

UNIVERSITY OF KWAZULU-NATAL

Education and the Gender Wage Gap in South Africa

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Education and the Gender Wage Gap in South Africa

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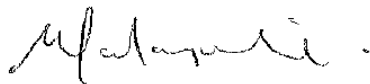
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Abstract

A vast literature on the gender wage gap across different institutional structures and economies exists. Men typically earn more than women, with this gap being attributed to differences in productive characteristics, occupational choice and discrimination. However less research exists on how this gap differs by level of education. Using the National Income Dynamics Study (NIDS) Wave 1 2008, this study aims to analyse the prevailing gender wage gap by level of education in South Africa. Using quantile regression I estimate the size of the gender wage gap at different points of the wage distribution, by the worker's level of education. Following the decomposition technique of Machado and Mata (2005) I then decompose the gender wage gap between men and women into different components. A key finding of this study is the presence of a glass ceiling for South Africa, which limits the ability of women's wages at the top of the earnings distribution to rise to match the wages of men.

Key Words: Gender wage gap, NIDS, quantile regression, quantile decomposition, sample selection

Contents

Chapter 1: Introduction	1
Chapter 2: Literature Review.....	4
2.1 Trends in the South African labour market post 1994	4
2.2 Explanations of the Gender Wage Gap	7
2.2.1 Human Capital	7
2.2.2 Occupational Choice and Over Crowding.....	8
2.2.3 Discrimination	9
2.3 Empirical studies on the Gender Wage Gap: An International and Local Review.....	11
2.4 The Gender Wage Gap by Level of Education.....	13
2.5 Conclusion.....	16
Chapter 3: Data and Descriptive Analysis.....	18
3.1 Data.....	18
3.2 Descriptive Analysis.....	19
3.2.1 Employment Statistics	20
3.2.2 Education Statistics.....	21
3.2.3 Kernel Density Estimation of Earnings	21
3.2.4 Descriptive Statistics: Mean Characteristics by Gender	23
3.3 Conclusion.....	26
Chapter 4: Methodology and Results	28
4.1 Quantile Regression (QR).....	28
4.1.1 Methodology	28
4.1.2 Quantile Regression Results.....	29
4.2 Sample Selection.....	38
4.3 Quantile Decomposition.....	39
4.3.1 Quantile Decomposition Results	40
4.4 Conclusion.....	43

Chapter 5: Conclusion	45
Appendix	48
A.1: Sample Selection	50
References	51

List of Tables and Figures

Chapter 3: Data and Descriptive Analysis	19
Table 3.1: Summary statistics of employment status, by gender.....	19
Table 3.2: The distribution of education of wage employed workers	21
Table 3.3: Mean Characteristics of wage employed men and women with low and high levels of education.....	24
Figure 3.1: Kernel density plot of the wage distribution by gender and level of education	22
Chapter 4: Results	29
Table 4.1: Quantile regression of log of hourly wages for low educated workers	31
Table 4.2: Quantile regression results of log of hourly wages for high educated workers.....	35
Table 4.3: Quantile decomposition results for workers with low education	41
Table 4.4: Quantile decomposition results for workers with high education.....	42
Appendix	50
Table A1: Probit Model	48
Table A2: Quantile Regression with Sample Selection	50

Chapter 1: Introduction

As early as the 1950s, gender equality was widely accepted as a socially and economically important goal internationally. It has been recognized as not merely a moral value but one which can be used as a tool to stimulate economic growth and welfare through the utilization of the full productive work force. As such, almost all countries in the world have undertaken efforts to ensure equal treatment of women in the labour market via various policy objectives. The most common approach is through the setting of various laws pertaining to equal opportunity as well as those related to paternal leave and child care. While these policies are expected to impact positively upon the gender wage gap, much of their success lies in the efficiency of implementation. Furthermore what has come to light is that the assessment of such policies ultimately rests on the ability to measure this unequal treatment (Kunze, 2008). This study aims to contribute to the literature on the measurement and understanding of gender wage gaps, particularly as they relate to the educational attainment of the worker.

Several studies have shown that women continue to suffer penalties in the labour market related to employment opportunities, career progression and of course wages. In this respect there is a wealth of literature that exists that has attempted to estimate gender wage differentials. According to a meta-analysis conducted by Weichselbaumer and Winter-Ebmer (2005), the gender wage gap has been on a notable decline over time in industrialized countries. The authors submit that in particular the gender pay gap has declined from 65 percent in the 1960s to 30 percent in the 1990s. However Blau and Kahn (2006) suggest that if one were to remove the contribution of gender differences in characteristics, the current gender wage gap would be approximately 25 percent. Much of the decline observed in the gender wage gap can be attributed to changes in educational attainment, work experience and occupational choice (Blau and Kahn, 2006).

An initial investigation into how the gender wage gap varies by education was conducted by Katz and Murphy (1992), in which they compared the earnings gap between men and women who were both highly and lowly educated workers. In particular, the study focused on the change in relative wages of high school and college graduates over the period of the 1960s to the 1980s, and showed a clear distinction between wage earning capabilities on the basis of education. However, one drawback of this study was that it failed to consider skill difference, prices for skills and did not estimate the gap unexplained by differences in the productive characteristics of workers.

The typical method used for the empirical estimation of gender wage gaps is to estimate an earnings equation, usually using the Ordinary Least Squares (OLS) method, in which a gender dummy variable measures the difference in wages between men and women. However there is less evidence on the nature of this gap across the wage distribution. Therefore in order to estimate the gender wage gap at different points in the wage distribution, it is necessary to use quantile regression instead.

Recently, the focus of studies of the gender wage gap has turned to testing whether wage discrimination is higher amongst high wage (tertiary education) or low wage (primary/secondary education) workers (Kee, 2005). In other words, is the gender wage gap larger at the top end or the bottom end of the wage distribution? For instance, women may find that once they've reached a particular level in their career there is little further opportunity for advancement in terms of promotions as compared to men. Alternatively, or in addition, women may find themselves more concentrated in low wage work than is the case for men.

Inspired by the approach undertaken by de la Rica *et al* (2008) and Mussida and Picchio (2012) about the existence of a gender wage gap by education in Spain and Italy respectively, this study attempts to analyse how the gender wage gap varies by education and location in the wage distribution in South Africa.

According to the European Commission (2005) education is one of the most important observed characteristics which can explain the level of wage inequality between men and women. Importantly and of relevance to this study is the discrimination that women continue to endure in the workplace, even at the same educational level as their male counterparts.

The focus of this dissertation on education is an aspect of the gender wage gap that has largely been unexplored in the South African context, as such this study aims to:

- Review the underlying economic theory of the determinants of the gender wage gap with specific reference to the explained (human capital) and unexplained gap (discrimination);
- Estimate the magnitude of the gender wage gap across the earnings distribution, by the worker's level of education in South Africa, using data from the National Income Dynamics Study;
- Assess the extent to which the wage gap can be attributed to gender differences in the workers' characteristics and in the returns to their characteristics, across the distribution and by their level of education.

The study is structured as follows:

Chapter 2 will review the literature on the gender wage gap as it relates to education. It begins with an overview of the South African labour market and proceeds with a discussion of the theoretical explanations for the gender wage gap, highlighting firstly the issues of human capital and occupational crowding before concluding with the residual effect, that of discrimination. The chapter then provides an in-depth look at the existing international and local empirical literature on the gender wage gap before turning to a discussion of how the gender wage gap differs by level of education in South Africa.

Chapter 3 begins by introducing the reader to the data that are used for this study, that is, the National Income Dynamics Study (2008) Wave 1. It then proceeds to present descriptive statistics on the education and employment characteristics of the chosen sample of workers, as well as their earnings, by gender.

Chapter 4 sets out the methodologies and results of the various techniques undertaken to derive the empirical results for this chapter. Specifically Section 4.1 outlines the quantile regression methodology chosen for this study before presenting the results. Section 4.2 considers how the findings are affected by sample selection into employment. Section 4.3 decomposes the gender wage gap by level of education using the quantile decomposition technique of Machado and Mata (2005), adapted by Albrecht *et al* (2003). Section 4.4 concludes.

Finally, Chapter 5 summarizes the study, outlining the key findings of each of the various chapters and discussing the relevance of the results. It also provides some recommendations for possible future research.

Chapter 2: Literature Review

The gender wage gap can be defined as “the observed difference between wages paid to women and wages paid to men” (U.S Department of Labour, 2010). A gender wage gap in favour of men has been found to exist in a wide variety of countries and time periods, in a wealth of economic research (See Blau and Kahn, 1997; Oostendorp, 2004; Bhorat and Goga, 2012) In recent years, a number of researchers have focused on how the gender wage differential differs depending on the level of education acquired by workers. This dissertation is inspired by these studies, with the focus being on the current gender wage gap by education level in South Africa.

The chapter is structured as follows: Section 2.1 provides an overview of the trends in the South African labour market post 1994. In particular, this section speaks to the issues of female labour force participation as well as education, before briefly touching on the influence of education on wages. Section 2.2 explores explanations for the existence of the gender wage gap in theory, looking at human capital theory (which accounts for productivity differences), occupational crowding and then at discrimination (which can be thought of as a residual explanation for the gender wage gap). Section 2.3 then provides a background of empirical studies on the gender wage gap in the international and domestic literature. Section 2.4 reviews more closely previous studies of the gender wage gap by education level. Finally, Section 2.5 concludes.

2.1 Trends in the South African Labour Market Post-1994

The year 1994 witnessed the first democratically elected government in South Africa. However with this transition came the inheritance of a labour market which had been subject to an inadequate and unequal education system, international economic isolation and economic policies that had favoured capital over labour. After two decades of democracy, a number of these acute labour market challenges remain, in particular unemployment, poverty and income inequality.

This is not to say that the labour market hasn't undergone significant reform. Since 1994, a number of laws have been institutionalised, aimed at protecting workers at the middle and lower end of the skill spectrum as well as promoting individuals from previously disadvantaged backgrounds. These laws include The Basic Conditions of Employment Act of 1997; The Labour Relations Act of 1996; and The Employment Equity Act of 1998 (Burger and Woolard, 2005).

Using labour statistics in October 1995 and February 2002, Burger and Woolard (2005) provide a snapshot of changes in the labour market since democracy. In terms of employment, there has

been a significant increase in the economically active population which noted a growth rate of 4.8 percent per year between 1995 and 2002. This implied a substantial increase in labour force participation. A number of possible reasons for this increase included migration from rural to urban areas, increasing education levels as well as an increase in the number of households.

However what was interesting to note was that almost three fifths of these entrants were women. While male labour force participation grew at an average annual rate of 3.5 percent, female labour force participation grew twice as fast, the net effect of which suggested a definite feminisation of the labour force. However, while female labour force participation grew, this paradoxically led to a higher female unemployment rate of 46 percent in 2002 from 39 percent in 1995, as employment growth did not keep up with the increase in participation.

In addition it should be noted that while some growth in female employment occurred, much of the increase was in the informal sector. To some extent it can then be said that the female employment rate can mask the fact that women are highly concentrated in domestic work and informal self-employment (Burger and Woolard, 2005).

Therefore while trends in the post-apartheid period seem to suggest a feminisation of the labour market, this has largely been accompanied by rising levels of female unemployment and a feminisation of low paid insecure forms of employment. The question then becomes one of the reasoning behind the sudden increase in female labour force participation and the extent to which education could be influencing this labour market outcome.

It should be noted that education was of the most inaccessible and unequal resources during the Apartheid era. Therefore, post-apartheid, the South African government has sought to reduce inequality by promoting high quality education. While the first reform of the education system was aimed at removing the apartheid curriculum and its outdated content, the second reform saw continuous assessment being introduced into schools. The most ambitious and possibly the most controversial of these reforms is the third, which led to the introduction of outcomes based education (Jansen, 1998).

In terms of schooling, Branson *et al* (2012) has shown that while average levels of education have improved within South Africa, a bulk of the population still have incomplete secondary education. Furthermore, while South Africa's higher education system in the areas of research and postgraduate attainment is far better than most African countries, it continues to suffer from the same educational inefficiencies and poor educational performance as the school system. For example, its enrolment rate was found to be approximately 16 percent of the population, which is

low by developed country standards, and throughput rates are poor. Therefore despite efforts to improve higher education, this sector suffers from high attrition and low participation (Fisher and Scott, 2011).

Before proceeding to analyse the gender wage gap by education in South Africa, it is important to mention the role of the quality of education. According to most researchers, a better quality of education can significantly improve the outcomes observed in the labour market. For example, in a study conducted by Anderson, Case and Lam (2001) the authors showed that education can be used as a foundation in explaining many issues faced by South Africans today. These issues include racial differences in income, trends in unemployment and intergenerational transmission of inequality. Using the 1995 October Household Survey (OHS), Education Atlas and the School Register of Needs as well as the Gugulethu High School Study, the authors arrived at several key conclusions. In particular they showed that both quantity and quality had a strong influence on adult economic outcomes. Individuals who grew up with access to better education often earned more than those who did not.

However of importance to this study is the influence that education has on the wage earning capability of men and women. The South African empirical literature on the determinants of earnings has confirmed that education is a crucial factor in explaining earnings (see, for example, Mwabu and Schultz, 1996; Borat and Leibbrandt, 2001). Using the method of Ordinary Least Squares (OLS), Mwabu and Schultz (1998) estimated wage premia for education and location by gender and race in South Africa. Firstly, the authors found that wage premia received by African men for an additional year of primary, secondary and post-secondary schooling were 8.4, 15.8 and 29.4 percent respectively. Similarly, African women were found to receive a wage return of 6.2, 24.9 and 39.6 percent for one additional year of primary, secondary and post-secondary schooling respectively. This pattern was striking and was observed for white, Indian and coloured workers also. In essence wage returns to schooling increased for the different race groups at higher levels of schooling, and the returns differed by gender.

The South African labour market has thus experienced significant changes in the rates of employment and labour force participation post-apartheid. However due to structural changes in the family unit, this has resulted in more women choosing to enter the labour market which has further exacerbated the female unemployment rate. In addition, while female employment has increased, this has largely been in the informal sector.

Research has shown that returns to education are positively linked to higher levels of education. As workers attain higher levels of education so their ability to earn higher wages increases at an increasing rate. However as will be shown during the course of this research, workers may be disproportionately rewarded for equal levels of educational attainment depending on their gender.

2.2 Explanations for the Gender Wage Gap

Concern surrounding the gender wage gap and the subsequent wage discrimination faced by women in the labour market has long been discussed by researchers and policymakers. Ultimately the assessment of the effectiveness of the policies developed rests on the ability to measure the unequal treatment of female workers.

According to Gary Becker (1964) wage discrimination can be defined through the comparison of wages for equally productive workers. The calculation is often conducted by estimating differences in wages between workers, conditional on their productivity potential which is represented by their human capital characteristics.

More specifically, the gap can be decomposed into a portion that is explained and a portion that is unexplained (often referred to as the residual). The explained portion is characterised by the observed differences in human capital endowments. The residual or unexplained is often characterised by unequal remuneration interpreted as an estimate of discrimination for example. However as will be explained further on, the residual can also be the result of differences in ethnicity, family background and unobserved skills.

2.2.1 Human Capital

Historically the growth of an economy has typically been explained by the development of three factors of production: labour, land and capital. However, over time, the idea that any unexplained growth could be explained by technological change became increasingly less plausible and attention has thus shifted to the notion of human capital (Psacharopoulos, 2007). Over time, investment in human capital has played an important role in the development of economies, as it has allowed countries to respond to increased globalization and the ever changing patterns of the demand for labour.

In particular, the concept of human capital came about as a result of the acknowledgement that an individual's or firm's choice to invest in human capital is analogous to that of the decision to invest in other forms of capital. Human capital can be decomposed into three components. These

include early ability (either intrinsic to the individual or attained over time), qualifications as well as knowledge (attained during education) and lastly skills, experience and competencies (gained during on the job training). It is important to note that investment in human capital is undertaken in the same manner as most other investments, that is, only when the return exceeds the cost. The theory of human capital hypothesises that increased education and training has the capacity to augment worker productivity thereby raising future expected income (Blundell *et al.*, 1999).

Initially introduced by Mincer and Polachek (1974), the human capital explanation largely focuses on providing insight into the reasons behind gender differences in economic outcomes based on productivity. Due to the division of labour within the family unit, especially regarding children, women are anticipated to spend less time in the labour market or lead less continuous work lives. This results in them being less willing to fully commit to attaining formal education and on the job training, severely negatively impacting upon earnings potential. Furthermore given the time taken out of the labour market, this has the potential to lead to a deterioration of both their skills and experience.

For these reasons, employers are less willing to hire female workers. In addition, in firms which have high turnover costs, employers are reluctant to invest in the on the job training of women. Since it is difficult to differentiate between those women who are more career-orientated and those that are not, some women are unfortunately subjected to this form of statistical discrimination.

2.2.2 Occupational choice and crowding

Before proceeding to look at discrimination, another aspect which follows on from the previous discussion is occupational segregation. Occupational segregation refers to the exclusion of women from otherwise male orientated jobs, resulting in women being crowded into traditionally female orientated jobs (Blau and Kahn, 2001). Occupational crowding of women occurs when “a high proportion of total female employees are located in a small number of occupations” (Lewis, 1996: 107).

According to Bielby and Baron (1986) the continued presence of occupational crowding in the labour market and in particular its effect on women has traditionally been linked to the unobservability of individual female productivity. In explaining this concept further, the authors use the model of statistical discrimination which posits that firms on average believe that marginal productivity differs by gender for various reasons discussed below.

Extending on the discussion of Section 2.1.1, it was emphasized that women expect to spend less time in the labour market given child rearing responsibilities which in turn influences their investment in human capital. Furthermore as a result of their family responsibilities this results in much time taken out of the labour force which leads to a deterioration of their skills. However in addition to these factors women also choose occupations where the wage penalties for labour force interruptions are less severe. In other words they seek out occupations that will provide them with a more comfortable, flexible lifestyle in order to still pursue their child rearing responsibilities. Women also, in the absence of parental leave, avoid occupations that require significant investments in firm-specific skills, as they will only benefit so long as they remain within that particular job (Mincer and Polachek, 1974). Once again due to the choice that women make in the labour market, it becomes difficult for firms to differentiate between less career orientated and more career orientated women. As a consequence it is common for firms to invest less in in the on the job training of women which has negative implications for women in the labour market overall. (Blau, 1996; Bielby and Baron, 1986).

As a result it can be said that women are in a sense prevented or discouraged from assuming male orientated jobs which require significant on the job training and which also have high turnover costs. For these reasons women are often crowded into so called female orientated jobs or careers which include for example teaching and nursing. How this translates into lower wages for women was touched on by a model of occupational crowding developed by Bergmann (1974). In particular her model showed that employers in maintaining this social system in which women are discriminated against, hold constant the productivity of men and women in their decision to hire and as such results in women continually earning less than men.

2.2.3 Discrimination

Labour market discrimination can be defined as the differences in pay between groups that cannot be explained by productivity differences but which may reflect differences in unmeasured qualifications or compensating differentials between groups (Blau and Kahn, 1996).

The theory of discrimination was first introduced by Gary Becker (1957) in his analysis of race discrimination. Becker defined discrimination as a product of people's personal prejudice or taste against a particular group of individual which he termed to be a form of pure wage discrimination. According to Arrow (1971), estimation of pure discrimination is difficult, as it requires the estimation of the residual gender wage gap, after accounting for gender differences in productive characteristics, which often leads to discrimination being under or overestimated. An example of

the underestimation of discrimination includes, unmeasured qualifications. If one supposes that men are heavily endowed with this unmeasured qualification, then the extent of discrimination will be overestimated. On the other hand, if a factor, which should be controlled for, is itself affected by discrimination, this will result in discrimination being underestimated (Blau and Kahn, 1996)

Later on, models of statistical discrimination were developed such as that by Bielby and Baron (1986). These models primarily focused on the expected value associated with productivity or on the reliability by which productivity can be predicted. Although considered above, for completeness statistical discrimination can be defined as the situation whereby individuals with the same abilities but from separate groups earn different wages based on the real or perceived average quality of the group.

Before proceeding it should be noted that estimating discrimination relies on estimation of a residual gender wage gap which cannot always be reasonably explained by gender differentials in qualifications. For instance some researchers have linked the unexplained portion of the gender wage gap to unobserved skills, ethnicity, family background, and schooling amongst others.

Turning back to the explanation of human capital and the family unit put forward by Mincer and Polachek (1974) to the estimation of the unexplained gap in earnings between men and women, Polachek (1974) notes that care should be taken in assuming that family characteristics have the same effect on both the earnings capabilities of men and women.

In particular, he presents a model in which he decomposes the measure of discrimination into two parts, that is, that part which measures the wage differential caused by differences in the earnings structure of men and women and; secondly that part which is unexplained by either differences in male-female coefficients or endowments.

In this paper, Polachek (1974) speaks to the presence of an inherent specification bias that can often go unnoticed. In particular, he showed that because certain characteristics (namely, marital status and number of children) have opposite effects on the wages of men and women, if adjustment were made only for the difference in male-female characteristics and neglected the structural differences in the earnings function of men and women, this would result in an overstating of discrimination. In other words while it is understood that family characteristics affect both labour force participation and wages differently, emphasis was placed on showing that it had an opposite effect on wages for men and women given that women were more likely to have shorter work lives due to child rearing. Three main findings of this paper are summarised below. Firstly, by assuming the same earnings structure for men and women, biases occur in the

estimation of the market discrimination coefficient by grouping the effects of the division of labour in the household into the estimate. Secondly, even if the division of labour is a result of discrimination in the form of different wages for the same work, traditional estimates still overestimate the original wage gap by assuming that men and women identically specialize. Finally, to the extent that the division of labour is caused by other factors, for example the preconditioning of society, the bias observed can become even more enhanced.

In summary, according to the models outlined above, not only are women likely to find themselves earning less than men, due to their human capital or to discrimination, but they are also likely to be found in more female orientated jobs, such as teaching and nursing, compared to men. It must be noted that while the two explanations of the gender wage gap are both plausible, they are not mutually exclusive. Both may play key roles in causing wage differentials, although their relative magnitudes may differ cross-sectionally and across time.

Another issue associated with measuring the gender wage gap has to do with the presence of feedback effects. For example, it is acknowledged that the traditional division of labour within the family unit has the potential to negatively impact upon women's labour market outcomes. However, it is also the case that by reducing the potential rewards to female human capital investment and labour force attachment, discrimination may provide further support for this traditional division of labour within the family unit (Blau and Kahn, 2001).

2.3 Empirical Studies on the Gender Wage Gap: An International and Local Review

Over time, almost every industrialised country has passed laws which mandate the equal treatment of women in the labour market. However a gender wage gap in favour of men remains in most of these countries. There is a wealth of research internationally that has explored this issue over time, including for example Oaxaca (1973), Sorenson (1989), and Blau and Kahn (1996). This section does not aim to review this literature comprehensively, but rather discusses a limited number of influential and relevant studies, with a focus on developing countries.

Traditionally, economists have looked to gender-specific factors, for instance female shortfalls in human capital accumulation as reasons for its persistence. However as was noted by Juhn, Murphy and Pierce (1991), the overall wage structure can also have a major influence on the relative wages of different subgroups in the labour market.

The wage structure can be defined as the “array of prices set for various labour market skills (measured and unmeasured) and rents received for employment in particular sectors of the economy” (Blau and Kahn, 1997:2). Both the wage structure and the workers’ characteristics affect the size of the gender wage gap. For example, given the assumption that women are less experienced than their male counterparts, a rise in the return to experience would result in the gender wage gap widening, even if the relative level of experience and the gender-specific treatment of women by employers remained unchanged.

Despite the gender wage gap declining over time in most countries, the size of the gap continues to vary considerably. For example while Blau and Kahn (2001) estimated the gap to be as low as 14.4 percent in the US, studies done in countries such as Slovenia and Japan report gaps as high as 85 percent (Nopo, Daza and Ramos, 2011). Different reasons for these variations per region have been put forward and are briefly discussed below.

Looking at the case of Sub-Saharan Africa, factors such as education, work allocation with gender selection and differing rates of unemployment across genders are just some of the key drivers of the gender wage gap. For example, in Ethiopia differences in educational attainment between men and women currently account for about one fifth of the existing gender wage gap (Nopo, Daza and Ramos, 2011).

Turning to Europe and Central Asia, it is rather female segregation into low wage occupations that act as a main contributor to the gap. Furthermore there also appears to be a distinct difference between public and private sector wages. In particular, while men and women’s wages are generally on par in the public sector, there is a large gender wage gap in favour of men in the private sector (Nopo, Daza and Ramos, 2011).

Finally, in terms of East Asia and the Pacific, the economic liberalization policies of 1986 have not had much effect on lowering the gender wage gap in Vietnam. Liu (2001) and Son (2007) showed that while the overall gender difference in earnings narrowed, the unexplained part of the gap remained the same. Most of the decline in the contribution of the observable characteristics has largely been due to increased education in these regions.

In summary, it could be said that much of the gap observed in different countries is largely due to differing institutional structures and wage setting mechanisms.

2.4 The Gender Wage Gap by Level of Education

While there is a general consensus in the international literature that investment in human capital is good for both growth and the reduction in inequality, there still remains some disagreement over the precise quantitative effects of human capital on growth, poverty and inequality and the best form of investment in education. According to Galor and Moav (2004) lack of finances and access to credit are some of the main reasons why poorer households are unable to adequately invest in education. By not addressing liquidity constraints faced by households, the distribution of human capital will continue to remain unequal and educational investments will remain at levels that are unable to stimulate growth. The study by Galor and Moav (2004) is useful in the sense that it developed a growth theory that demonstrated that human capital accumulation was once the prime engine through which inequality in economic growth was reduced and that ultimately human capital remains a key mechanism through which inequalities may be reduced. Klasen (2002), while focusing more on gender inequality in education, derives a similar conclusion for South Africa in which the author speaks to human capital accumulation as being important in addressing inequalities in society. However the question remains as to how education impacts upon gender wage inequality.

As noted previously, the studies of the gender wage gap have largely An initial study on gender wage differentials by education in Spain was first carried out by de la Rica *et al.* (2008). Using the 1999 (6th wave) of the European Community Household Panel for full time workers and quantile regression, the authors decomposed the gender wage gap in terms of differences in productive characteristics and in the rewards based on these characteristics.

The key finding of this paper relates to the irregular evolution of the gender wage gap and the difference between the patterns of the gap for groups with high and low educational attainment. The authors find that amongst the high educated group the gender wage gap tends to increase up the income distribution, in line with the glass ceiling hypothesis¹, while the gender wage gap tends to be strongly declining for the lower educated group of individuals (a floor pattern). The authors notes that this last finding appeared to be in contrast to that which is found more commonly in central and northern European countries where the gap increases as one moves up the earnings distribution, regardless of educational attainment. They found that one possible reason for this relates not to non-random selection but rather to statistical discrimination. Due to the low rate of female labour force participation amongst the low educated group of individuals,

¹The glass ceiling is a metaphor used to describe an invisible barrier that exists in the labour market which in this case prevents women from earning above a certain threshold (de la Rica and Dolado, 2008).

employers are arguably using statistical discrimination to discriminate against women (de la Rica and Dolado, 2008).

In addition, the authors provide valuable insight into policy decisions that could assist in lowering the gender wage gap overall. Specifically they advise that policymakers should look to ways of reconciling family and work life. If this can be achieved, rates of labour force participation amongst women would be generally higher, having positive consequences for the gender wage gap (de la Rica and Dolado, 2008).

A similar study by Addabbo and Favaro (2011) aimed to estimate the gender wage gap by education in Italy, using quantile regression analysis as well as a decomposition technique proposed by Machado and Mata (2005).

Key findings of the study reveal the following. Firstly, there is indeed a robust relationship between education and the gender wage gap. At any point in the wage distribution it was found that this gap tends to be lower amongst more educated women than less educated women. In particular, a wage loss of between 4.8 percent and 11.3 percent is estimated for highly educated female workers, compared to males, while a wage loss of 11.7 to 16.1 percent is predicted for low educated female workers. Secondly, while the gap tends to increase and then settle for low educated female workers, the gap tends to increase steadily from the bottom to the top of the earnings distribution for more highly educated workers, with only a marginal decrease at the top. This finding suggests that women are discriminated against compared to men across the entire earnings distribution, but to different degrees depending on their education.

This issue is further supported in a study by Mussida and Picchio (2012). In order to carry out this study the authors used data from the European Community Household Panel (ECHP). In particular, their methodology encompassed the estimation of wage distributions in the presence of covariates and sample selection and on simulation algorithms to derive counterfactual distributions and decompose the gender wage gap. Two key findings emerged from this study. Firstly it was found that, even in the event that men and women had identical characteristics, women would continue to be penalised in the wages that they earn, irrespective of whether the authors correct for non-random selection into full-time employment and on educational levels. Secondly, women with low education were found to suffer much higher penalties at the bottom end of the wage distribution than at the top. More specifically the authors found a sticky floor for low educated females and a glass ceiling for high educated females. This finding implied that low educated females were more likely to find employment in the full time labour force as compared

to more highly educated females. The authors thus conclude that in order to reduce the gender wage gap more focus should be placed on low educated women in low quality jobs, as the level of discrimination was more severe for women with high levels of education.

Ultimately these three studies using different methodologies have in essence arrived at the same conclusion. The ability for education to impact upon wage earning is real. As such governments need to focus attention on assisting with greater educational attainment in order to assist in reducing the gender wage gap.

In South Africa there still exists considerable inequity in the labour market. Pre labour market discrimination is composed of various dimensions which continue to impact upon gender wage differentials, which include the quality of schooling, accessibility to tertiary education, adequate learning conditions and access to educational bursaries to name a few. In addition gender segmentation is still large within South Africa due to its apartheid history given that many women during this time remained in rural areas with limited access to quality education and employment, while men migrated to urban areas in search of employment.

Furthermore under the apartheid era, education policy was observably unequal. The majority of resources were distributed to white only schools, with non-white South Africans receiving a very low standard of education. Post-apartheid, the South African government has thus sought to reduce inequality and promote high quality education for all, and thus the education system in South Africa has undergone several key reforms. However despite efforts, the problems that continue to underlie this sector are not due to under-resourcing but rather to the inefficiency in both service delivery and quality (Leibbrandt *et al*, 2009). For example, according to the National School Register of Needs Survey (which seeks to quantify the allocation of infrastructure and facilities), schools continue to have limited access to basic necessities such as water, electricity, libraries and computers. In addition there is also the issue of overcrowding (Spreen and Vally, 2006).

Therefore although gender gaps in wages have been shown to exist widely, the nature of such gaps may differ according to the local and historical labour market context. This section therefore discusses the labour market and educational environment in South Africa, particularly as it pertains to gender differences in human capital, in order to support the empirical analysis in the following chapters.

Apartheid also contributed significantly to gender segmentation within the labour market. Using data for the period 1993-1995, Bhorat (2000) showed that although a wage gap existed in favour

of men, there was a decline in the gender wage gap since immediately before democracy. In addition there was a distinct gender wage inequality amongst workers with a matric and tertiary education.

This finding was further supported by Casale (2004). Analysing earnings by level of education, race and sex, Casale (2004) showed that returns to education were always lower for women, at every level of education. However she showed that higher education played a crucial role in providing women with the opportunity to earn higher wages. Therefore, the results place some emphasis on the need for higher education to improve one's livelihood.

She reiterated this point further by showing that average real earnings changes among employed white women. For instance between 1995 and 2001, there was a notable increase of approximately 17 percent in the average real earnings of white women with a degree as compared to other categories of education.

However as Ntuli (2007) went on to show while there is gender wage gap, this tends to vary along the wage distribution. Using data from the September (2004) Labour Force Survey for the period 1995 to 2004, the author finds that, educational attainment is associated with higher returns but, using quantile regression analysis, she shows that this is not constant along the entire wage distribution. For instance as one approaches the top end of the earnings distribution, returns to secondary education decline for both genders. Also, women enjoy higher returns than men to the secondary level of education. In contrast men enjoy higher returns to tertiary education compared to women. This finding indicates that men are better rewarded at the top end of the labour market for the same level of education as women (Ntuli, 2007). However, the author did not calculate the size of the gender wage gap at different levels of education, which is the contribution of this dissertation.

2.5 Conclusion

In summary the unequal treatment of women internationally is not uncommon and governments continue to make a concerted effort to reduce the inequality experienced by this group of individuals. One such type of unequal treatment involves the observed difference in earnings between men and women, which forms the focus of this study.

Essentially the gender wage gap can be decomposed into a portion that is explained (due to productive characteristics) and unexplained (often referred to as the residual). The theoretical discussion on the gender wage gap was broken down into three parts, that is, human capital,

over-crowding and discrimination. Using a model developed by Mincer and Polachek (1974) it was shown that women choose to invest less in human capital as a result of their family responsibilities. This in essence leads to both a deterioration of their human capital due to the time taken out the labour force and lower wages due to the uncertainty surrounding their job tenure.

In addition to these factors it was found that women also choose occupations to match their family responsibilities. As such they often choose occupations that require less on the job training and ones which would occupy more of their time. Given these decisions it is generally difficult for employers to identify more career driven women from less career driven women which results in not only lower wages but also less skills training for women.

In terms of labour market discrimination there are two main forms which are present, namely pure wage discrimination and statistical discrimination. While pure wage discrimination is the result of employers' personal prejudices, statistical discrimination has more generally been used to explain the discrimination that women experience in the labour market. Statistical discrimination relates to employers' reluctance to invest in women in the labour market due to preconceived notions of women's lack of commitment to remaining in the workforce. However following on from the analysis of the family unit, it was found that in terms of discrimination while family characteristics impact upon men and women differently in the family, it has opposite effects on their wage earning capability.

The chapter showed that overall the gender wage gap appears to be declining internationally over time. However of importance to this study was the evidence of a gender wage gap by education. Considering international literature, the situation differed between countries, however it was clear that overall education does have a significant influence on the gender wage gap.

Turning to the South African context it was shown that returns to education do differ along the wage distribution. However to my knowledge there is no study that has specifically concentrated on the gender wage gap by education in South Africa. Therefore in the chapters that follow, this dissertation uses data from the National Income Dynamics Study Wave 1 (2008) to assess the gender wage gap by education, and how it varies across the earnings distribution, in South Africa.

Chapter 3: Data And Descriptive Analysis

The previous chapter showed that a large body of literature on gender inequalities in the labour market exists. Over time the focus has been primarily on wages, given that wages are considered to be a good indicator of access to resources and opportunities. The empirical analysis in this dissertation will explore the relationship between education and gender inequalities across the wage distribution. In particular, it will seek to understand the extent to which the gender wage gap can be attributed to gender differences in the distribution of personal characteristics or in the

remuneration of the same characteristics at different points in the distribution of earnings, and for workers with high and low levels of education (Mussida and Picchio, 2012). Chapters 3 and 4 will explore this issue using recent South African data, inspired by similar analyses conducted by de la Rica et al (2008) and Mussida and Picchio (2012) for Spain and Italy respectively.

This chapter is structured as follows: Section 3.1 outlines the data that are used for the study, Section 3.2 presents descriptive statistics on the education and employment characteristics of the chosen sample of workers, by gender, and Section 3.3 concludes.

3.1 Data

The empirical analysis is based on a sample taken from Wave 1 (2008) of the National Income Dynamics Study (NIDS). The National Income Dynamics Study is the first national household panel study in South Africa and was initiated as part of government's multi million rand effort to gain a better understanding of the dynamics of poverty in the country.

The study began in 2008 and is conducted on a bi-annual basis whereby teams of interviewers are sent into the community to track the movements of a nationally representative sample of approximately 7300 unique households, comprising of an estimated 28 255 household residents in total. Themes captured include but are not limited to poverty and well-being; the composition of the household; fertility; migration; labour market participation; health and education; vulnerability and social capital (NIDS, 2015).

Throughout the dissertation, the estimates are presented at the level of the sample, which means that to the extent that the sample is not completely representative of the South African population, these results are valid for the sample only. Although population weights could have been used in the early analysis, the quantile decomposition analysis conducted in Chapter 4 does not support the use of population weights, therefore weights are also not used in this chapter for the sake of consistency of estimates between the descriptive statistics and later analysis.

3.2 Descriptive Analysis

3.2.1 Employment Statistics

Before proceeding with an in-depth consideration of wages and other characteristics amongst the employed, it is important to first gain a broad understanding of the construction of the sample using descriptive statistics. Later analysis in Chapter 4 will take into account selection into employment, and therefore Table 3.1 illustrates the differences in employment status by gender.

Employment status is classified into four categories of employed, searching unemployed, non-searching unemployed, and economically inactive. For the purposes of defining participation in the labour force, this study has used the broad definition of unemployment. This category includes the non-searching unemployed, who may wish to work but who are not actively seeking work.

Table 3.1: Summary statistics of employment status, by gender

	Male	Female	Total
Employed	0.4906 (0.5000)	0.3350 (0.4720)	0.3990 (0.4897)
Searching Unemployed (broad)	0.0424 (0.2016)	0.0950 (0.2933)	0.0734 (0.2608)
Non-Searching Unemployed (strict)	0.1194 (0.3243)	0.1495 (0.3566)	0.1371 (0.3440)
Inactive	0.3475 (0.4762)	0.4205 (0.4937)	0.3905 (0.4879)
Total	1	1	1

Source: National Income Dynamics Study 2008, own calculations.

Notes: The sample includes all those between the ages of 15 and 59. Standard deviations are shown in parentheses.

Unemployment in South Africa remains particularly high. In the 2008 sample data shown above, 4.24 percent of men and 9.50 percent of women are searching unemployed. In addition, on average 39.05 percent of individuals are economically inactive in this sample. While not the focus of this study, this has clear implications for economic welfare, production, erosion of human capital and social instability. Furthermore and unsurprisingly, a larger proportion of women are economically inactive as compared to men. Reasons for this inactivity could be associated with issues related to women's labour force participation as outlined in Chapter 2.

In terms of employment, 39.90 percent of individuals are employed in this sample. However, as for unemployment and inactivity, there are substantial gender differences in employment, as only 33.50 percent of females but 49.06 percent of males are employed.

3.2.2 Education Statistics

The main goal of the study is to examine gender differences in earnings, by education. However, earnings from self-employment are expected to be determined by different factors than earnings amongst the wage employed. The sample has therefore been restricted to include all individuals between the ages of 15 and 59 who are wage employed. The lower age limit will assist in capturing those individuals who choose to leave school and enter the labour market. The upper age limit excludes those who will be eligible for a pension beyond the age of 60. Education has been classified into five categories depending on the highest level of education that the worker has completed. Table 3.2 shows the distribution of education by gender for this sample.

Table 3.2: The distribution of education of wage employed workers

Level of Education	Male	Female	Total
No schooling	0.0946 (0.2928)	0.1107 (0.3138)	0.1026 (0.3034)
Primary schooling (grades 1 – 7)	0.2579 (0.4376)	0.2658 (0.4418)	0.2618 (0.4397)
Incomplete secondary (grades 8 – 11)	0.3826 (0.4861)	0.3603 (0.4802)	0.3716 (0.4833)
Matric (grade 12)	0.2242 (0.4171)	0.2123 (0.4090)	0.2183 (0.4131)
Tertiary	0.0406 (0.1974)	0.0510 (0.2200)	0.0458 (0.2090)
Total	1	1	1

Source: National Income Dynamics Study 2008, own calculations.

Notes: The sample includes all those between the ages of 15 and 59 who are full time wage employed. Standard deviations are shown in parentheses.

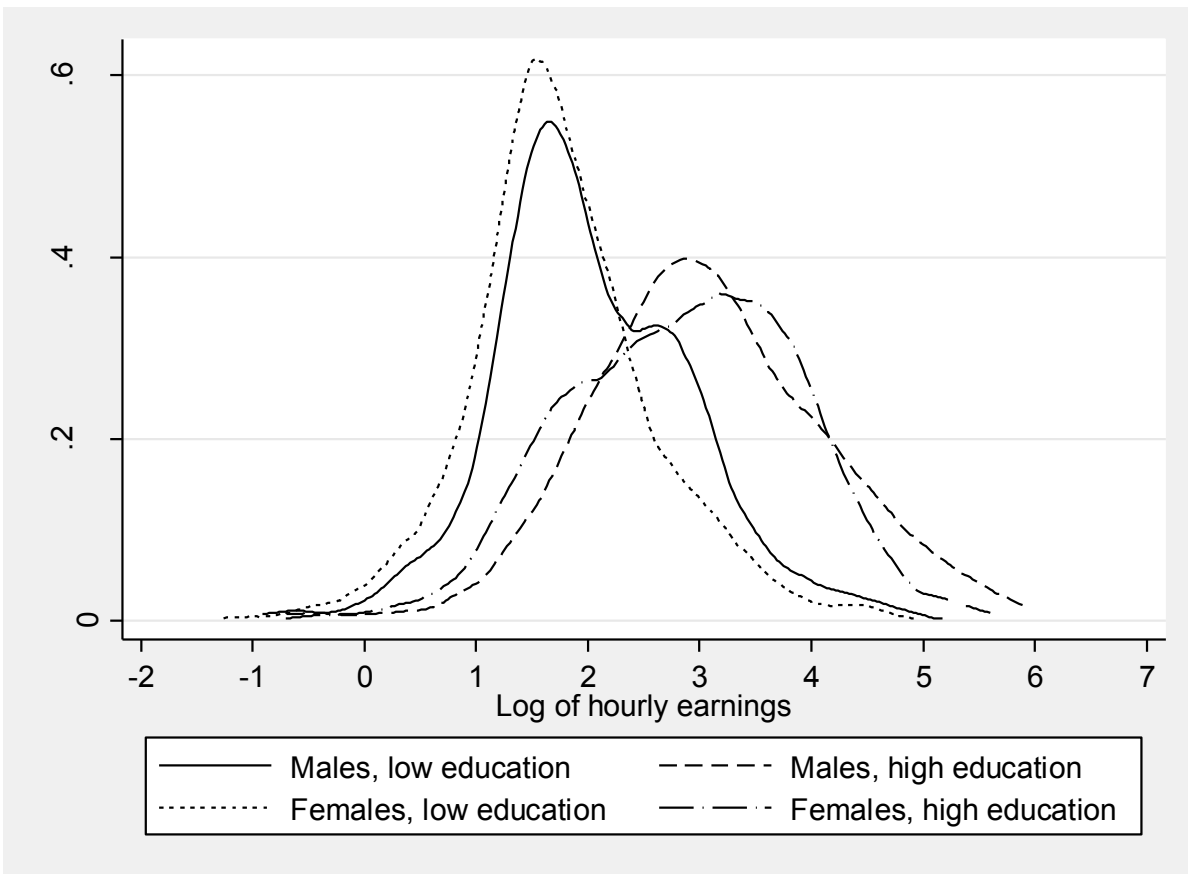
A majority of workers have an incomplete secondary education, followed by primary school and matric. Given South Africa's history and the difficulties that government has faced in the rolling out of education since democracy, it is unsurprising that individuals have attained only a relatively low level of education. For the purposes of this study, a low education is defined as a worker who has no schooling, primary school, or incomplete secondary education. In contrast, an individual with a high level of education is categorised as having a matric or tertiary education. The group of workers with high education thus comprises approximately one quarter of the sample, for both genders.

In addition, a slightly higher proportion of women have a tertiary education than men. It is not clear at this stage the extent to which this will translate into higher wages and will be part of the focus of my study.

3.2.3 Kernel Density Estimation of Earnings

The outcome variable in the study is hourly earnings. Earnings consist of the individual's take home pay from their main job, converted into hourly wages using the reported average hours worked. The hourly wage is then logged so as to mitigate any skewness in the wage distribution; in addition this approach will assist in making the estimates less sensitive to outliers. Figure 3.1 below illustrates the log wage distribution by gender and level of education in the form of a kernel density plot. This approach assists in illustrating the extent to which wages differ between groups across the distribution.

Figure 3.1: Kernel density plot of the wage distribution by gender and level of education



Source: NIDS 2008

For both genders, the wage distribution lies substantially to the right for workers with high education, compared to those with low education. In addition, wages are more dispersed for more highly educated workers. In terms of low educated men and women, women's wages have a higher density at the lower region of the wage distribution i.e. more low educated women than men are located at the lower tail of the wage distribution. Low educated men are substantially more likely than women to have logged earnings of 2.5 (approximately R12 per hour) and above.

In terms of highly educated men and women the results are as follows. Firstly, it would appear that there is a slightly wider disparity in wages between highly educated men and women as compared to low educated men and women. Secondly, at both the lower and upper tails of the distribution, highly educated men earn more than women. However, there is a small area of the upper middle range of the distribution where women's wages dominate men's.

In developed countries, the group of highly educated workers consists only of those with post-secondary schooling, whereas here workers with a matric education have been included in this

group. According to Table 3.2, less than five percent of people in South Africa have a tertiary education. As such, the sample would be too small to estimate quantile regressions and decompositions, especially since the NIDS sample is smaller than most other national datasets in South Africa. In addition, South Africa's population is thus different to other countries in that a majority of people have primary or incomplete schooling. This again is due to the inaccessibility of education.

Thus there appears to be a gender wage gap in favour of men amongst both low and high educated workers, although the size of the gap varies at different locations in the distribution, and by the worker's level of education. Chapter 4 will explore these differences further using regression and decomposition analysis.

3.2.4 Descriptive Statistics: Mean Characteristics by Gender

The characteristics displayed and discussed in this section are those that are often included in Mincerian models, which capture differences in personal characteristics, human capital, job characteristics and job tenure which may affect earnings. Table 3.3 below displays the mean characteristics of wage employed men and women with low and high levels of education.

Table 3.3 Mean characteristics of wage employed men and women with low and high levels of education

Variable	Male Low Education		Female Low Education		Male High Education		Female High Education	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Hourly Wage	11.7819	14.9688	8.7380	11.4885	37.7255	49.7216	28.1155	31.7915
Average hours worked/week	43.4330	14.3323	39.1122	15.1139	42.8308	14.2673	39.5820	12.5020
Full time (35 hours/week)	0.8734	0.3327	0.7295	0.4445	0.8501	0.3573	0.7529	0.4318
Part time	.1266294	.3327123	.270482	.4444586	.1498929	.3573492	.2471132	.431832
Demographics								
Age	37.4088	11.0021	39.6599	10.5970	34.0899	9.3955	34.6651	9.4581
<i>Race</i>								
White	0.0234	0.1511	0.0247	0.1554	0.1806	0.3851	0.1972	0.3984
Indian	0.0093	0.0963	0.0034	0.0580	0.0258	0.1587	0.0464	0.2106
Coloured	0.2393	0.4268	0.2925	0.4552	0.1849	0.3887	0.1763	0.3815
African	0.7280	0.4452	0.6794	0.4670	0.6086	0.4886	0.5800	0.4941
<i>Marital Status</i>								
Married	0.4013	0.4904	0.2941	0.4559	0.4325	0.4960	0.3857	0.4873
Living Together	0.1937	0.3954	0.1448	0.3521	0.0985	0.2983	0.0624	0.2421
Widow	0.0158	0.1249	0.0842	0.2778	0.0107	0.1030	0.0370	0.1889
Divorced	0.0196	0.1385	0.0595	0.2367	0.0214	0.1449	0.0670	0.2503
Never Married	0.3669	0.4822	0.4141	0.4928	0.4240	0.4947	0.4457	0.4976
<i>Health Status</i>								
Excellent Health	0.3399	0.4739	0.2200	0.4145	0.4433	0.4973	0.4480	0.4979
Good Health	0.5158	0.5000	0.5859	0.4928	0.4946	0.5005	0.4919	0.5005
Poor Health	0.1378	0.3449	0.1863	0.3896	0.0514	0.2210	0.0600	0.2378
Job Characteristics								
<i>Occupation</i>								
Legislators	0.0149	0.1212	0.0168	0.1287	0.0857	0.2802	0.0485	0.2151
Professional	0.0102	0.1007	0.0292	0.1684	0.1734	0.3790	0.2818	0.4504
Technicians and associate professionals	0.0223	0.1479	0.0236	0.1518	0.0493	0.2166	0.0739	0.2619
Clerical workers	0.0186	0.1352	0.0527	0.2237	0.1071	0.3095	0.2263	0.4189
Service and sales	0.0894	0.2854	0.0988	0.2985	0.2163	0.4121	0.1594	0.3664
Skilled agricultural, forestry and fish	0.2020	0.4017	0.1190	0.3239	0.0171	0.1299	0.0092	0.0958
Craft and related trade	0.2253	0.4180	0.0494	0.2168	0.1734	0.3790	0.0508	0.2199
Plant and machine operators, and assembly	0.1853	0.3887	0.0348	0.1834	0.0814	0.2737	0.0254	0.1575
Elementary Occupations	0.2225	0.4161	0.5758	0.4945	0.0707	0.2565	0.1109	0.3143
<i>Duration of Employment Contract</i>								
Permanent	0.5531	0.4974	0.4658	0.4991	0.6767	0.4683	0.6767	0.4683

Variable	Male Low Education		Female Low Education		Male High Education		Female High Education	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Limited	0.1061	0.3082	0.1134	0.3172	0.1221	0.3277	0.1386	0.3459
Unspecified	0.3408	0.4742	0.4209	0.4940	0.2013	0.4014	0.1848	0.3885
Trade Union Membership								
Member	0.2449	0.4302	0.1448	0.3521	0.4004	0.4905	0.3695	0.4832
Non member								
N	1074		891		467		433	

Source: NIDS Wave 1 2008, own calculations

Notes: The sample include all individuals between the ages of 15 and 59 who are wage employed. Standard Deviations (SD) have also been shown.

Before proceeding to analyse the descriptive statistics by demographics and job characteristics, a look at the raw gender wage gap reveals that low and highly educated men earn more than women, by a margin of approximately R3 per hour and R9 per hour respectively. In addition men tend to work more hours in a week at their primary occupation than women for both levels of education, therefore the disparity in monthly earnings would be even larger. Overall more men than women enjoyed full time employment for both levels of education. Amongst women, a slightly greater proportion of the highly educated (75.29 percent) were full time workers as compared to low educated women (72.59 percent).

Workers with high levels of education are generally younger than low educated workers for both males and females. This finding aligns with expectations as in the post-apartheid period there has been an emphasis on improving rates of educational attainment which has significantly affected the younger generation.

Similarly, although not the focus of this study, it is also worth noting that amongst the races it would appear that there is a greater proportion of low educated men and women who are African as compared to those with high education, which could be attributed to South Africa's political background.

Turning to marital status, the work of Mincer and Polachek (1974) regarding marital status and human capital accumulation should be borne in mind. According to these authors, human capital is expected to be significantly higher for women who remain unmarried as compared to married women. The results of Table 3.3 seem to support this theory, indicating the presence of a greater proportion of women (both low and highly educated) who were never married as compared to all

other categories of marital status. This finding suggests a possible negative relationship between marriage and human capital accumulation.

The indicator of perceived health status is important in terms of capturing the effect of health on the ability to engage actively in work amongst the employed. A large proportion of highly educated workers reported having an excellent or good health status. However a higher proportion of low educated workers reported having poor health status, especially amongst women.

Health status can essentially be linked to ones earning capabilities which is positively linked to their occupation. However occupation is also key in understanding the extent of occupational segregation in the labour market. In this sample, low educated workers tend to be highly concentrated into elementary occupations, while highly educated workers tend to be concentrated into professional occupations. However decomposing this finding by gender, it is surprising that amongst the highly educated, there is a greater proportion of women (28.18 percent) who are professionals as compared to men (17.34 percent). This is unexpected given that men earn higher wages than women. It may indicate the occupational crowding of women into teaching and health care professions, where the opportunity for career and earnings advancement is limited. This would signal a gender bias in terms of wage earning capability between the genders.

A greater proportion of highly educated workers reported permanent employment as compared to low educated workers. In terms of men and women, it can be seen that highly educated men and women were relatively on par in terms of securing permanent employment. However, for low educated men and women there is a significant difference in the attainment of permanent employment between the genders. In particular, 55.31 percent of low educated men reported having permanent employment as compared to just 46.58 percent of low educated women. A further 42.09 percent of low educated women reported having an unspecified contract. This was the highest proportion as compared to low educated men as well as both highly educated men and women. Finally in terms of trade union membership, women are less likely than men to belong to a union. More highly educated workers were found to be more likely to belong to trade unions than low educated workers. Therefore, low educated women may be employed in more vulnerable, less protected jobs than men, in addition to having lower earnings.

3.3 Conclusion

This chapter aimed to provide an overview of the characteristics of high and low educated workers within the sample. It began by describing employment status and education. It was found that there was a greater proportion of employed men than women in the labour market. There are no

large gender disparities in educational attainment, although a slightly greater proportion of men than women had incomplete secondary education, while a slightly greater proportion of women than men had a tertiary level of education.

Turning to the kernel density plot by gender and level of education, there is a gender wage gap in favour of men amongst both low and high educated workers. However, the size of the gap varies at different locations in the earnings distribution, and by the worker's level of education.

Finally, section 3.2.4 then set out the remaining mean characteristics for both low and highly educated men and women. A number of key findings were noted. Firstly, as expected the average hourly wage was found to be higher for men than for women for both levels of education. Secondly, highly educated men and women tend to be concentrated within professional occupations. However more highly educated females hold these positions than males and women were relatively on par with highly educated men in being able to secure permanent contracts. These findings would therefore suggest that even when women have the same level of education as men, and occupy the same position in the labour market, there still remains a disparity between the wages earned between the two groups. Finally amongst workers with low education, a key finding related to the extent to which they were able to secure permanent employment in the labour market. While significantly more men were able to secure permanent employment than women, it was apparent that low educated women are in the worst position in the labour market, recording the highest proportion of unspecified contracts.

The findings of this chapter therefore seem to reinforce the literature in terms of the state of the wage earning potential amongst women as compared to men. However it also assisted in pointing out the link between education, employment and wages, and some irregularities that exist in the labour market. It was clear that while men occupy fewer high ranking positions than women, and have similar characteristics in many other regards, they earn higher average wages. This last point thus sets the tone for the regression and decomposition analysis which follows in Chapter 4. This analysis will therefore aim to compare the size of the gender wage gap at different points in the distribution, while controlling for the effects of each of the characteristics touched on in this chapter, and to elaborate further on the extent to which the gender wage gap is influenced by education.

Chapter 4: Methodology and Results

The previous chapter showed that, descriptively, there is a gender wage gap in favour of men amongst both low and high educated workers. It also presented descriptive statistics to provide

an overview of the sample at hand. This chapter examines more closely the extent to which the individual and job characteristics presented in the previous chapter influence the wage earned.

Quantile regression as introduced by Koenker and Basset (1978) can be viewed as a natural extension of the classical least squares estimation model. Using quantile regression, I first decompose the gender wage gap at each quantile of the wage distribution into two parts, that is, a part due to differences in coefficients determining the wage structure and a part due to differences in individual characteristics. One of the main benefits of using this method is that I will be able to estimate the size of the gender wage gap at different points in the conditional wage distribution for workers with low and high levels of education. Secondly, I attempt to contribute to the existing literature on gender wage gaps by documenting the extent to which sample selection shapes the profile of the gender wage gap components across all the quantiles of the wage distribution at different levels of education. It is generally understood that studies of this nature should always take cognisance of sample selection as it has been shown that estimates of the gender wage gap can be severely biased. Finally using a variation of the popular Oaxaca decomposition technique, I decompose the gender wage gap by education using the quantile decomposition technique made famous by Machado and Mata (2005). This approach allows me to analyse more closely the predicted wage gap at different points of the female wage distribution scale.

The chapter is organised as follows: Section 4.1 sets out the methodology and results of the quantile regression analysis. This is followed by Section 4.2 which considers the issue of sample selection and its influence on the results of the quantile regression. Section 4.3 uses a method proposed by Machado and Mata (2005) to decompose the quantile regression in order to establish what women would have earned with the same characteristics and rewards as men. Finally, Section 4.4 concludes.

4.1 Quantile Regression (QR)

4.1.1 Methodology

First introduced by Koenker and Basset (1978), quantile regression analyses the conditional quantiles of the dependent variable using covariates. More specifically, quantile regression analysis estimates the regression function for different quantiles of the conditional wage distribution. As expected, the 50th quantile represents the conditional median regression.

Quantile regression therefore provides an alternative approach to overcome a number of shortcomings associated with mean (Ordinary Least Squares) regression analysis. First, it is possible to observe different conditional quantiles of the distribution and not just the conditional mean of the dependent variable, thus allowing the effects of the covariates to differ across the distribution. Furthermore, given that quantile regression is estimated by minimizing the sum of absolute values of residuals instead of the sum of squared residuals, it can be said to be robust to heteroscedasticity (Heinze, 2010).

Following Buchinsky (1998), the model of Koenker and Basset (1978) can be expressed as follows:

$$w_i = x_i' \beta_\theta + u_{\theta i} \quad \text{with} \quad \text{Quant}_\theta(w_i | x_i) = x_i' \beta_\theta \quad (i= 1, \dots, n)$$

Where β_θ and x_i are $K \times 1$ vectors, and $x_{i1} = 1$. $\text{Quant}_\theta(w|x)$ denotes the θ th conditional quantile of w given x . The distribution of the error term u_i , $F_{u\theta}(\cdot)$ is left unspecified, assuming that u_i satisfies $Q_\theta(u_{\theta i} | x_i) = 0$.

The vector of QR coefficients estimated is given by, $\hat{\beta}_\theta$ and can be found using the optimization techniques illustrated in Koenker and Basset (1982). This vector represents the marginal change in the conditional quantile θ due to a marginal change in the corresponding element of the vector of coefficients on x ,

4.1.2 Quantile Regression Results

The dependent variable in the regressions is the natural log of gross hourly earnings, as shown in Chapter 3. Quantile regression equations are estimated at the 10th, 25th, 50th, 75th and 90th quantiles.

The analysis begins by estimating quantile regressions separately for low and high educated workers, where a male dummy variable has been included to capture the extent to which the gap in earnings remains unexplained after controlling for individual differences in the observed characteristics. The model is estimated conditional on selection into wage employment. A model which is estimated without selection into wage employment would significantly understate the gender wage gap. Therefore it is imperative that one controls for selection in order to avoid overstating women's relative position in the labour market or alternatively misrepresenting the gender wage gap. The results are displayed in Table 4.1 and 4.2 for low and high educated workers respectively.

Interpreting the results of the estimation for low educated workers first, a number of key findings stand out. Firstly, the male dummy variable is significant and positive across the entire wage distribution. In Chapter 3, it was shown that male workers with low education earned higher wages than female workers with low education. The quantile regression results here thus concur with the earlier findings of men earning more than women of the kernel density estimates, but show that this significant earnings differential persists even after controlling for gender differences in observable characteristics. In addition, the size of the wage differential varies somewhat across the quantiles of the conditional distribution.

There are two distinct conclusions that can be made from these results. Firstly, for low educated workers the gender wage gap is largest at the upper end of the wage distribution, that is, at the 75th quantile the gender wage gap is estimated to be 0.310 log points. Contrary to this the gender wage gap is smaller at the lower end of the wage distribution, that is, at the 10th quantile the gender wage gap is estimated to be 0.283 log points. Although no pattern can clearly be defined, that is, the presence of a sticky floor or a glass ceiling, it can be said that the results do seem be contrary to the findings of Mussida and Picchio (2012). As discussed in Chapter 2, Mussida and Picchio (2012) noted a sticky floor at the bottom end of the wage distribution for low educated workers. This finding emphasises the distinct differences that can be found when estimating gender wage gaps in various countries.

Table 4.1 Quantile regression of log of hourly wages for low educated workers

	q10	q25	q50	q75	q90
Demographics					
Male	0.283** (2.73)	0.293*** (5.74)	0.264*** (6.29)	0.310*** (7.57)	0.286*** (4.47)
Age	0.00448 (0.17)	0.0202 (1.30)	0.0224 (1.81)	0.0272* (2.43)	0.0310 (1.89)
Age squared (/100)	0.00208 (0.06)	-0.0163 (-0.79)	-0.0194 (-1.22)	-0.0229 (-1.59)	-0.0267 (-1.30)
<i>Race</i>					
White	-0.134 (-0.29)	0.353* (2.25)	0.546*** (3.58)	0.675*** (5.27)	0.664*** (3.94)
Indian	0.605*** (4.71)	0.351* (2.26)	0.141 (0.49)	0.414* (2.00)	0.254 (0.64)
Coloured	-0.182* (-2.49)	-0.113* (-2.18)	-0.0131 (-0.36)	-0.00419 (-0.10)	0.0557 (0.76)
<i>Marital Status</i>					
Married	0.198** (2.74)	0.138* (2.29)	0.131** (3.01)	0.147** (3.18)	0.156** (2.67)
Human Capital					
<i>Education</i>					
Primary	0.0577 (0.67)	0.113 (1.80)	0.0823 (1.59)	0.141** (2.94)	0.157 (1.91)
Secondary	0.250** (3.00)	0.304*** (4.82)	0.284*** (5.68)	0.356*** (5.57)	0.417*** (4.97)
<i>Health Status</i>					
Excellent	0.102 (1.10)	0.221** (2.85)	0.245*** (4.11)	0.198*** (3.32)	0.182* (2.36)
Good	0.168* (2.10)	0.249*** (4.00)	0.178** (3.24)	0.182*** (3.53)	0.180* (2.36)
Job Characteristics					
<i>Occupation</i>					
Legislators	0.556 (1.62)	0.271 (1.61)	0.179 (1.06)	0.307* (2.48)	0.433 (1.78)
Professional	0.157 (0.34)	0.274 (1.21)	0.453* (2.34)	0.895** (3.23)	0.780*** (3.54)
Technicians and associate professionals	0.443 (1.70)	0.312 (1.77)	0.389** (2.90)	0.378*** (4.24)	0.564** (2.83)
Clerical workers	0.449 (1.70)	0.471*** (3.36)	0.472*** (4.99)	0.445*** (3.69)	0.788** (3.12)
Service and Sales	0.129	0.171	0.235**	0.236**	0.294*

	q10	q25	q50	q75	q90
	(0.95)	(1.83)	(3.29)	(3.00)	(2.36)
Craft and related trade	0.150	0.190	0.265***	0.340***	0.521***
	(1.37)	(1.89)	(4.45)	(5.58)	(5.55)
Plant and machine operators, and assembly	0.281*	0.151	0.251***	0.268***	0.432***
	(2.37)	(1.92)	(3.81)	(3.63)	(4.14)
Elementary Occupations	0.227*	0.136*	0.116**	0.176***	0.213**
	(2.03)	(2.19)	(2.71)	(4.30)	(3.12)
<i>Duration of Employment</i>					
Permanent	0.331***	0.270***	0.206***	0.188***	0.216***
	(4.01)	(4.75)	(4.76)	(4.58)	(3.95)
Limited	0.0206	0.0980	0.163*	0.130**	0.166
	(0.17)	(0.84)	(2.53)	(2.69)	(1.43)
Full-time	-0.448***	-0.549***	-0.718***	-1.171***	-1.408***
	(-4.53)	(-8.74)	(-11.14)	(-19.42)	(-16.91)
<i>Trade Union Membership</i>					
Trade Union	0.341***	0.445***	0.539***	0.525***	0.507***
	(3.78)	(7.73)	(8.74)	(8.50)	(7.53)
Constant	0.354	0.481	1.031***	1.567***	1.899***
	(0.64)	(1.61)	(4.19)	(6.55)	(5.59)
N	1960				

Source: NIDS, own calculations

Notes: t statistics are shown in parentheses. $p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$

Given South Africa's history of Apartheid the results of Table 4.1 tend to fall in line with expectations. Compared to African workers, whites earn significantly more at the median and above, Indians earn significantly more only at the 10th percentile, and coloureds earns significantly lower hourly wages only at the lower end of the wage distribution.

Being married has a significant positive effect on wages throughout the wage distribution. This would imply that low educated married workers earn more than low educated workers of any other marital status. This effect is smallest in the centre and largest in the tails of the distribution. In the

labour market, marriage is often viewed as a proxy for stability, discipline and motivation and hence being married could be said to be influencing employers.

Given that this study is focused on trying to establish the extent to which this gap can be explained by education, included in the model are the dummy variables primary and incomplete secondary (no schooling has been taken as the base category). That is, even amongst low educated workers, those with more education can be expected to earn more. The literature suggests that educational attainment is associated with higher returns, although the returns to education in South Africa are known to be highly convex.

Looking more closely at wages changes across the wage distribution for primary school workers, it can be seen that wages tend to increase above the 50th quantile. However the log of wage was only significant at the 75th quantile *ceteris paribus*. Turning to the case of secondary education, it was found that the wages were largely significant across the entire wage distribution. Furthermore they tended to increase as one moves up the wage distribution, that is, at the 90th quantile workers with an incomplete secondary education earned 0.417 log points more than workers with no schooling, *ceteris paribus*. In other words having an incomplete secondary education benefits workers more at the top of the conditional wage distribution.

According to Mincer and Polachek (1974), human capital not only comprises of educational attainment but also through the home environment, investments in health, mobility and information to name a few. Therefore turning to health status, wages were only significantly higher than that of wages of workers with poor health status for the 25th quantile and above, *ceteris paribus*. In terms of good health status, wages are significantly higher across the entire wage distribution and tend to increase up the wage distribution.

It was noted earlier that low educated workers are predominantly concentrated into elementary occupations. According to the regression results, these workers earn significantly more than agriculture, fish and forestry workers (base category) throughout the distribution. However wages tend to decline up the wage distribution. Plant and machine operators are the only other category to have significantly higher earnings at the very bottom of the distribution, while all occupations enjoy significantly higher wages in the centre and upper distribution when compared to agricultural workers.

Turning to the duration of employment, for workers who can secure a permanent contract, wages are significantly higher than that of wages for workers with an unspecified contract *ceteris paribus*.

However, the wage benefit associated with permanent work decreases as one moves up the wage distribution, other than the larger benefit at the 90th percentile.

In terms of full time and part time workers it is interesting to note that low educated full time workers earn significantly lower hourly wages than low educated part time workers. This confirms the findings of other studies on the premium to part-time work (See Posel and Muller, 2008). The size of the premium increases consistently as one moves up the wage distribution, with a wage gap of 1.4 log points at the 90th percentile.

Finally although the descriptive statistics revealed that fewer low than high educated workers belong to trade unions, being a trade union member significantly raises the wages of low educated workers as compared to low educated non trade union members. However it should be noted that this return is largest in the centre of the wage distribution.

The following discussion analyses the results of the quantile regression for high educated workers. This model includes all workers who have completed at least a matric qualification, with the results presented in Table 4.2.

As before the male dummy variable was found to be significant across the entire wage distribution. Thus, as was the case for low educated workers, significant earnings differentials persist even after controlling for gender differences in observable characteristics. Here, the gender wage gap amongst high educated workers is smallest at the median, but increases towards both the bottom and top ends of the distribution. Therefore, there is evidence of both a 'sticky floor' and a 'glass ceiling' for female workers with high education in South Africa.

Table 4.2 Quantile regression results of log of hourly wages for high educated workers

	q10	q25	q50	q75	q90
Demographics					
Male	0.308*** (3.51)	0.280*** (4.80)	0.267*** (4.13)	0.302*** (4.04)	0.317** (2.98)
Age	0.0203 (0.59)	0.0328 (1.62)	0.0323 (1.94)	0.0562 (1.66)	0.0470 (1.14)
Age squared (/100)	-0.0151 (-0.31)	-0.0259 (-0.97)	-0.0241 (-1.09)	-0.0539 (-1.20)	-0.0373 (-0.68)
<i>Race</i>					
White	0.652*** (4.88)	0.694*** (8.20)	0.726*** (11.91)	0.698*** (7.22)	0.444** (3.13)
Indian	0.646** (2.97)	0.552** (3.07)	0.708*** (4.44)	0.690*** (3.83)	0.606* (2.07)
Coloured	0.00820 (0.06)	0.00959 (0.14)	0.0412 (0.64)	0.107 (1.11)	0.111 (0.70)
<i>Marital Status</i>					
Married	0.282* (2.36)	0.269*** (4.36)	0.218** (3.18)	0.141 (1.78)	0.184 (1.73)
Human Capital					
<i>Education</i>					
Tertiary	0.600*** (4.57)	0.622*** (5.78)	0.674*** (7.41)	0.632*** (4.20)	0.731*** (4.84)
<i>Health Status</i>					
Excellent	0.333 (1.27)	-0.0722 (-0.36)	0.0413 (0.41)	0.166 (1.32)	0.453** (2.70)
Good	0.259 (0.97)	-0.0538 (-0.29)	0.0649 (0.65)	0.162 (1.47)	0.438* (2.36)
Job Characteristics					
<i>Occupation</i>					
Legislators	-0.162 (-0.62)	0.266 (1.44)	0.386** (2.73)	0.459 (1.36)	0.203 (0.50)
Professional	-0.331 (-1.58)	-0.0447 (-0.42)	0.0330 (0.21)	0.270 (0.90)	-0.258 (-0.85)
Technicians and associate professionals	-0.274 (-0.67)	0.135 (1.08)	0.0917 (0.64)	0.208 (0.73)	-0.0852 (-0.25)
Clerical workers	-0.329 (-1.63)	-0.0666 (-0.65)	0.111 (0.92)	0.122 (0.40)	-0.275 (-0.85)
Service and Sales	-0.564* (-2.43)	-0.142 (-1.37)	-0.0865 (-0.70)	-0.0212 (-0.07)	-0.590 (-1.91)

	q10	q25	q50	q75	q90
Craft and related trade	-0.113 (-0.46)	0.0498 (0.53)	0.123 (1.02)	0.126 (0.40)	-0.309 (-0.85)
Plant and machine operators, and assembly	-0.684 (-1.89)	-0.224 (-1.29)	-0.0286 (-0.20)	0.0706 (0.23)	-0.674 (-1.92)
Elementary Occupations	-0.654* (-2.34)	-0.284 (-1.95)	-0.188 (-1.43)	-0.279 (-1.00)	-0.987** (-3.01)
<i>Duration of Employment</i>					
Permanent	0.398** (2.76)	0.216* (2.03)	0.316*** (4.93)	0.299** (3.14)	0.225 (1.64)
Limited	0.0636 (0.20)	0.00637 (0.05)	0.0989 (0.98)	0.207 (1.15)	0.193 (1.06)
Full-time	-0.361* (-2.12)	-0.431*** (-3.91)	-0.594*** (-5.92)	-0.880*** (-7.74)	-0.994*** (-7.55)
<i>Trade Union Membership</i>					
Trade Union	0.450*** (3.71)	0.432*** (6.59)	0.384*** (5.46)	0.342*** (4.45)	0.259* (2.52)
Constant	1.062 (1.48)	1.414** (3.28)	1.605*** (4.97)	1.703** (3.00)	2.674*** (3.46)
N	896				

Source: NIDS, own calculations

Notes: t statistics are shown in parentheses. p<0.05*, p<0.01**, p<0.001***

Considering race, white individuals still earn significantly above that of African individuals throughout the distribution, although the gap is smallest at the very top of the distribution. However what is interesting to note is whereas the gaps in wages between low educated Indian and African workers were relatively insignificant for low educated workers, high educated Indian workers' wages are significantly higher. This finding suggests that Indian workers benefit more relative to African the higher their education.

In terms of marriage, the results indicate that wages for married workers both increase and are only significant at the 50th quantile and below. This is contrary to what was found for low educated

workers. This finding would seem to suggest that high educated married workers are not as highly regarded across the entire wage distribution as compared to low educated workers.

Turning to human capital, having some type of tertiary education is included as an explanatory variable, with a matric education being used as the base category. Having a tertiary education is significant throughout the wage distribution and is highest at the 90th quantile at 0.731 log points. This means that high educated workers earn significantly more than high educated workers with a matric education. This finding emphasises the influence that education has on wage earning capability.

In terms of health status, it is interesting to note that unlike the case of low educated workers, the wage of workers with excellent and good health status were only significant at the very top end of the wage distribution (the 90th quantile).

Unlike with low educated workers, occupation largely has no significant effect on wages earned for highly education workers. However, what is similar to that of low educated workers is the effect of job characteristics, namely the duration of employment and whether a worker is full time or part time. Permanent workers gain the largest wage premium at the bottom of the distribution, while the hourly wage penalty to full-time work increases consistently at higher quantiles. Furthermore, workers who belong to a trade union earn more than workers who do not. However, the return decreases as we move up the wage distribution, with the union wage premium at the 90th percentile being approximately half of the size of the premium at the 10th percentile.

In essence the results of Tables 4.1 and 4.2 assist in drawing attention to the factors that significantly influence the wage earned. Specifically, for both low and high educated workers, there is a significant gender wage gap in favour of men after controlling for observable differences in characteristics, but this gap is smallest in the centre of the distribution. For workers with low education, the largest gender wage gaps are at the 75th and 25th percentiles. For highly educated workers, there is evidence of both a sticky floor and a glass ceiling for women. In addition the rate of return for some other personal and job characteristics differed according to whether the worker had a high or low education, and the location in the conditional wage distribution.

4.2 Sample Selection

The results presented thus far are estimated conditional on selection into wage employment. Briefly, selection into employment is often modelled as a binary choice model with the underlying assumption being that unemployment is voluntary. However, given that unemployment is not

under normal circumstances a voluntary choice in South Africa, it is not appropriate to model selection into employment using this approach (Bhorat and Leibbrandt, 2001b). Individuals can instead choose to participate in the labour market; however, participation does not necessarily ensure employment.

Econometrically, sample selection is usually corrected by using the Heckman selection procedure for the estimation. This requires the identification of one or more exclusion restrictions. In quantile regression models, however, there is more debate about the best method to correct for selection. Presented below is the methodology undertaken by Ntuli (2007) in terms of correcting for sample selection.

The author's estimation framework consisted of two stages. In the first stage using quantile regression the authors estimated human capital earnings functions for both males and females separately at different percentiles of the wage distribution. Next, the author then controlled for selection bias in three sequential steps. Step one involved the author estimating probit models of the labour force participation decision of women. This step allowed for the estimation of sample selection correction terms (λ s). These sample selection correction terms control for selection into employment. Secondly, controlling for selectivity the authors then fit employment probits on the sample of female participants. Finally, λ 's from the employment process are also computed and included in the wage models. Using quantile regression decomposition methods, the second stage involved analysing the size of the components of the gender wage gap over the entire conditional wage distribution.

Following the approach of Ntuli (2007), in this study, the probability of being wage-employed was estimated using a probit model, for all working age individuals. Selection was controlled for in the quantile regression by including the selection term, λ , as a quartic function. However after controlling for sample selection, it was found that the selection terms were individually largely insignificant.² This finding was further supported by a test of joint significance. This result of no significant sample selection is in line with the findings of Ntuli (2007). Given that sample selection is insignificant, the rest of the decomposition analysis will be performed without such corrections.

4.3 Quantile Decomposition

Thus far, the quantile regression analysis has provided insight into the wage earning capability of men and women, after controlling for their observed characteristics, across the whole wage

² The full results, including the selection correction, can be found in the Appendix.

distribution. Having established that a significant gender wage gap exists in favour of men, for workers with both low and high levels of education, the analysis now turns to further investigation

Quantile decompositions provides a useful complement to quantile regressions in that they allow one to observe whether differences in the observed distribution follow from differences in estimated coefficients or from differences in the composition of the workforce. Such decompositions follow in the tradition of the Oaxaca-Blinder decomposition method (Oaxaca, 1973; Blinder, 1973).

Briefly the Oaxaca-Blinder decomposition presents a useful way of comparing actual observation with counterfactual ones. Setting up the model, the authors denote the returns to men and women by β^f and β^m respectively. The authors then denote men and women's characteristics by x^f and x^m respectively. Ultimately one is interested to know if men and women's characteristics are viewed as being different in the labour market. In others words we are concerned with determining what a women would be paid if she were paid according to her returns but with men's characteristics. We expect that in a market without discrimination, $\beta^f = \beta^m$, that is, men and women would earn identically provided they had the same productive characteristics. Therefore it can be said that when considering counterfactual wages of women, observed wage differences between the genders can be attributed to the disparity in treatment between the genders. However one drawback of this approach is that the measure of discrimination is based on the mean. Therefore one cannot in the estimation of the gender wage gap at quantile θ , measure discrimination using this approach.

Therefore rather than decomposing differences in the mean wage, quantile decomposition aims to decompose differences across the full earnings distribution. Following Albrecht *et al* (2003) adaptation of Machado and Mata (2005) bootstrap method I am able to implement the decomposition directly at each quantile. It should be noted that the work of Machado and Mata (2005) is highly respected and is particularly useful in conducting the quantile decomposition and has been used in research papers by a number of authors. These include Albrecht, Bjorklund, and Vroman (2003), Arulampalam, Booth and Bryan (2007); and de la Rica, Dolado, and Llorens (2008).

In general the idea of the approach set out by Albrecht *et al* (2003) is to generate two counterfactual densities. The first is the female log wage density which is what would happen if women were given men's labour market characteristics but were continued to be paid like women.

The second is the density that would arise if women instead retained their labour market characteristics but were then paid like men.

According to Albrecht *et al* (2003), the Machado and Mata approach to estimating the first density can be described as follows:

- I. Draw n numbers at random from $(0,1)$, say $\theta_1, \theta_2, \theta_3, \dots, \theta_n$.
- II. Using the female database, estimate the coefficient vector β_θ^f at the θ^{th} quantile.
- III. Make n draws at random with replacement from the male data set, denoted by x_m
- IV. The counterfactual density is then calculated as $\{w = x_m \beta_\theta^f\}$

The approach for estimating the second counterfactual density, that is, what women would be paid if they retained their labour market characteristics but were remunerated as men, is simply the reverse of the roles of men and women in steps II and III above. In other words one would use the male data set to estimate the quantile regression coefficients and make the bootstrap draw from the female data set.

Finally using the generated wage distribution one can then construct the counterfactual gap as $(\beta_\theta^m x^f - \beta_\theta^f x^f)$ which essentially represents that part of the raw gender wage gap explained by different rewards.

This procedure is carried out twice: once for workers with low education, and a second time for workers with high education.

4.3.1. Quantile Decomposition Results

The procedure outlined above was carried out using the quantile regressions model specifications by education level, as estimated in section 4.1. The quantile decomposition results are shown below in Table 4.3 and 4.4, for workers with low and high levels of education respectively. The first column shows the observed gender difference which is the raw wage difference, and does not control for any other characteristics. The second column shows the size that the gap would be if women had the same characteristics as men. Finally, the last column shows the size that the wage gap would be if women were rewarded for their characteristics as men.

Table 4.3 Quantile decomposition results for workers with low education

Quantile	Observable distributions	Characteristics		Coefficients	
		Effect	Share	Effect	Share

.10	.2233*	-.0353	-0.1581	.2586*	1.1581
	(.0517)	(.0434)		(.0625)	
.25	.2190*	-.0272	-0.1242	.2462*	1.1242
	(.0408)	(.0306)		(.0440)	
.5	.2549*	-.0431	-0.1691	.2980*	1.1691
	(.0392)	(.0358)		(.0383)	
.75	.3686*	-.0963	-0.2613	.4649*	1.2613
	(.0529)	(.0521)		(.0593)	
.9	.3493*	-.2142*	-0.6132	.5635*	1.6132
	(.0784)	(.0670)		(.0984)	

Source: NIDS 2008, own calculations

Notes: Standard errors are shown in parentheses, and have been produced through bootstrapping using 100 replications. $p < 0.05^*$ at the 5% significance level. Share is the proportion of the total observable gap at that quantile that can be attributed to each effect.

The raw wage gap for workers with low education is largest at the top two quantiles of the distribution. Turning to the second column, which is the effect of the characteristics, all of the estimates are negative. This indicates that based on their observable characteristics there should be a wage gap in favour of women, that is, that low educated women have better productive characteristics than men, and should be earning higher wages than men. The magnitude of the effect increases substantially at the top of the wage distribution, indicating that women at the 90th percentile have characteristics that are substantially better than men. It should be noted that this was the only result that was found to be significant.

The last column indicates the contribution of the returns to characteristics, that is, the difference in the rate at which measured characteristics are remunerated. The values are large and positive, indicating that men's characteristics are better rewarded than women's, such that if both genders had the same characteristics, the wage gap in favour of men would be substantially higher than what is observed.

In addition, the contribution of the coefficients rises as we move up the wage distribution. Since the coefficient effect includes the effects of discrimination, this suggests a worsening of discrimination for low educated women as we move up the distribution.

Table 4.4 presents the decomposition for high educated workers, with the following key findings.

Table 4.4 Quantile decomposition results for workers with high education

Quantile	Observable distributions	Characteristics		Coefficients	
		Effect	Share	Effect	Share
.10	.2786* (.1059)	-.0274 (.0555)	-0.0983	.3060* (.0962)	1.0983
.25	.2006* (.0955)	-.0352 (.0570)	-0.1755	.2358* (.0734)	1.1755
.5	.1156 (.0857)	-.1047 (.0747)	-0.9057	.2203* (.0660)	1.9057
.75	.1561 (.0866)	-.1824* (.0923)	-1.1685	.3385* (.0800)	2.1685
.9	.3139* (.1018)	-.3162* (.1160)	-1.0073	.6301* (.1137)	2.0073

Source: NIDS 2008, own calculations

Notes: Standard errors are shown in parentheses, and have been produced through bootstrapping using 100 replications. $p < 0.05^*$ at the 5% significance level. Share is the proportion of the total observable gap at that quantile that can be attributed to each effect.

Firstly, the raw wage gap for workers with high education is largest at the top quantile of the distribution.

Secondly, in terms of the effects of the characteristics it can be seen that all the results as in the case of low educated workers is negative, but is only significant at the top two quantiles of the wage distribution. This implies that women have substantially better characteristics than men at these two quantiles.

Finally the results of the last common are all significantly large and positive. Furthermore the magnitude of the effect increases substantially up the wage distribution. As before, this implies a worsening of discrimination for high educated women.

In summary, the results of the decomposition reiterate the presence of discrimination in the labour market to the extent that women's wages would be significantly higher if they were rewarded as men for both levels of education. In particular it was found when observing the results for the effect of coefficients, discrimination increased up the wage distribution for both low and high educated women. This implies that even if women were considered to have the same characteristics as men, they would still experience discrimination in the wage earned.

4.4 Conclusion

This chapter set out to further investigate the gender wage gap established at the mean in Chapter 3, with regards to the nature of the gap across the wage distribution, and the contribution of worker characteristics and rewards to the size of the gap. Throughout the analysis, workers are compared according to their level of education.

The results of the quantile regression analysis showed that certain characteristics have the ability to influence the wage earned. Three key findings are worth noting. Firstly, with regards to the gender wage gap it was found that for both low and high educated workers the gender wage gap was smallest at the centre of the wage distribution. However what was particularly interesting for high educated workers was the distinct presence of a glass ceiling and sticky floor.

Secondly, and quite crucial to this analysis, were the results related to human capital. Although sample selection is often considered to be a critical factor in these types of analyses, the results of this model were largely insignificant as noted earlier. While for low educated workers having a primary school education was found to be largely insignificant, the opposite was true for an incomplete secondary education. In this instance having an incomplete secondary education was found to be significant across the entire wage distribution and increased towards the 90th quantile. This finding indicating that amongst workers with a low education, they would be economically better off with an incomplete secondary education than just a primary school education with the base category being no schooling.

Thirdly, in terms of full time and part time workers, a clear distinction was found between low educated and high educated workers. In the case of low educated workers, it was found that low educated full time workers earn significantly lower hourly wages than low educated part time workers. This confirms the findings of other studies on the premium to part-time work. On the other hand the opposite was true for high educated workers where it was found that the hourly wage penalty to full-time work increases consistently at higher quantiles. This would imply that having a high education allows workers to benefit from full time rather than part time work.

Turning to the decomposition, using Albrecht *et al* (2003)'s adaptation of the Machado and Mata (2005) bootstrap method, the decomposition was conducted separately at each quantile. The results for both the low and high educated models indicated that there appears to be a bias in the rewarding of men and women in the labour market. Specifically, across the distribution and for both levels of education, women have better observable characteristics than men. However, men are better rewarded for their characteristics, with the disparity in remuneration being especially

large at the top of the distribution for low education workers, and the upper half of the distribution for those with high education. This finding reinforces other research which finds discrimination on the basis of gender for men and women with equal levels of education, and contributes to the understanding of the source of the 'glass ceiling' effect for women.

Chapter 5 summarises the findings and concludes, suggesting areas for further research. For instance, given that the NIDS is a panel dataset, one could examine more closely how the gender wage gap by level of education varies across time.

Chapter 5: Conclusion

The main objective of this study was to analyse the prevailing gender wage gap by level of education in South Africa, using the National Income Dynamics Study (2008) Wave 1. Specifically this study aimed to review the underlying economic theory of the gender wage gap with specific reference to the explained (human capital) and unexplained gap (or residual). Secondly it sought to estimate the magnitude of the gender wage gap across the earnings distribution, by the worker's level of education in South Africa. Finally, it aimed to assess the extent to which the wage gap can be attributed to gender differences in the workers' characteristics and in the returns to their characteristics, across the distribution and by their level of education.

Chapter 2 began with a review of the underlying economic theory of the gender wage gap. In particular the theory of the gender wage gap can be sub-divided into three categories, that is, human capital, occupational choice and crowding, and discrimination.

Human capital can be thought of as being composed of early ability (either intrinsic to the individual or attained over time), qualifications as well as knowledge (attained during education) and lastly skills, experience and competencies (gained during on the job training). Given that wage discrimination is defined by comparing wages of equally productive workers and that human capital is a precursor for productivity, it becomes necessary to understand the extent to which human capital accumulation differs amongst men and women. Firstly, due to the family unit and child rearing responsibilities of women, it was found that women are expected to have less continuous work lives. As such their investment in human capital tends to be lower than that of men. Furthermore, the time spent out of the labour market has the added effect of significantly deteriorating their skills and experience. Given the difficulties that employers face in separating career orientated women from less career orientated women, women thus continue to be subjected to statistical discrimination.

In addition to the above factors it was also shown that women can also be subjected to occupational crowding. Once again given the division of labour within the family unit, women often choose occupations that provide them a more flexible lifestyle and that do not require significant investments in human capital. Although this may not be true for all women, it was found that women are generally discouraged from entering what is considered to be male orientated jobs, and are "crowded" into female orientated jobs such as teaching and nursing.

Finally turning to the issue of pure discrimination and taking into account the family unit, it was found that even when men and women have the same productive characteristics, employers still

prefer men over women. This effect can be explained as the residual component of the gender wage gap, that is, the component of the gap between men and women after differences related to real or expected productivity have been accounted for.

Having considered the underlying economic theory of human capital, the discussion then went on to examine evidence on the current gender wage gap before looking more closely at the literature surrounding the gender wage gap by level of education. Briefly, the gender wage gap was found to be declining internationally over time, although the magnitude of the gap differed from country to country. This is mainly due to the different institutional structures and policies in place which dictate how inequality is essentially addressed. Each part of the world has unique issues that have to be dealt with differently.

Turning to the gender wage gap by level of education, focus was given to several key studies. In Spain, de la Rica *et al* (2008) found the presence of a glass ceiling for high educated female workers and a sticky floor for low educated females. The works of Addabbo and Favaro (2011) and Mussida and Picchio (2012) arrive at similar conclusions for Italy. Finally turning to the South African case, Ntuli (2007) demonstrated that while women earned higher returns than men for secondary education, men earned higher returns for tertiary education than women. While these studies undertook different methodologies and observed the results for different countries, it was clear that education does impact the gender wage gap.

Turning to the empirical analysis, Chapter 3 provided an overview of the characteristics of high and low educated workers in the sample by means of descriptive statistics. As expected the average hourly wage disparity was found to be in favour of men. However two key findings of this section speak to the underlying theoretical issues of the gender wage gap. Firstly, according to the theory of human capital, women are expected to invest less in education than men. However it was found that there was a higher proportion of women with tertiary education than men, signalling that women are interested in investing in human capital, contrary to theory. Secondly, it was found that while men and women can be concentrated equally in high paying occupations, and have the same level of education, women are still being paid less than men. These findings motivate for the further investigation of the influence of education on the gender wage gap.

Using a combination of quantile regression analysis, sample selection correction techniques and quantile decomposition techniques, Chapter 4 looked more closely at the extent of the gender wage gap by education. To summarize, the results of the quantile regression indicated the existence of a gender wage gap in favour of men for both low and high educated workers,

although it was shown that this gap was smallest at the centre of the wage distribution. However, one of the key findings of this analysis was evidence of both a sticky floor and glass ceiling for high educated workers.

In addition and crucial to this analysis were the results related to human capital. Primary school education was shown to offer no earnings benefit compared to workers without any formal schooling. For low educated workers, having an incomplete secondary education was found to significantly raise earnings compared to having no education across the entire wage distribution and increased towards the 90th quantile. Given that there is a greater proportion of workers with an incomplete secondary education than any other level of education, and that South African workers are typically less skilled, this finding emphasises the lack of adequate educational attainment in South Africa and ultimately the effect of this on the earnings of workers.

Although the analysis attempted to consider the issue of sample selection, the results were largely insignificant and as such the remainder of the estimation results were presented conditional on selection into employment. Estimating the quantile decomposition, the results supported the findings of the quantile regression analysis. In particular, men are better rewarded than women for their characteristics, with the disparity in remuneration being especially large at the upper tail of the distribution for those with high education. This finding reinforcing the presence of a glass ceiling for South Africa, which limits the ability of women's wages at the top of the earnings distribution to rise to match the wages of men.

In conclusion, the results of this study reinforce the disparity in wage earning capability between men and women with the same level of education. The investigation of this issue thus brings attention to the continued discrimination faced by women in the labour market.

Given that the National Income Dynamics Study is a panel study, going forward trends in the gender wage gap by level of education can be explored, although such an analysis was beyond the scope of this study. This type of research would contribute to an understanding of whether the inequalities faced by women are improving or worsening over time.

Appendix

A1. Sample Selection

Table A1: Probit Model

Employed	Coefficient	Std. Err.	z	P>z	[95% Confidence Interval]	
Male	0.5746	0.0478	12.02	0.000	.4809836	.6683148
Age	0.2038	0.0125	16.30	0.000	.179323	.2283328
Age2	-0.2463	0.0170	-14.52	0.000	-.279494	-.2130148
Living	-0.0477	0.0729	-0.65	0.513	-.1906352	.0951774
Widow	-0.0744	0.1030	-0.72	0.470	-.2761994	.1273767
Divorced	0.3096	0.1315	2.36	0.019	.0519636	.5673031
White	0.4651	0.1263	3.68	0.000	.2175716	.7126454
Indian	0.2784	0.2120	1.31	0.189	-.1372076	.6939713
Coloured	0.1513	0.0690	2.19	0.028	.0159979	.2865115
Primary	0.0458	0.0821	0.56	0.577	-.1150317	.2066914
Secondary	0.0782	0.0833	0.94	0.348	-.08497	.241366
Matric	0.3653	0.0938	3.90	0.000	.1815028	.5490954
Tertiary	1.2089	0.2008	6.02	0.000	.8153541	1.602465
Household Size	-0.0999	0.0190	-5.26	0.000	-.137167	-.062744
Number of children in the household	0.0717	0.0334	2.15	0.032	.0063542	.1371224
Non-labour income	-0.0000	0.0000	-3.33	0.001	-.0000636	-.0000165
Constant	-3.8890	0.2397	-16.22	0.000	-4.358883	-3.419151

Source: NIDS 2008, own calculations

Table A2: Quantile Regression with Sample Selection

Quantile	Θ=10	Θ=25	Θ=50	Θ=75	Θ=90
Male	0.0873 (0.1738)	-0.0354 (0.1446)	0.0791 (0.1673)	0.1201 (0.1506)	-0.0067 (0.2319)
Age	-0.1297 (0.0570)	-0.1169 (.0483)	-0.0472 (.0500)	-0.0257 (0.0498)	-0.0575 (0.0730)
Age2	0.1595 (0.0708)	0.1479 (0.0593)	0.0598 (0.0602)	0.0335 (0.0605)	0.0752 (0.0752)
White	0.3295 (0.4927)	0.2559* (0.3127)	0.3973* (0.2153)	0.5438* (0.2217)	0.0752* (0.3314)
Indian	1.3038 (0.4484)	0.9855 (0.3276)	0.6920 (0.2703)	0.3753 (0.2131)	0.2011 (0.2622)
Coloured	-0.1645 (0.1414)	0.0299 (0.0821)	-0.0641 (0.0737)	0.0139 (0.0801)	-0.02105 (0.1469)
Married	0.2717 (0.1280)	0.1306 (0.0879)	0.1696 (0.0724)	0.1330 (0.0767)	0.1216 (0.0983)
Excellent	0.2045 (0.1585)	0.2324 (0.1337)	0.1919 (0.0826)	0.2381 (0.0918)	0.1427 (0.1462)
Good	0.2756 (0.1543)	0.2319 (0.1040)	0.1372 (0.0708)	0.1487 (0.0840)	0.0217 (0.1135)
Fulltime	-0.5618 (0.1444)	-0.6621* (0.1152)	-0.8892* (0.1354)	-1.1125 (-1.1125)	-1.3900* (0.1947)
Legislators	0.0520 (0.6087)	0.1271 (0.4832)	0.4110* (0.3918)	0.5296 (0.3102)	0.5014 (0.2794)
Professional	0.6786 (0.3575)	0.3308 (0.3496)	0.4230 (0.4481)	0.7080 (0.6897)	1.3592 (0.5923)
Technicians and associate professionals	0.7816 (1.0943)	0.4514 (0.1535)	0.4853 (0.2004)	0.5067 (0.1599)	0.6468 (0.6468)
Clerical workers	0.7323 (0.2517)	0.6826 (0.1817)	0.6187 (0.1772)	0.7652 (0.1733)	1.3288 (0.3643)
Service and Sales	0.2502 (0.2262)	0.0791 (0.1399)	0.2347 (0.1217)	0.3680 (0.1206)	0.4748* (0.4748)
Craft and related trade	0.2043 (0.1435)	0.3565 (0.1353)	0.3883 (0.0940)	0.4244 (0.0899)	0.5841 (0.1595)

Plant and machine operators, and assembly	0.3015 (0.1632)	0.2098 (0.1405)	0.2194 (0.0978)	0.4723 (0.0976)	0.4860 (0.1767)
Elementary Occupations	0.4079 (0.1294)	0.1831 (0.0846)	0.2575 (0.0767)	0.2708 (0.0587)	0.2854* (0.1338)
Permanent	0.1790 (0.1031)	0.1633* (0.0739)	0.1752* (0.0666)	0.2089 (0.0579)	0.1252 (0.0991)
Contract	0.2143 (0.1905)	0.0207 (0.1214)	0.0110 (0.1443)	0.0829 (0.0937)	0.0603 (0.1129)
Trade Union	0.4044* (0.1478)	0.5462 (0.1122)	0.6228* (0.0961)	0.5187* (0.0634)	0.4189 (0.1013)
Sample Selection					
Lambda	-0.5627 (4.3188)	-4.6213 (3.8590)	-2.0827 (3.6667)	-3.3494 (3.2765)	-.6984 (3.8226)
Lambda2	0.0586 (6.8395)	5.3647 (6.4109)	2.3785 (6.0338)	4.4205 (5.6809)	-1.2221 (6.5235)
Lambda3	-0.2700 (4.5084)	-3.0304 (4.5098)	-1.3748 (4.0204)	-2.5569 (3.9002)	1.5696 (4.5101)
Lambda 4	0.1165 (1.0500)	0.5932 (1.1352)	0.2716 (0.9278)	0.5097 (0.9009)	4.5101 (1.0964)
Constant	3.6669	5.0850	3.5730	3.8358	1.0963
N	771				

Source: NIDS 2008, own calculations

Notes: Bootstrap standard errors are shown in parentheses, and have been produced through bootstrapping using 100 replications. $p < 0.05^*$ at the 5% significance level.

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