	0.243	0.429	2882
BT - F	0.310	0.463	2882
Any Treatment - F	0.473	0.499	2882
DLA	0.204	0.403	3151
DLA - F	0.136	0.343	3151

Panel B: ***Older Individuals***

	Fstats		
	Mean	SD	Observations
CTB	0.528	0.499	3363
BT	0.441	0.497	3363
Any Treatment	0.873	0.333	3363
CTB - F	0.541	0.498	3363
BT - F	0.466	0.499	3363
Any Treatment - F	0.772	0.420	3363
DLA	0.447	0.497	3233
DLA - F	0.321	0.467	3233

TABLE C.4: Summary descriptive statistics of the groups of treated individuals by the different welfare reforms (by level of deprivation)

Panel A: ***Less deprived area***

	Fstats		
	Mean	SD	Observations
CTB	0.328	0.469	2140
BT	0.286	0.452	2140
Any Treatment	0.696	0.460	2140
CTB - F	0.329	0.470	2140
BT - F	0.321	0.467	2140
Any Treatment - F	0.632	0.482	2140
DLA	0.371	0.483	2173
DLA - F	0.263	0.440	2173

Panel B: ***More deprived area***

	Fstats		
	Mean	SD	Observations
CTB	0.429	0.495	3985
BT	0.391	0.488	3985
Any Treatment	0.706	0.456	3985
CTB - F	0.434	0.496	3985
BT - F	0.422	0.494	3985
Any Treatment - F	0.655	0.475	3985
DLA	0.292	0.455	4081
DLA - F	0.202	0.401	4081

C.2.2 Descriptive statistics - Average GHQ plots

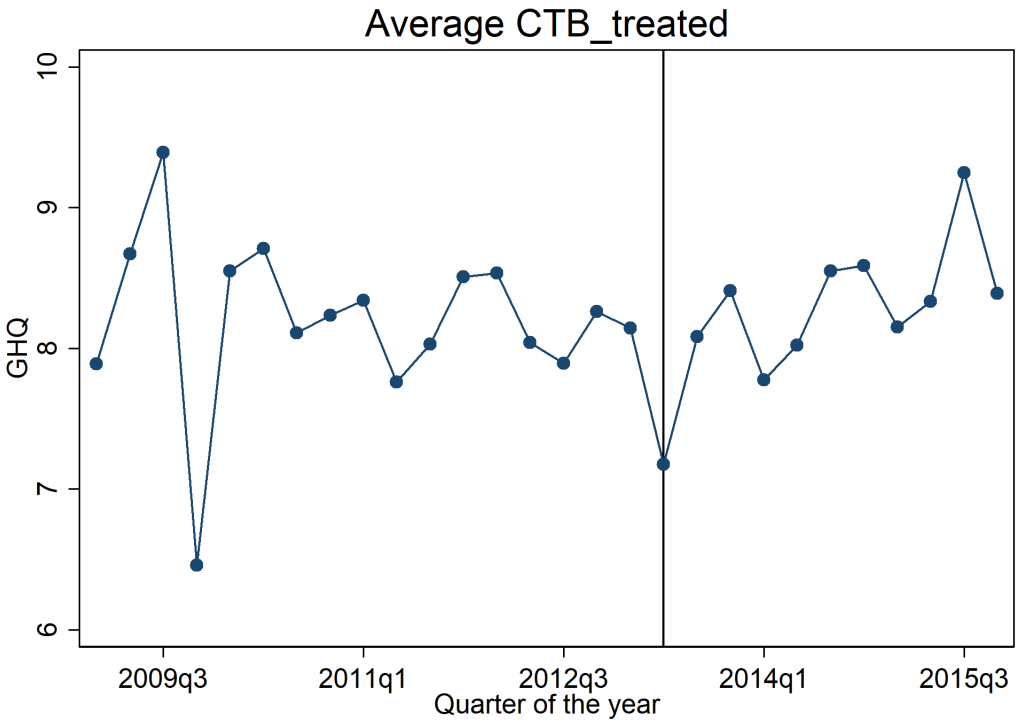

FIGURE C.1: Mean of GHQ when the treated of the CTB are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms)

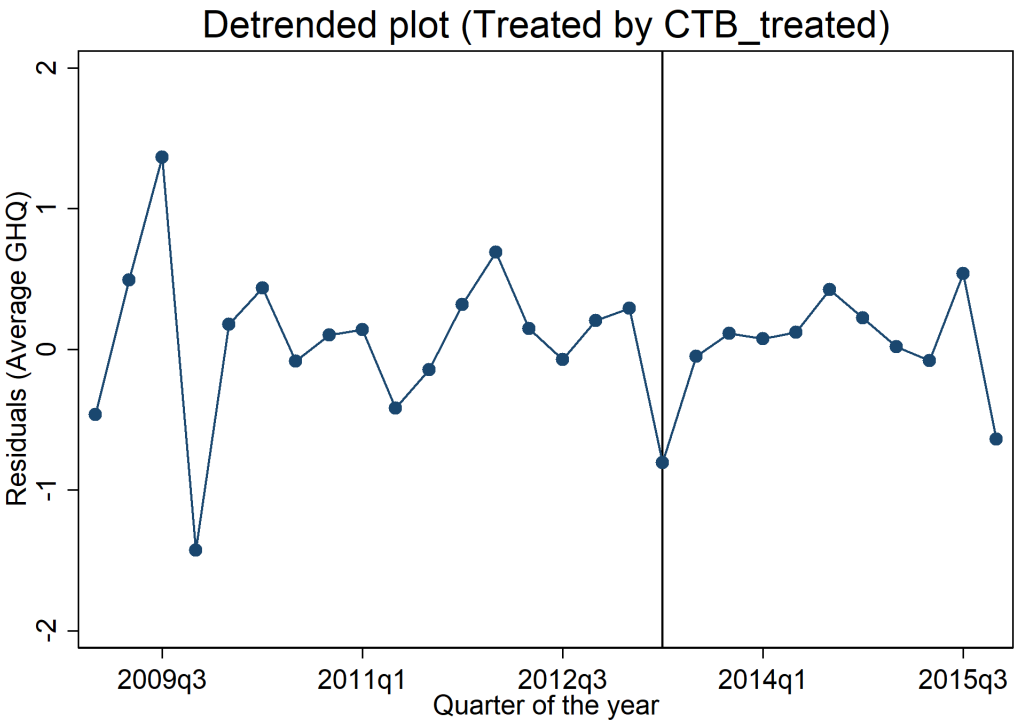

FIGURE C.2: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the CTB are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms - treated individuals)

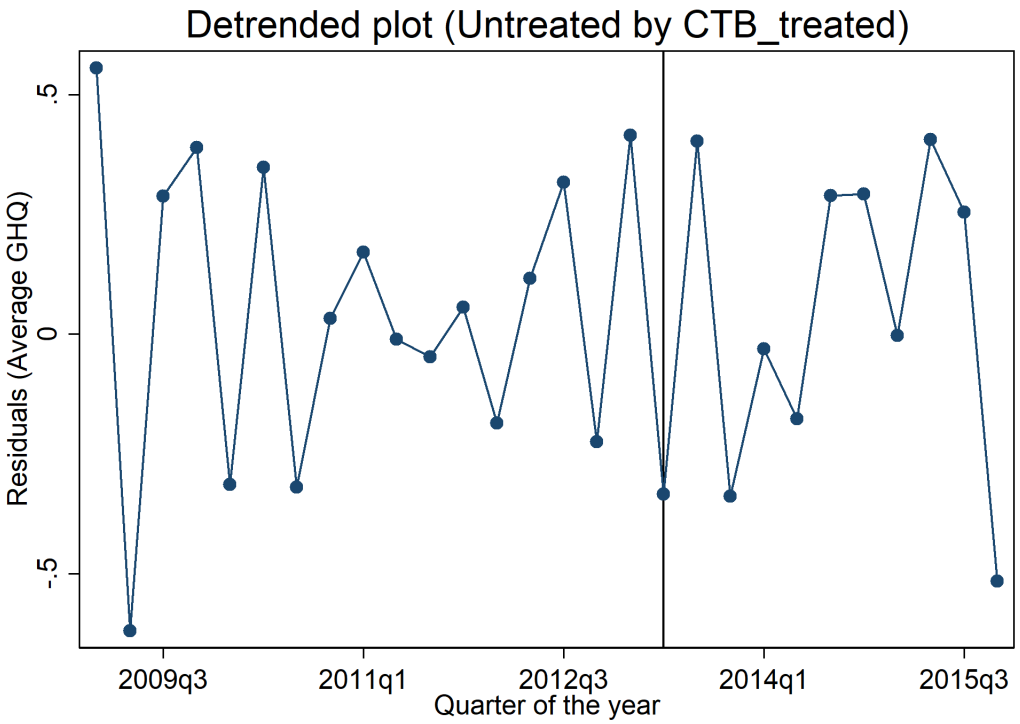

FIGURE C.3: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the CTB treatment are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms- untreated individuals)

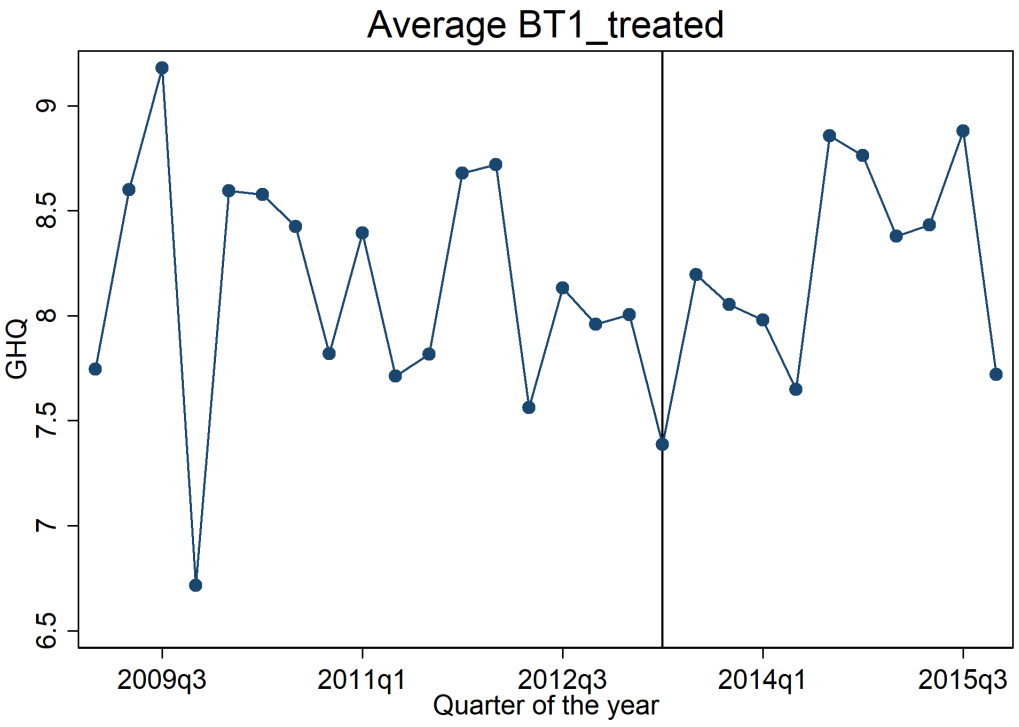

FIGURE C.4: Mean of GHQ when the treated of the BT are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms)

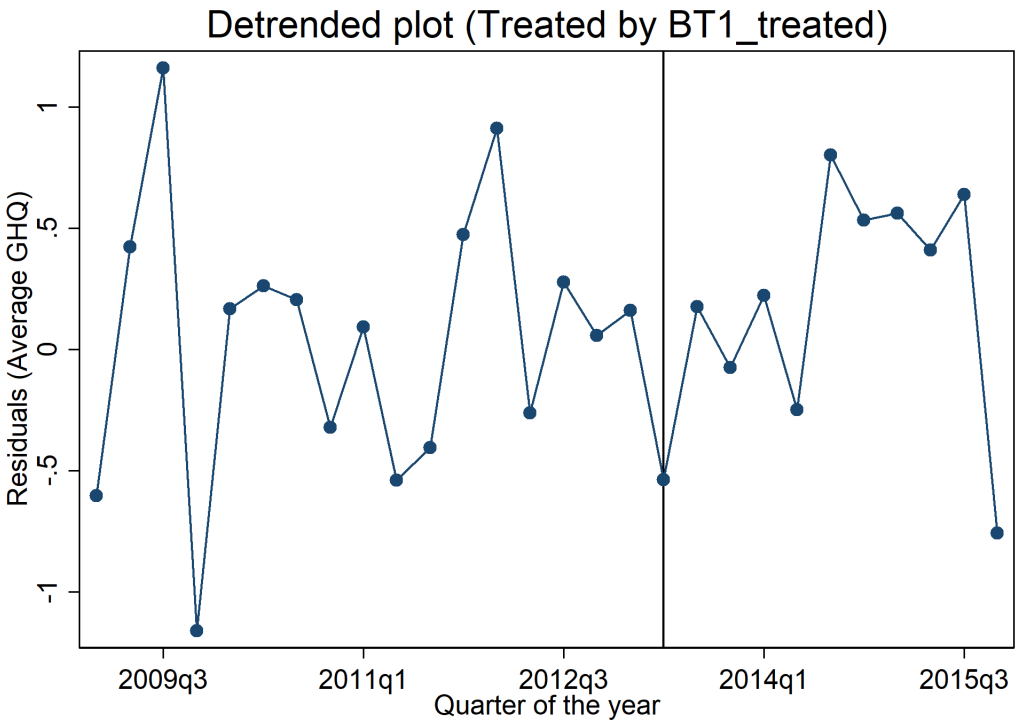

FIGURE C.5: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the BT are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms - treated individuals)

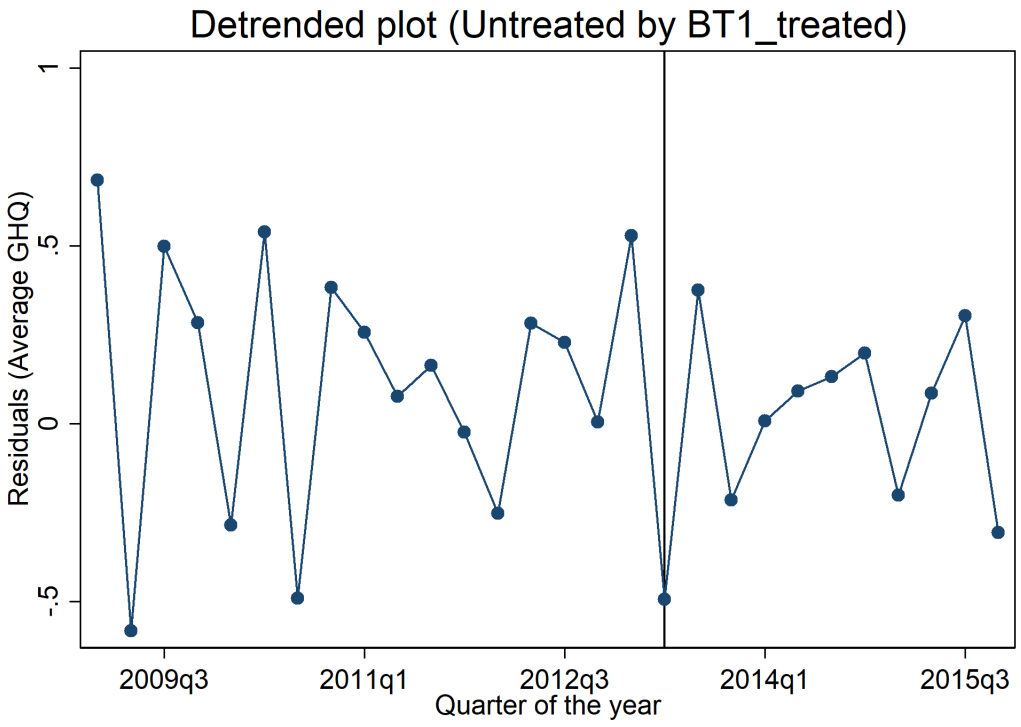

FIGURE C.6: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the BT treatment are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms- untreated individuals)

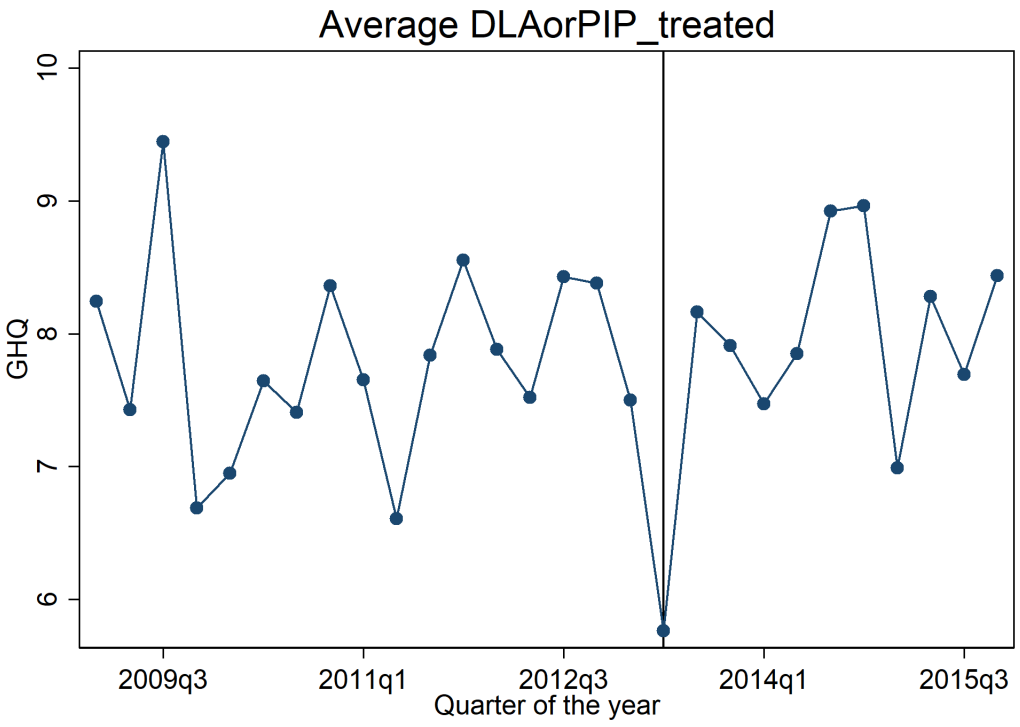

FIGURE C.7: Mean of GHQ when the treated of the DLA/PIP are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms)

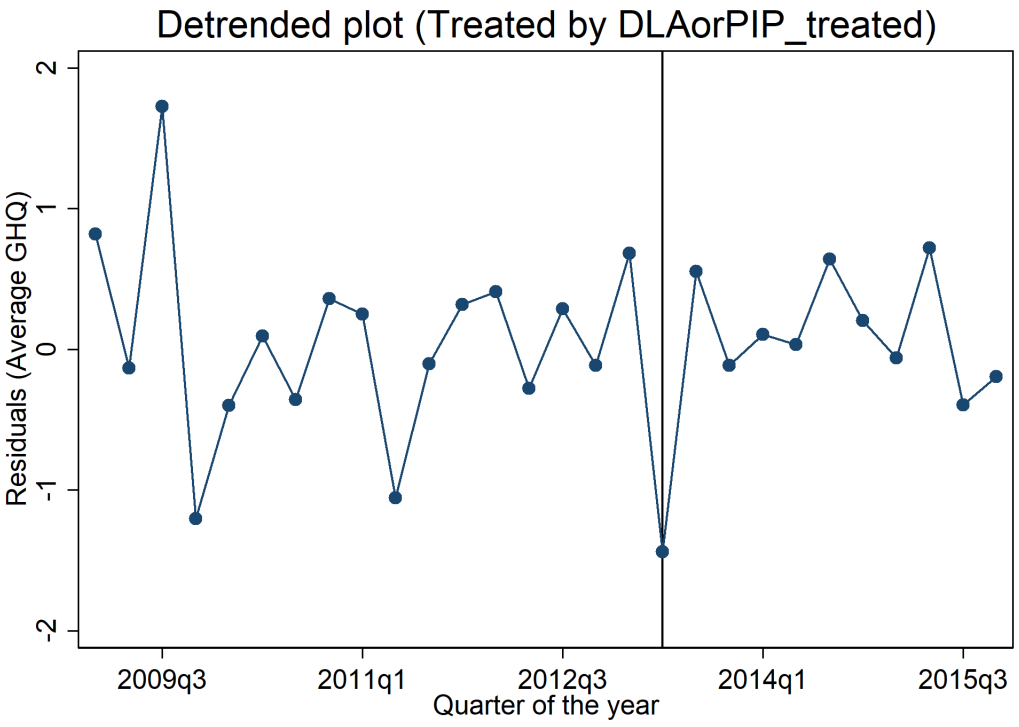

FIGURE C.8: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the DLA/PIP are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms - treated individuals)

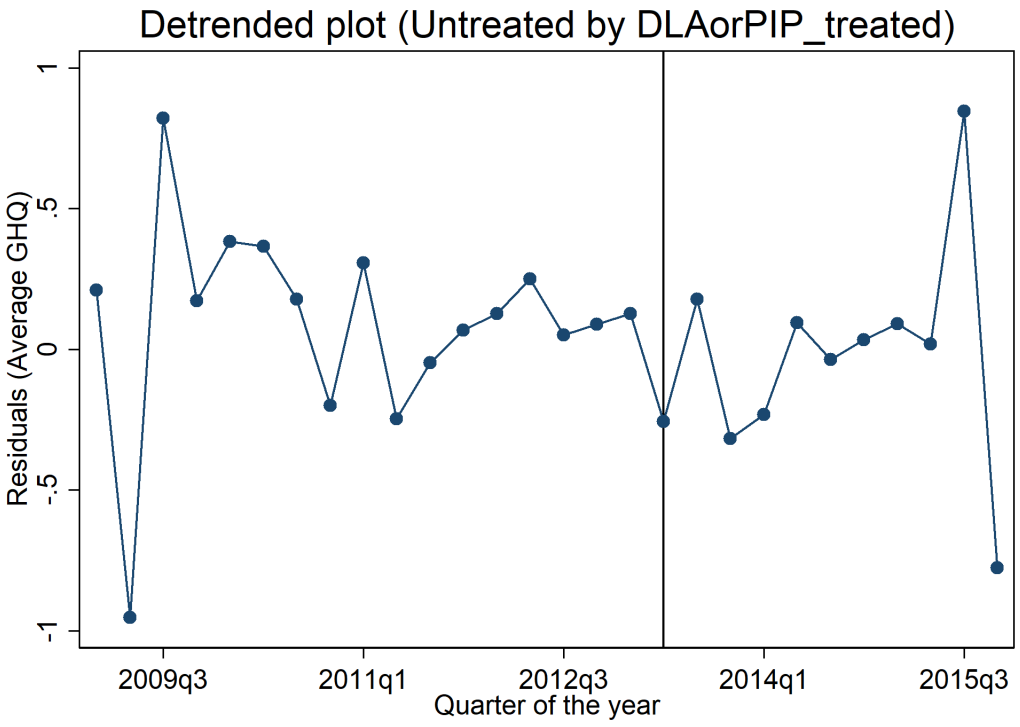

FIGURE C.9: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the DLA/PIP treatment are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms- untreated individuals)

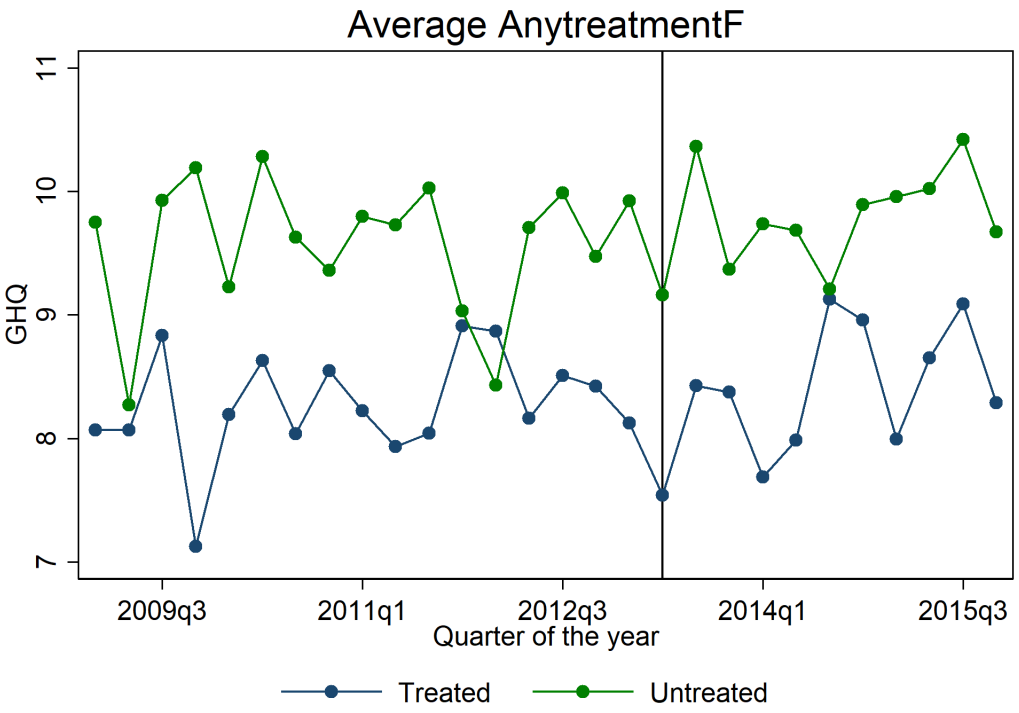

FIGURE C.10: Mean of GHQ when the treated of the CTB are identified based on the information provided by Fetzer (2019) (Sample: Observed at least once before and once after the reforms)

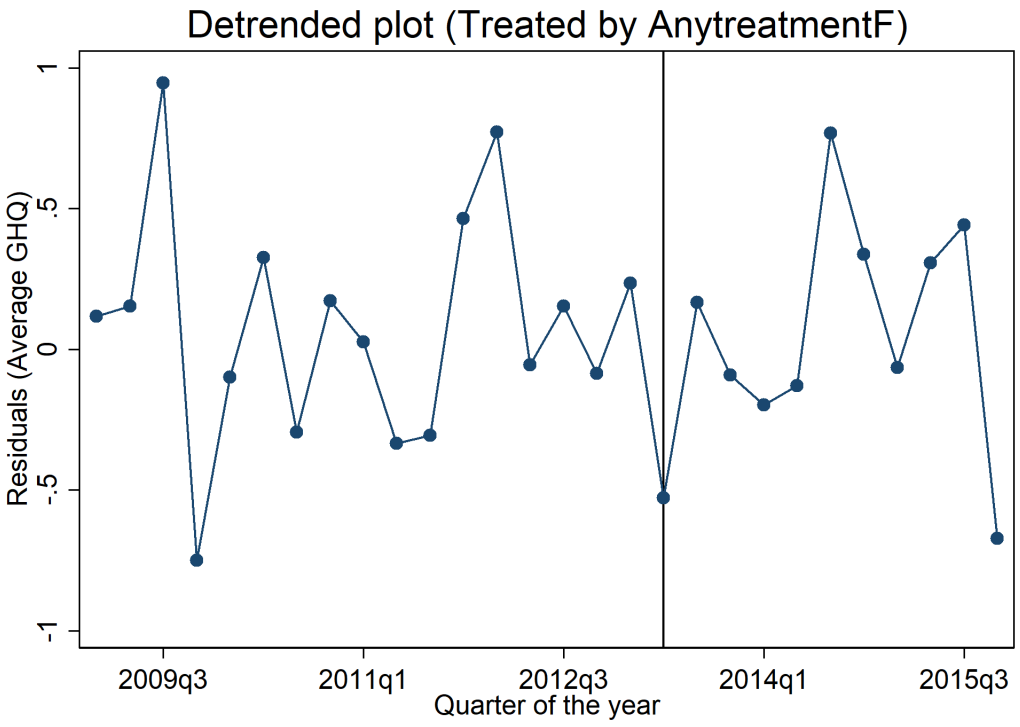

FIGURE C.11: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the CTB are identified based on the information provided by Fetzer (2019) (Sample: Observed at least once before and once after the reforms - treated individuals)

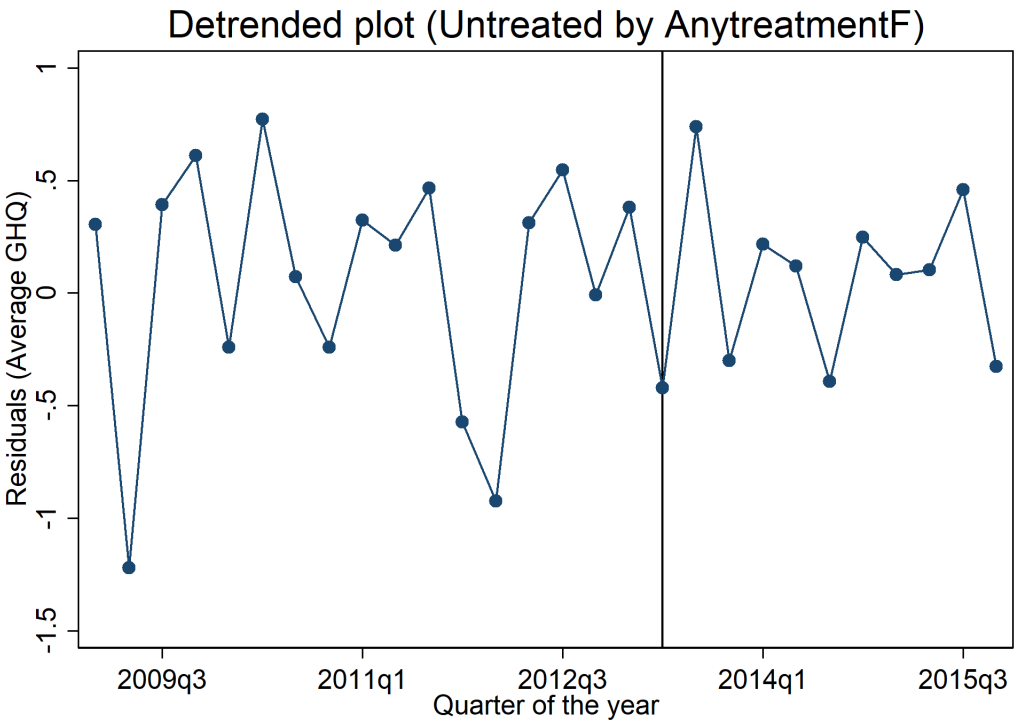

FIGURE C.12: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the CTB treatment are identified based on the information provided by Fetzer (2019) (Sample: Observed at least once before and once after the reforms- untreated individuals)

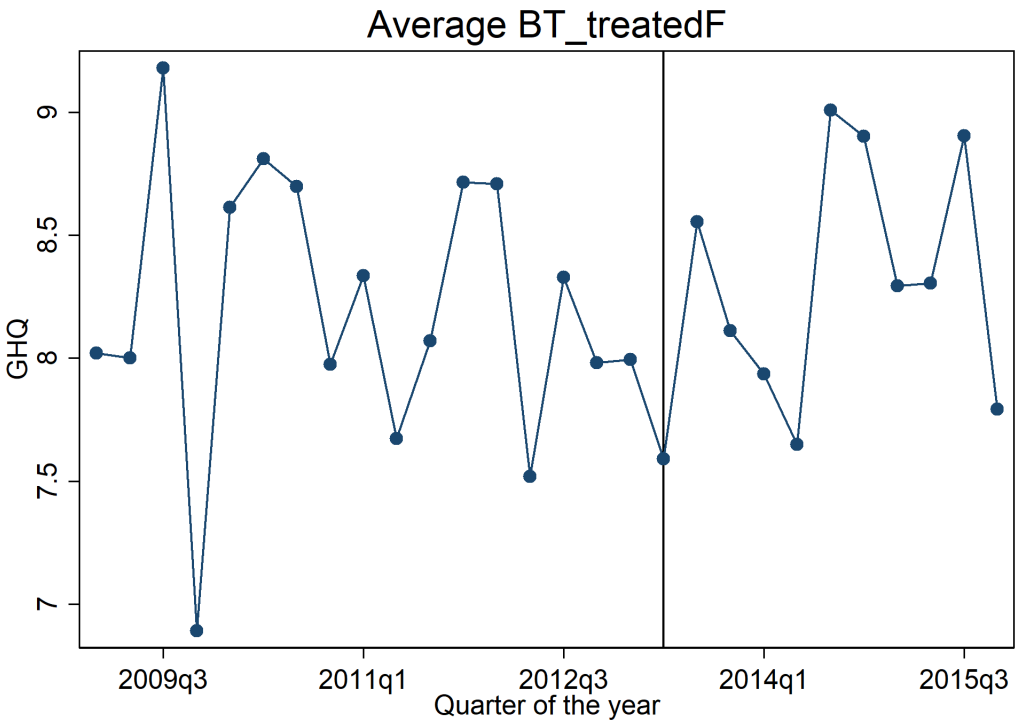

FIGURE C.13: Mean of GHQ when the treated of the BT are identified based on the information provided by Fetzer (2019) (Sample: Observed at least once before and once after the reforms)

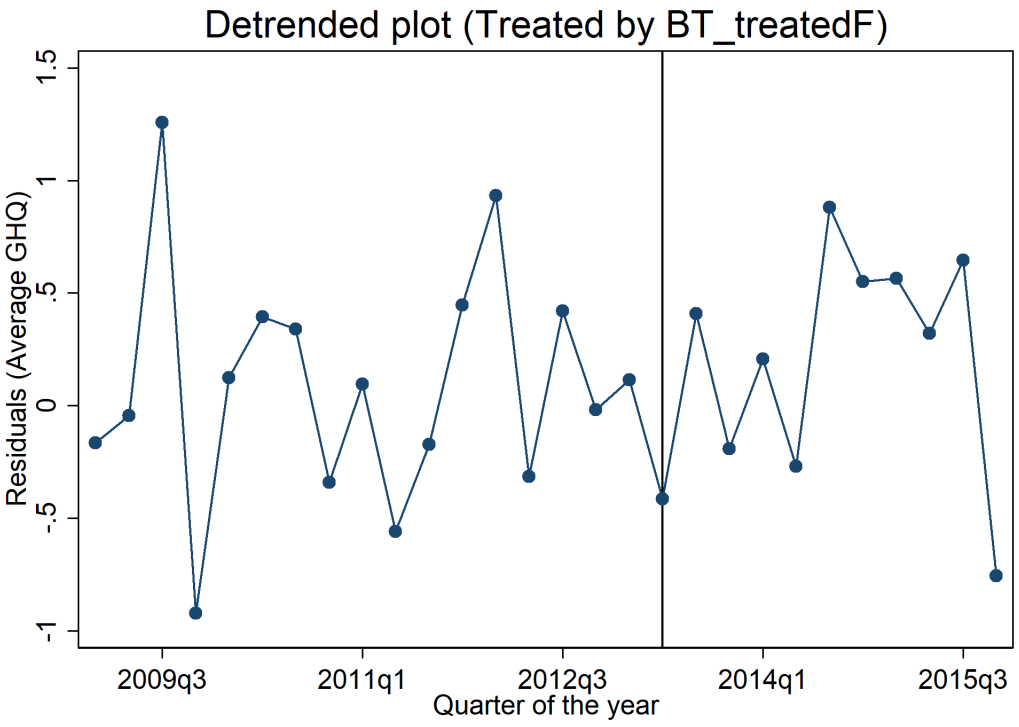

FIGURE C.14: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the BT are identified based on the information provided by Fetzer (2019) (Sample: Observed at least once before and once after the reforms - treated individuals)

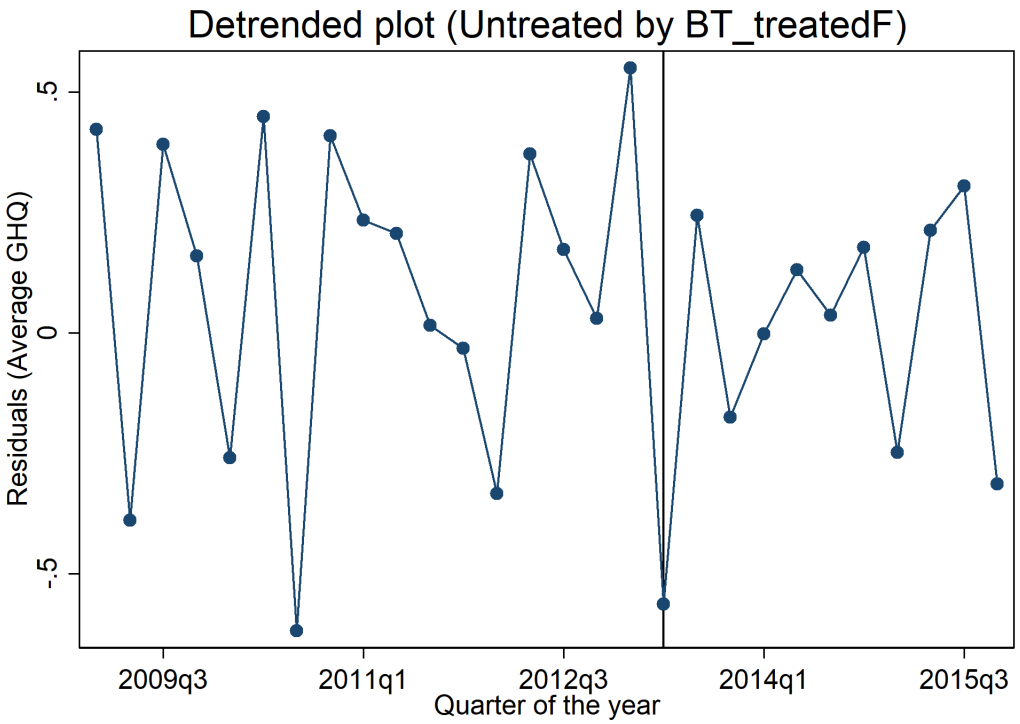

FIGURE C.15: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the BT treatment are identified based on the information provided by Fetzer (2019) (Sample: Observed at least once before and once after the reforms- untreated individuals)

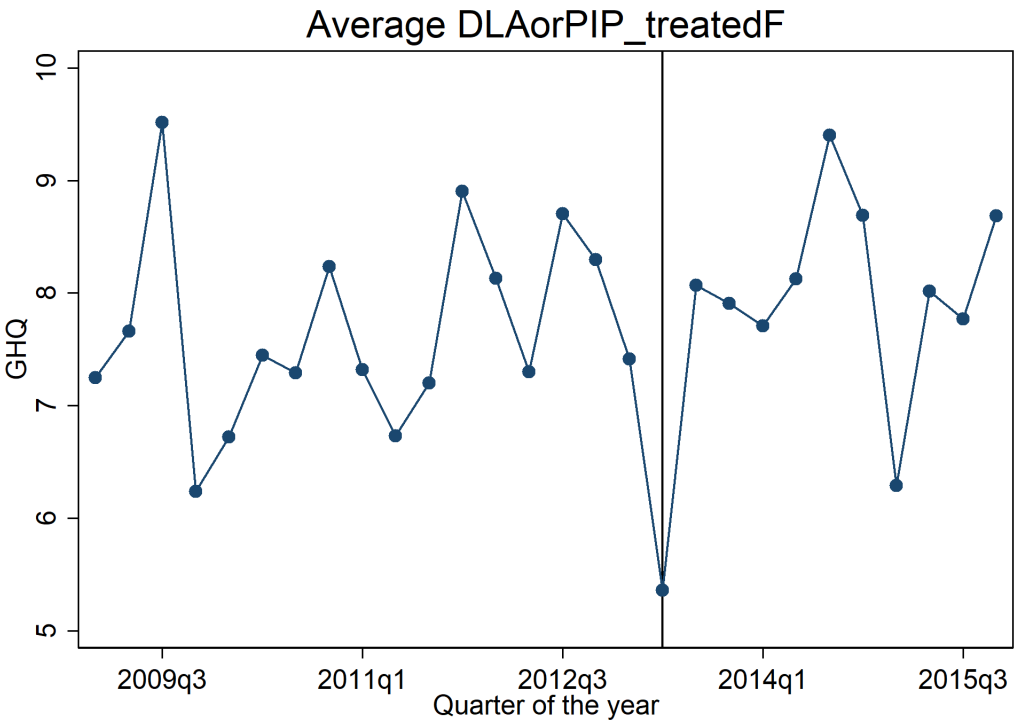

FIGURE C.16: Mean of GHQ when the treated of the DLA/PIP are identified based on the information provided by Fetzer (2019) (Sample: Observed at least once before and once after the reforms)

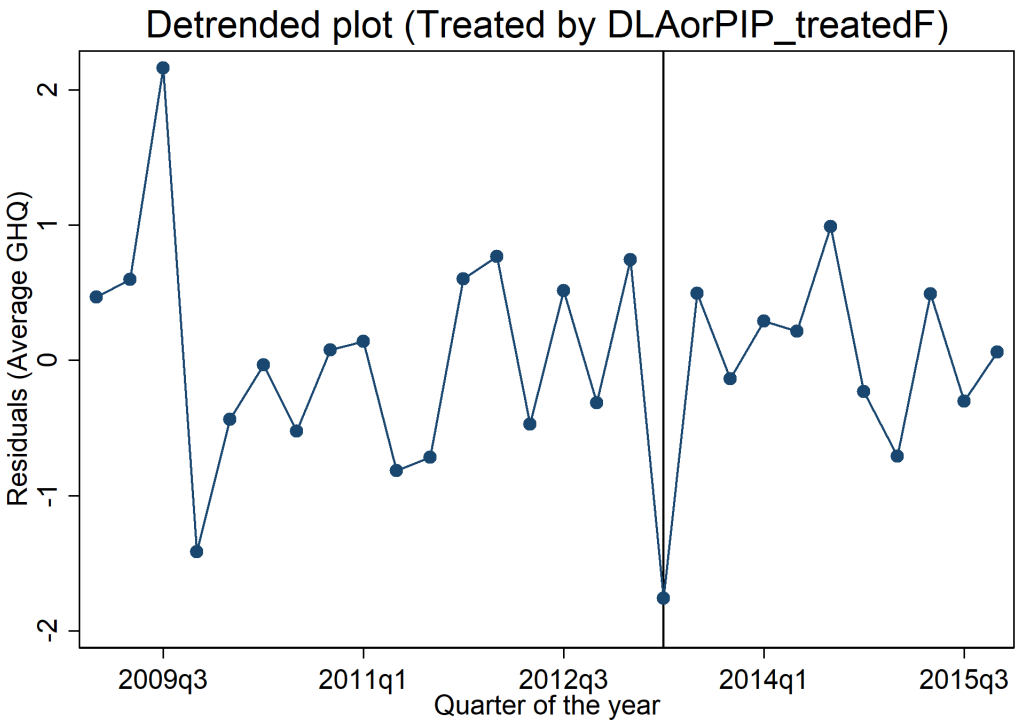

FIGURE C.17: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the DLA/PIP are identified based on the information provided by Fetzer (2019) (Sample: Observed at least once before and once after the reforms - treated individuals)

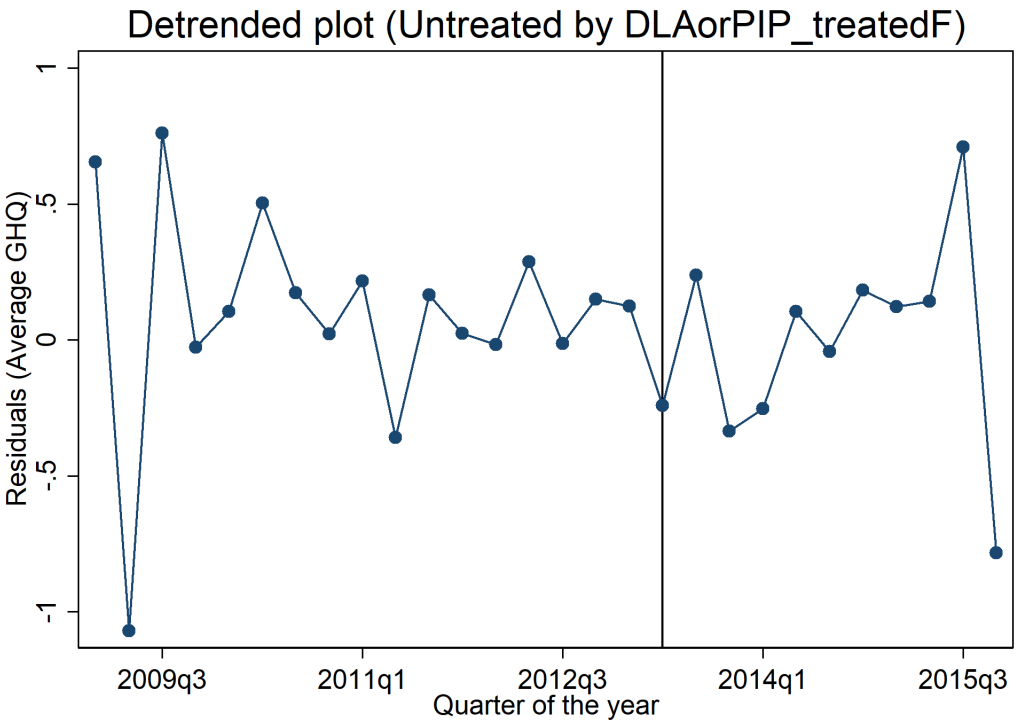

FIGURE C.18: Mean of GHQ (dendrended plot when controls for time (the quarter of the year), squared time and year fixed effects are included) when the treated of the DLA/PIP treatment are identified based on the information provided by Fetzer (2019) (Sample: Observed at least once before and once after the reforms- untreated individuals)

C.2.3 The change on the social benefit income due to the implementation of the welfare reforms

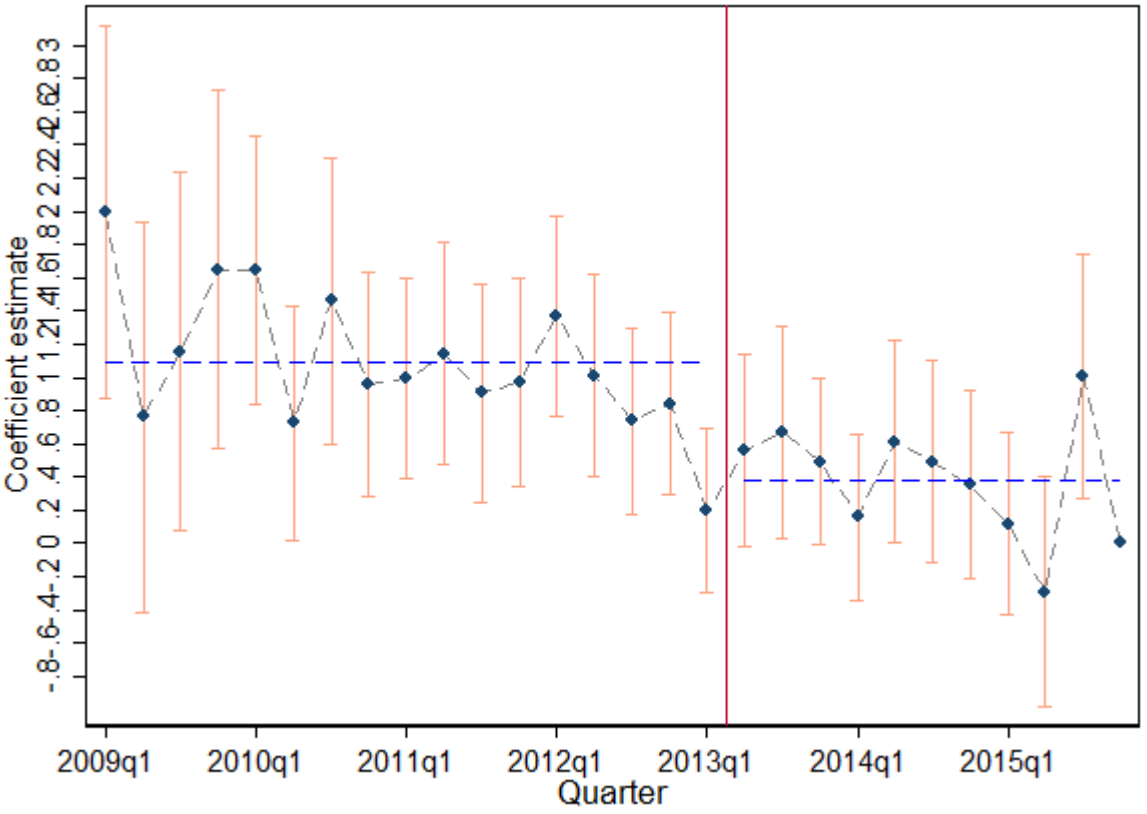

FIGURE C.19: Social benefit income: I include the interaction term of treatment status and time variable (quarter of the year). Also, I control for the individuals' fixed effect and time fixed (quarter of the year).

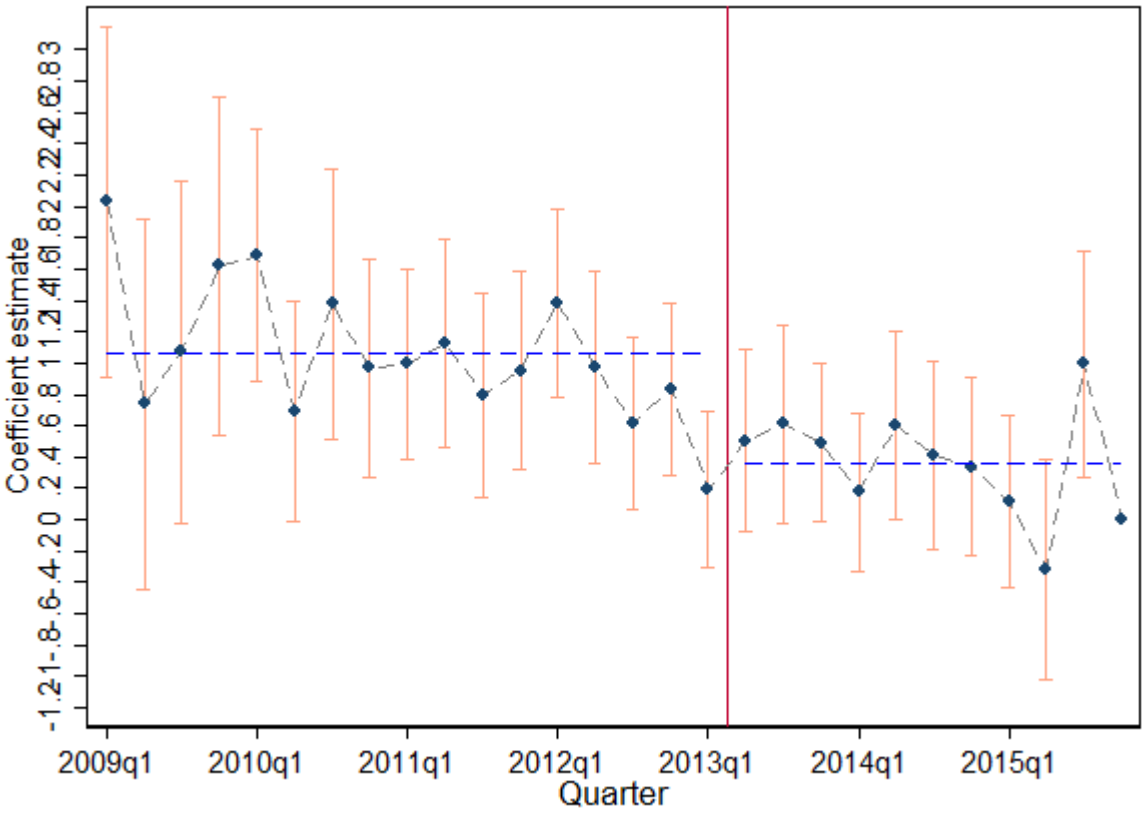

FIGURE C.20: Social benefit income: I include the interaction term of treatment status and time variable (quarter of the year). Also, I control for the individuals' fixed effect and wave by time fixed (wave x quarter of the year).

C.3 The impact of austerity on individuals' mental health - OLS models (Controls: individuals' fixed effect, wave and time fixed effect)

TABLE C.5: The Impact of the welfare reforms on individuals' mental health

	Any	Any - F
Dependent Variable: GHQ		
Post × Reform	-0.0329	-0.0577
	(0.167)	(0.163)
Mean of Dependent Variable	8.73	8.73
PIDP	1622	1622
Number of Observations	6245	6245
Individual FE & Wave x Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for survey's wave by time fixed effect (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

C.3.1 The impact of austerity on individuals' mental health based on the level of the social benefit income decline for the impacted individuals

TABLE C.6: The Impact of austerity on individuals' mental health - Heavily impacted individuals

	Any	Any - F
Dependent Variable: GHQ		
Post × Reform	-0.320	-0.218
	(0.404)	(0.362)
Mean of Dependent Variable	9.72	9.72
PIDP	683	683
Number of Observations	2175	2175
Individual FE & Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for time fixed effect (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

TABLE C.7: The Impact of austerity on individuals' mental health - Heavily impacted individuals

	Any	Any - F
Dependent Variable: GHQ		
Post × Reform	-0.340	-0.251
	(0.405)	(0.364)
Mean of Dependent Variable	9.72	9.72
PIDP	683	683
Number of Observations	2175	2175
Individual FE & Wave x Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for survey's wave time fixed effect (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

TABLE C.8: The Impact of austerity on individuals' mental health - Mildly impacted individuals

	Any	Any - F
Dependent Variable: GHQ		
Post × Reform	0.0160	-0.0750
	(0.206)	(0.204)
Mean of Dependent Variable	9.07	9.07
PIDP	996	996
Number of Observations	3585	3585
Individual FE & Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for time fixed effect (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

TABLE C.9: The Impact of austerity on individuals' mental health - Mildly impacted individuals

	Any	Any - F
Dependent Variable: GHQ		
Post × Reform	0.0111	-0.0838
	(0.207)	(0.207)
Mean of Dependent Variable	9.07	9.07
PIDP	996	996
Number of Observations	3585	3585
Individual FE & Wave x Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for survey's wave and time fixed effect (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

C.4 The results of the Event Study Analysis (Controls: individuals' fixed effect, wave and time fixed effect)

The results of Event Study Analysis when the definition of the treated individuals is based on the information provided by the variable "ficode" (Controls: individuals' fixed effect and time fixed effect):

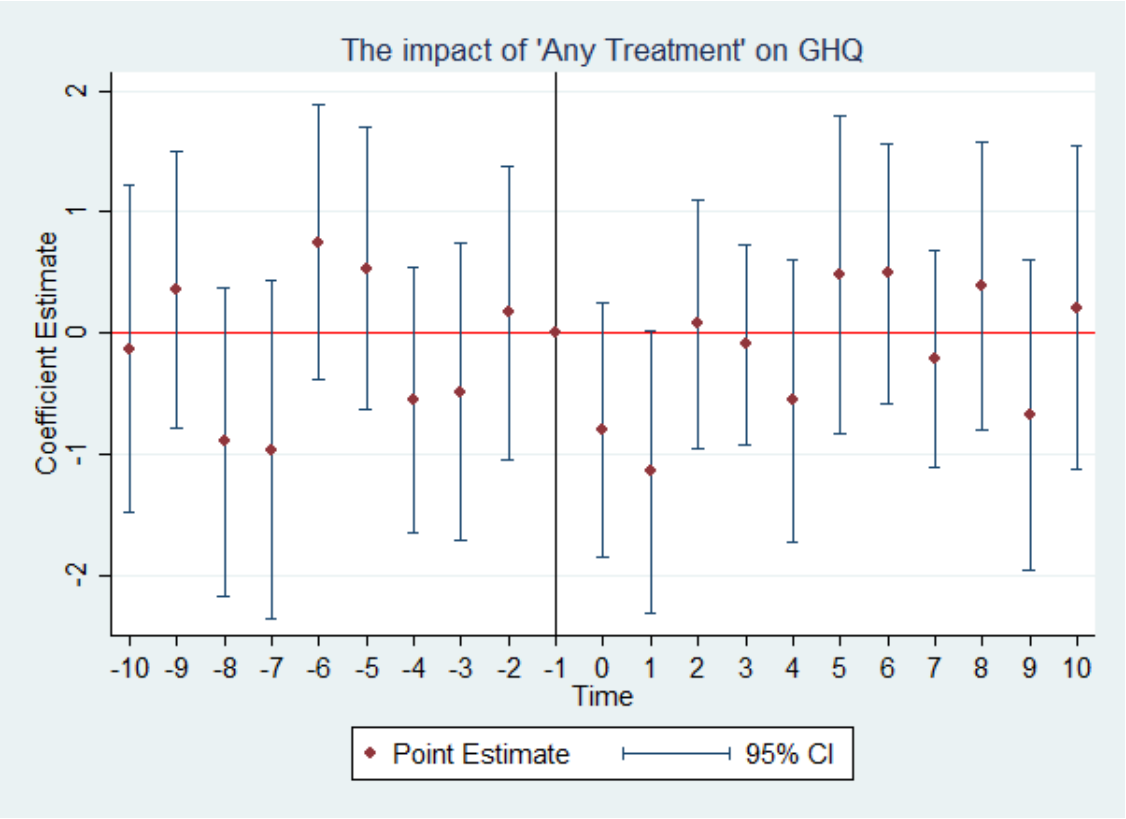

FIGURE C.21: Event Study Analysis when treated of Any treatment are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms, Controls: individuals' fixed effect and survey's and time fixed effects)

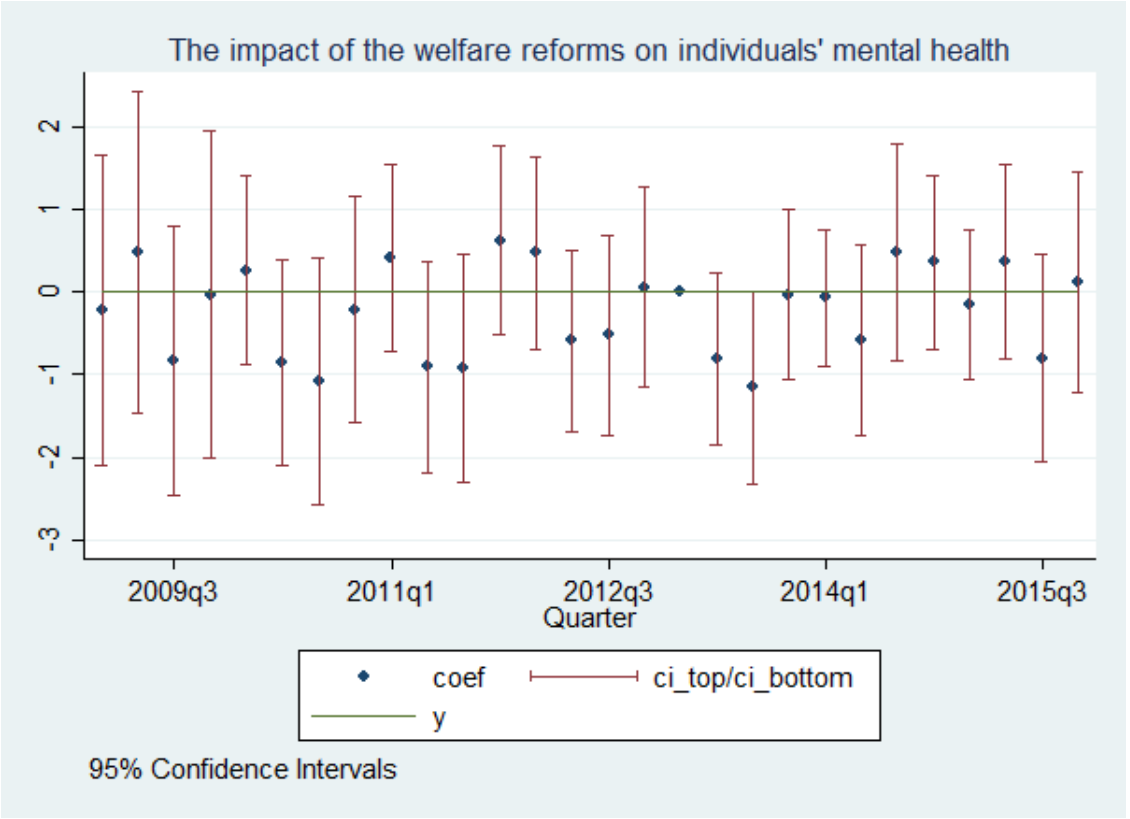

FIGURE C.22: Evidence regarding the parallel trend assumption by working similarly to Autor (2003). Event Study Analysis when treated of Any treatment are identified based on the information provided by the variable "ficode" (Sample: Observed at least once before and once after the reforms, Controls: individuals' fixed effect and time fixed effects)

C.5 Placebo falsification test regarding the validity of the DiD analysis (Controls: individuals' fixed effect, wave and time fixed effect)

TABLE C.10: The Impact of austerity on individuals' mental health (placebo falsification)

	Any	Any - F
Dependent Variable: GHQ		
Post × Reform	0.332	0.212
	(0.312)	(0.294)
Mean of Dependent Variable	8.67	8.67
PIDP	1622	1622
Number of Observations	3399	3399
Individual FE & Wave x Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The false time of the implementation of the reforms is the first quarter of the year 2011.The analysis includes the data of the years 2009Q1-2013Q1. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for survey's wave and time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

C.6 Results from the heterogeneous analysis (Controls: individuals' fixed effect, wave and time fixed effect)

C.6.0.1 Results from the heterogeneous analysis - By sex

TABLE C.11: The Impact of austerity on individuals' mental health (GHQ score)

	Any	Any - F
Panel A: ***Men***		
Post × Reform	-0.0607	0.0975
	(0.240)	(0.237)
Mean of Dependent Variable	9.19	9.19
PIDP	671	671
Number of Observations	2485	2485
Individual FE & Wave x Time FE	Yes	Yes
Panel B: ***Women***		
Post × Reform	-0.0266	-0.109
	(0.240)	(0.224)
Mean of Dependent Variable	8.43	8.43
PIDP	951	951
Number of Observations	3760	3760
Individual FE & Wave x Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ).The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for survey's wave and time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

C.6.0.2 Results from the heterogeneous analysis - By age group

TABLE C.12: The Impact of austerity on individuals' mental health (GHQ score)

	Any	Any - F
Panel A: ***Younger individuals***		
Post × Reform	0.230	0.146
	(0.219)	(0.227)
Mean of Dependent Variable	9.25	9.25
PIDP	823	823
Number of Observations	2882	2882
Individual FE & Wave x Time FE	Yes	Yes
Panel B: ***Older individuals***		
Post × Reform	-0.526*	-0.228
	(0.308)	(0.252)
Mean of Dependent Variable	8.29	8.29
PIDP	799	799
Number of Observations	3363	3363
Individual FE & Wave x Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for survey's wave and time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

C.6.0.3 Results from the heterogeneous analysis - Deprivation level of the area that individuals live

TABLE C.13: The Impact of austerity on individuals' mental health (GHQ score)

	Any	Any - F
Panel A: ***The (first) quintile that represents the least deprived***		
Post × Reform	0.161	0.302
	(0.364)	(0.334)
Mean of Dependent Variable	8.89	8.89
PIDP	370	370
Number of Observations	1315	1315
Individual FE & Wave x Time FE	Yes	Yes
Panel B: ***The (fifth) quintile that represents the most deprived***		
Post × Reform	-0.335	-0.179
	(0.345)	(0.346)
Mean of Dependent Variable	8.74	8.74
PIDP	453	453
Number of Observations	1530	1530
Individual FE & Wave x Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for survey's wave and time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

TABLE C.14: The Impact of austerity on individuals' mental health (GHQ score)

	Any	Any - F
Panel A: ***Individuals who live in a less deprived area***		
Post × Reform	0.00762	-0.0228
	(0.295)	(0.284)
Mean of Dependent Variable	8.75	8.75
PIDP	592	592
Number of Observations	2140	2140
Individual FE & Wave x Time FE	Yes	Yes
Panel B: ***Individuals who live in a more deprived area***		
Post × Reform	-0.0531	0.0206
	(0.218)	(0.213)
Mean of Dependent Variable	8.74	8.74
PIDP	1097	1097
Number of Observations	3985	3985
Individual FE & Wave x Time FE	Yes	Yes

Notes: OLS estimates regarding the impact of the different welfare reforms on individuals' mental health (GHQ). The sample of the analysis includes working age social benefit recipients individuals who are observed at least once before and once after the implementation of the reforms. The time of the implementation of the reforms is the second quarter of the year 2013. The study includes the data of the years 2009-2015. The controls for individuals' fixed effect is included exploiting the within individual variation. Also, I control for survey's wave and time fixed effects (tq: quarter of the year). Standard errors clustered at the individual level (panel data unit).

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