School of Economics at the University of Cape Town

Minimum Wage Enforcement in South Africa: Measurement and Determinants

A dissertation submitted to the Economics Department, University of Cape Town, in partial fulfillment of the requirements for the award of a Masters Degree in Applied Economics

By

Natasha Mayet

Under supervision of Professor Haroon Bhorat

February 2010

Plagiarism Declaration

I, **Natasha Mayet** hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is my own.
2. I have used the APA referencing guide for citation and referencing. Each contribution to, and quotation in this thesis from the work(s) of other people has been contributed, and has been cited and referenced.
3. This thesis is my own work.
4. I have not allowed, and will not allow, anyone to copy my work.

Signature…….

Date: ……..

Table of Contents

List of Tables

List of Figures

Acknowledgements

The author of this dissertation is deeply indebted to Haroon Bhorat for his supervision of this dissertation, as well as for his valuable comments, ideas and discussions, and to Ravi Kanbur for his methodology of the **'***index of violation,'* his work on minimum wage enforcement, and his discussions and ideas on measuring enforcement in South Africa, which gave birth to the subject matter of this thesis. Appreciation also goes out to Shaun Feldman at the Department of Labour for providing data on a key variable in this study, namely the number of labour inspectors by province. The author would also like to thank Lynn Woolfrey and Matthew Welch at DataFirst for their information on geographic units in the Labour Force Survey data.

Abstract

The lack of compliance amongst employers with minimum wage legislation is a problem faced by many developing countries. South Africa is no exception, informal evidence suggesting that a large proportion of the employed in the country earn wages below the stipulated minima. This dissertation attempts to measure non-compliance or, in other words, 'violation' of employers in South Africa of minimum wage legislation, and to investigate the determinants of this violation. This study constitutes the first attempt to measure enforcement and compliance in South Africa. In order to measure the strength of government enforcement of minimum wages in South Africa, the number of labour inspectors is used as a proxy measure, while employer non-compliance, or violation, is measured using an approach developed by Kanbur (2007), referred to here as the '*Kanbur Index of Violation'*. Derived from the Foster-Greer-Thorbecke (1984) poverty measures, this index is used to measure the share of violated workers receiving sub-minimum wages, as well as the depth of violation, namely, the average gap between the stipulated minima and the actual wage paid. This is the first attempt in the literature on minimum wage enforcement to use the methodology proposed by Kanbur (2007) for the measurement of violation. The estimates obtained for South Africa show that the sectors where violation is most prevalent include the Security, Taxi and Farming sectors. A multivariate analysis is employed, using standard OLS, probit, and quantile regression techniques to investigate the determinants of the probability of a worker being violated by their non-compliant employer, as well as of the depth and extent of the violation, that is, the shortfall of their wage from the minimum. Another innovation of this paper, in addition to the use of the Kanbur index as a measure of violation, is the introduction of a number of spatial/density variables, such as the log of workers per square kilometre, the density of labour inspectors in a District Council, and the unemployment density in the area. The construction of these variables was made possible by mapping the statutory minima, which are location specific, to the geographic units in the Labour Force Survey data for South Africa. The principal findings of this analysis are that violation is an outcome of a range of

variables, including individual, firm-level/contractual, sectoral, as well as spatial/density characteristics. A key marker of the probability of minimum wage violation and the depth of violation is the density of labour inspectors in the District Council where the worker is employed. Firm-specific characteristics such as firm size also play a leading role. The results from this dissertation carry important policy implications for minimum wage legislators in South Africa, especially regarding interventions around the enforcement of sectoral minima.

I. Introduction

Developing countries are notorious for poor labour market conditions (Ronconi, 2008). While most developing countries have extensive labour regulations and social security systems, compliance with legislation in these countries is generally low (Ronconi, 2008; Strobl & Walsh, 2003). A key problem affecting wage earners in developing countries is the issue of law enforcement, particularly the enforcement of legislation pertaining to minimum wages. There is a burgeoning literature on the problem of non-compliance amongst employers with minimum wage laws in developing countries (Basu, Chau & Kanbur, 2007; Andalón & Pagés, 2008). According to Kanbur (2007), non-compliance by employers can be considered as a violation of minimum wage legislation by employers. The measurement of non-compliance, or in other words, violation, however, remains elusive. One way in which non-compliance can be measured is as the fraction of all workers covered by minimum wage legislation whose wages are below the minimum (Kanbur, 2007). However, this approach is not an accurate measure of non-compliance since it cannot distinguish between different levels of non-compliance. For instance, a wage just below the minimum is counted the same as a wage at one third of the minimum-surely an inexact way to measure a violation of regulation. Given this drawback, this dissertation uses a methodology developed by Kanbur (2007), which proposes an '*index of violation'* based on the Foster-Greer-Thorbecke (1984) poverty measures as a measure of both the level and extent of violation of minimum wages in South Africa. The strength of enforcement is measured by the density of labour inspectors in a location. This is the first exercise attempting to measure non-compliance and enforcement in South Africa, and to quantify the relationship between enforcement and non-compliance. Another innovation in this paper is the matching of the sectoral and occupational minima to their respective locations. In South Africa, minimum wages are issued specific to sector, occupation, and location. However, until now, the locational units available in the Labour Force Survey data for South Africa had not been mapped to the local municipalities of the minimum wage legislation issued. This dissertation constitutes the first

attempt to control for the spatial uniqueness of sectoral minima in South Africa by mapping individual wage earners to their specific locational minima.

Overall, this dissertation contributes to the literature on enforcement of minimum wages in developing countries and the issue of non-compliance with minimum wage regulations in two main ways. Firstly, a new methodology is employed in the measurement of non-compliance in South Africa, namely Kanbur's index of violation (Kanbur, 2007). Secondly, it constitutes the first endeavour to measure the level, depth and extent of violation of minimum wages by employers in South Africa, and to empirically investigate the determinants of this violation.

The rest of the dissertation is structured as follows. Section II below provides a review of the existing literature on non-compliance in South Africa and other countries. Section III attempts to describe the methodology surrounding the measurement of non-compliance with minimum wage laws. This section presents the index of violation proposed by Kanbur (2007) that captures both the number of wage earners below the minimum and how far below the minimum their wages fall. The datasets to be used and data issues confronted are also presented here, along with the process used to map the area units to the sectoral minima. Section IV presents the results from the analysis. Estimates of Kanbur's index of violation for South Africa's various sectoral wage minima are presented, followed by a multivariate analysis of the key factors shaping violation. The final section, Section V, concludes with some suggestions for policy.

II. Literature Review

Generally speaking, compliance amongst employers with labour regulations in developing countries is low, and minimum wage regulations are no exception (Ronconi, 2008; Basu, Chau, and Kanbur, 2009). For example, in Argentina, only half the workforce receives legally mandated benefits (for instance, wages above the legal minimum, hours worked below the legal maximum, compensation for work related injuries, etc.) (Ronconi, 2008). Minimum wage non-compliance rates in Kenya reach a disturbingly high estimate of 67 % in higher skilled occupations in urban areas. Studies also find substantial non-compliance in other developing countries such as Brazil (Lemos, 2006), Trinidad and Tobago (Strobl and Walsh, 2001) and several Latin American countries (Maloney and Nuñez, 2003). As Ronconi (2008) points out, it is not the lack of labour regulations in these countries which is the key issue. Indeed, most developing countries have an extensive web of labour regulations. For instance in South Africa, statutory minimum wages vary by occupation, sector and location, and consequently there are over 36 different wage minima (known as sectoral determinations in South Africa[1]). Hence, it seems that the key issue here is not a lack of legislation but rather a lack of compliance amongst employers, due to imperfect enforcement (Basu, Chau, and Kanbur, 2009). Despite the problem of low enforcement of minimum wage legislation in developing countries, the issues of enforcement and compliance with minimum wage legislation are significantly under researched, both empirically and theoretically. In this section, we attempt to take stock of some of the literature on minimum wage legislation in developing countries, paying particular attention to studies on South Africa.

Most of the literature on minimum wages concerns their impact on employment and poverty (Stewart, 2004; Card and Krueger, 1995), rather than the measurement of employer compliance with minimum wage legislation. There is much debate in the literature regarding the equity and efficiency tradeoffs of minimum wage hikes (Basu, Chau, and Kanbur, 2009). The concern for equity stems from the effect of an imposed minimum wage on income distribution,

[1] A complete listing of the sectoral determinations for South Africa can be found at the website of the Department of Labour (DoL). Available from: http://www.labour.gov.za/legislation/sectoral-determinations/sectoral-determination. [Accessed online September 2009].

while the efficiency concerns include the impact of a minimum wage on employment. Contributing to the equity-efficiency argument, a number of studies investigate the relationship between minimum wages and poverty (Saget, 2001; Vedder and Galloway, 2001; Fields and Kanbur, 2007; Card and Kreuger, 1995). While the general consensus in the literature is that minimum wages have important implications for poverty, the empirical evidence is mixed. Results for Latin America show that poverty levels fall as the minimum wage rises since the minimum wage may raise the wages of poor wage earners, hence lifting them above the poverty line (Andalón and Pagés, 2008). On the other hand, Fields and Kanbur (2007) find that the impact of a minimum wage on poverty can be positive, negative, or zero depending on a number of factors, such as poverty aversion, the ratio of the minimum wage to the poverty line, income sharing, and the elasticity of labour demand.

As in the literature on the interactions between minimum wages and poverty, the evidence on the employment effects of minimum wages is also mixed. For instance, Bhorat (2000) showed that minimum wage hikes in South Africa are associated with a decline in employment among low-paid Farm and Domestic workers. Maloney and Nuñez (2003) also found negative employment effects resulting from minimum wage increases in Columbia. In contrast, Lemos (2006) finds no significant effect of minimum wages in Brazil in either formal or informal employment. However, the general consensus that does emerge from the literature is that when there is imperfect enforcement, that is, both compliant and non-compliant employers are present in a labour market, the employment effect of a minimum wage hike may be positive or negative (Basu, Chau, and Kanbur, 2009). However, in developing countries, most of the evidence suggests a negative employment effect of minimum wages when enforcement is imperfect (Andalón and Pagés, 2008).

There are a number of studies that attempt to study compliance with minimum wages by examining the distribution of wages in a country around the minimum wage, or to measure

compliance as the fraction of workers who receive wages at the minimum (Andalón and Pagés, 2008). For instance, Andalón and Pagés (2008) measure the percentage of workers whose earnings are at the minimum wage level in Kenya. They find that only a small fraction of salaried workers earn wages equal to the statutory minimum. If the fraction is measured as the percentage of workers whose wages are within 2% of the statutory minimum, the estimate is only 0.3% for workers in agriculture and 2.1% for workers in urban areas. These estimates increase only slightly to 6.8% and 2.9% respectively if the range is increased to within 5% of the minimum wage. Hence, they conclude there is significant non-compliance with minimum wage legislation in Kenya. Their study is interesting in the South African context of more than one minimum wage, since in Kenya there are 17 different minimum wage orders, and the minimum wage floors vary by sector, occupation, and location. They determine the minimum wage that applies to each worker based on sector, occupation, and location. They find that enforcement is higher in non-agricultural industries, whilst non-compliance is higher among youth, women and the lesser educated. They attribute the low levels of enforcement in Kenya to the large number of categories of minimum wages which makes it difficult for firms to know them and arguably, for the government to enforce them. An interesting innovation in the Andalón and Pagés (2008) study is the estimation of the Kaitz index for Kenya, which measures the ratio of the minima set relative to the median wage. They show that in the 1998 to 1999 period, there were 18 minima in Kenya, which stood at higher than 70 per cent of the median wage in salaried employment, with the minimum wages in most sectors significantly exceeding the median wage for unskilled occupations. A notable result from the study is that although minimum wages in Kenya are set high relative to the median wage, non-compliance levels in the country are also high. What is interesting is that in Kenya, sectors and occupations with a high Kaitz index are also found to have a higher percentage of non-compliance (measured as the fraction of wage earners earning below the minimum) and vice versa (Andalón and Pagés, 2008). Certainly then, the ratio of the minimum wage to the median is an interesting measure to consider when investigating the

possible determinants of non-compliance or violation. The Kaitz index is therefore estimated for South Africa later on in this thesis (Section IVa).

While examining wage distributions and measuring the fraction of workers below the minimum wage in a country are both useful in providing initial evidence of compliance levels, such methods fail to deliver conclusive evidence about the relationship between enforcement and compliance. There is a need for more empirical studies measuring the effects of enforcement on compliance. Ronconi's (2008) study on Argentina constitutes one of the first attempts to empirically estimate the effect of government enforcement on compliance with labour regulations in a developing country. Using data for the period from 1995 to 2002, he attempts to analyse the effect of enforcement on the extent of compliance using a two stage least squares estimation procedure. Ronconi uses the number of labour inspectors working in provincial public enforcement agencies as a proxy for enforcement activity. He measured the extent of compliance by the percentage of private sector employees receiving legally mandated benefits (namely, wages above the legal minimum, hours worked below the legal maximum, legally mandated vacations, annual extra monthly salary, coverage against work related injuries, and health insurance). The author notes, importantly, that the number of inspectors is only a proxy measure for enforcement, since inspector productivity can change over time and across provinces (Ronconi, 2008). The study finds that enforcement increases with the number of labour inspectors. For instance, the correlation between the number of labour inspectors and the number of fines imposed was 0.89 in Argentina between 1996 and 1998. The results from the Ronconi study showed that enforcement, as measured by the number of labour inspectors, increases the extent of compliance (This measure of enforcement is also employed in the analysis later on in this paper for South Africa). Unemployment was found to be negatively correlated with compliance levels. It is worth noting that one of the main differences between Argentina and South Africa is that the minimum wage is constant at $200 across all provinces during the analysed period. Hence, in the Ronconi (2008) study, it was not necessary to account for sectoral,

occupational, or locational variations in minima. However, in attempting to conduct such an analysis for South Africa, it becomes necessary to control for the various statutory minima based on sector, occupation, and location.

Turing to South Africa, if the literature on enforcement of minimum wages in developing countries is scarce, South Africa is no exception. Since the introduction of the first sectoral determination (Contract Cleaners in 1999[2]), there have been a few studies in South Africa that have considered the impact of sectoral determinations on specific groups of workers. Among these have been Hertz (2005) who analysed the impact of minimum wages on employment and earnings of domestic workers in South Africa, and Murray and Van Walbeek (2007) who conducted a case study of the KwaZulu Natal North and South Coasts in order to determine the impact of the sectoral determinations on farm workers in the sugar industry. There has however been very little research on the overall impact of sectoral determinations on workers in South Africa. Evidence on the impact of minimum wages and compliance levels in South Africa is perhaps limited due to the difficulty of mapping the statutory minima to their respective sectors, occupations, and locations. This thesis constitutes the first attempt to undertake such an analysis for South Africa, measuring the level and extent of compliance with sectoral determinations in different sectors, as well as the first time that locational variations in the sectoral minima for South Africa are controlled for. An overview of sectoral determinations in South Africa and the mapping of the respective minima to the sector-occupation-location categories are presented in the following section.

2 Department of Labour (1999) Government Notice No. 622. Sectoral Determination 1: Contract Cleaning Sector, South Africa. Available from: http://www.labour.gov.za/legislation/sectoral-determinations/sectoral-determination-1-contract-cleaning-sector [Accessed September 2009].

III. Minimum Wage Violation in South Africa

Wage formation in the South African labour market proceeds via two main channels, notably bargaining councils, and government-mandated wage minima (DoL, 2003). The body responsible for issuing state legislation is the Employment Conditions Commission (ECC). The ECC is a representative body within the Department of Labour (DoL) established in 1999 in order to advise the Minister of Labour on appropriate and feasible sectoral determinations, effectively, sectoral wage minima. The broad aim of the ECC is to protect vulnerable workers in the South African labour force, that is, sectors in which workers are likely to be exploited, or in which worker organizations and trade unions are absent, and workers are not appropriately covered by the BCEA or other wage regulating mechanisms (DoL, 2003). Within this context for instance, agricultural and domestic workers form two of the most vulnerable groups in the South African labour market.

The DoL uses a team of labour inspectors whose job is to enforce compliance with these sectoral determinations. There has been some discussion attributing regional variation in the degree of violation of minimum wage laws to differences in the numbers and distribution of inspectors within areas, as well as the possibility of the corruption of the inspectorate deployed. Scant and poor quality data in the inspectorate however, renders this a difficult set of propositions to explain further.

The ECC sectoral determinations set general conditions for employment such as minimum wages, working hours, number of leave days, and termination rules. There are 11 different sectoral determinations set by the ECC, specifically Forestry, Agriculture, Contract Cleaning, Children in the Performance of Advertising, Artistic and Cultural Activities (under fifteen years of age), Taxi Operators, Civil Engineering, Learnerships, Private Security, Domestic Workers, Wholesale and Retails, and Hospitality[3].

[3] Detailed descriptions of each of the sectoral determinations are available on the website of the Department of Labour: Available from: http://www.labour.gov.za [Accessed September 2009).

The wage minima in these industries are regularly updated for inflation through a formal government gazetting process. Ultimately though, it is important to emphasise that within the South African labour market, no unitary national wage minimum exists. The different sectoral determinations, minima set, and year of enforcement are shown in Table A1 in the appendix.

III a: Sectoral Minima in South Africa

This section attempts below to provide a brief overview of the Ministry of Labour's sectoral minimum wage laws or, as they are officially known in South Africa, sectoral determinations. In total, nine sectoral determinations[4] are investigated, utilizing nationally representative labour force surveys to analyse and measure compliance levels in the South African labour market. Turning to the first of these minima then, the Retail and Wholesale sectoral determination covers all those employed in that sector, excluding the self-employed. Within this determination, there are six different sub-groups, which could be isolated using the labour force survey data, namely managers, clerks, shop assistants, sales assistants, drivers, and fork-lift operators. The minima which are set differ for each of these sub-groups depending on the region of employment. In most sectoral determinations, the state sets wage minima by location to account principally for urban and rural areas. Hence, it is commonplace to stipulate minimum wage levels by urban, rural and semi-urban areas.

Wage stipulations for Domestic Workers are taken to represent domestic workers or gardeners in elementary occupations working for private households. Within this determination, there are two area types, A and B. The prescribed minima are different on the basis of whether the number of hours worked is below or above 27 hours per week.

The Farm Worker sectoral determination applies to all agricultural sector workers, excluding workers in the forestry sector (The definition includes security guards working for a farm as well).

[4] In the analysis that follows below, the sectoral determination covering learnerships was excluded due to a lack of information in the LFS pertaining to learners. Naturally, the sectoral determination applicable to children working in performance arts was also excluded since children are not classified as being part of the working age population (15 to 65 years) in the LFS.

The sectoral determination for the Forestry sector sets a fixed minimum rate of remuneration for those working in all areas within the forestry sector, with no locational differential.

The sectoral determination for the Taxi sector applies to all categories of workers in the transport sector involved in the operation of minibus taxis, and excludes metered taxis. Within this determination a distinction is made between drivers and fare collectors.

The ECC's sectoral determination for the Private Security sector applies to all employers and employees involved in guarding or protecting fixed property, premises, goods, persons or employees. We assume that security workers employed in the retail sector fall under the retail sectoral determination. Minimum wages are differentiated by the security officers' grade (qualification) and the years of operation. Grades A to E are specified, but these cannot be isolated using the labour force data. Thus, for the purposes of this study, the minima for security workers were calculated as the average of the minima of the various grade officers was used along with the sectoral determinations of the 1st year of operation. There are five different area types demarcated within this determination.

In the wage minima for the Hospitality sector, the only variation in the minimum wage comes from the fact that small firms (less than ten employees) face a lower minimum wage than medium to large firms.[5]

The Contract Cleaning sector was identified as cleaners who work outside of the private household sector. The contract cleaning industry is difficult to isolate using the labour force survey data, and contract cleaners tend to report a range of industries but the most common sector of employment reported is the government, social and other services' sector. The minima prescribed for contract cleaners are hourly minima. These rates were adjusted to derive monthly

[5] Respondents in the data report the size of the firm for which they work. This information could be used to identify minimum wage levels for different workers within the hospitality industry.

minimum wages for this determination using 45 hours per week as the default. The areas for contract cleaners are demarcated into three areas locations[6].

The final sectoral determination is for workers employed in the Civil engineering industry. Within the Civil Engineering sector, hourly wages are set on the basis of task grade. Nine different task grades are defined. It was assumed that all workers were engaged in Grade 1 tasks (that is, general workers in the Civil Engineering sector) due to a lack of further information in the data. Within Grade 1, two different minima are set on the basis of geographical location.

III b: Methodological Approach: Kanbur's Index of Violation

In the enforcement literature, non-compliance with minimum wages or 'violation' is generally measured as the fraction of all covered workers whose wages fall below the statutory minimum. However, using this method of measuring compliance one is not able to distinguish between different degrees of violation. For example, a wage just below the minimum is equivalent in violation to a wage at one-third of the minimum. As a potential solution to the problem, Kanbur (2007) proposes what he refers to as an '*index of violation*' to capture both the number of wage earners falling below the minimum as well as the distance of their wages from the minima. This method is derived from the generic class of poverty measures introduced by Foster-Greer-Thorbecke (FGT) (1984)[7], namely the headcount index, the poverty gap and the squared poverty gap. This approach treats the minimum wage in the same way as the poverty line Z in the FGT poverty measures. By reworking the FGT class of poverty measures, Kanbur (2007) derives both an absolute and a relative measure of violation. It is worth noting, however, that unlike the standard FGT index where a fixed poverty line is set for the entire population, in this study each

[6] Three areas are specified for the Contract Cleaning sector, namely A, B, and C. Strictly speaking, the published minima do not pertain to area B, whose wages are determined by bargaining councils. However, for the sake of discussion we decided to include area B workers in our analysis, using the minimum rates for area A as the benchmark.

[7] The Foster-Greer-Thorbecke (FGT) class of poverty measures can be expressed as follows: $P_a = \frac{1}{n}\sum_{i=1}^{n}\left[\frac{z - y_i}{z}\right]^a \quad | y_i < z$

for α≥0 where z is the poverty line, yi is the standard of living indicator of the ith household, and α is the 'aversion to poverty' parameter. The higher the value of α, the more sensitive the measure is to the well-being of the poorest person. The headcount index is obtained by setting $\alpha = 0$ and the poverty gap by setting $\alpha = 1$. Setting $\alpha = 2$ gives the squared poverty gap (Foster-Greer-Thorbecke (1984).

worker covered by minimum wage legislation in South Africa faces a unique minimum depending on his or her sector, occupation, location, and hours worked. Using this approach then, one can consider the 'poverty line' Z for each individual worker as being equal to their respective minimum wage.

The index of violation as proposed by Kanbur (2007) is derived as follows:

Let the minimum wage for each worker be denoted by w_m. If there is full compliance or, in other words, enforcement of the minimum wage is perfect, then, strictly speaking, one would not expect to see any wages below w_m. Compliance of an employer in this context therefore means paying a wage w_m, and non-compliance means paying a wage that is below w_m. The measure of individual violation or in other words, employer non-compliance, can then be expressed as follows:

$$v = [(w_m - w)w_m]^a \qquad \forall\, a \geq 0 \tag{1}$$

The measure of violation of an individual, v, is positive if $w < w_m$ (non-compliance), v is equal to zero if $w = w_m$ (exact compliance), and v is negative if $w > w_m$ (over-compliance) (Defined as in Basu, Chan and Kanbur, 2009). The parameter *a* may take on values greater than or equal to zero. When $\alpha = 0$, v becomes a marker of violation of an individual, taking on a value of 1 when w is strictly less than w_m, and a value of 0 when w is greater than or equal to w_m. When the parameter $\alpha = 1$, v is the ratio of the gap between the actual wage received by the individual, w, and the official minimum w_m, to the minimum w_m. When $a > 1$, the value of the violation index, *v*, is more sensitive to larger violations.

The above equation provides a measure of violation for the wage on an individual. In order to obtain a measure of overall violation (V_a) in the labour market, the average of individual violation (v) over the entire wage distribution is estimated:

$$V_a = \frac{1}{n}\sum_{i=1}^{n}\left[(w_m - w)/w_m\right]^a \tag{2}$$

This expression is simply the equivalent of the familiar FGT poverty measures, with the minimum wage w_m substituting for the poverty line Z and w for income. In the FGT methodology, the parameter α is a measure of poverty aversion (Foster-Greer-Thorebecke, 1984). Analogously, we can treat α in the above expression as the 'aversion to violation' parameter. The higher the value of the parameter α, the more sensitive the measure is to high levels of violation. Setting α equals to 0 provides the proportion of violated individuals, whilst $\alpha = 1$ denotes the mean shortfall of wages from the minima or, in other words, the average depth of violation, and $\alpha = 2$ is the squared depth of violation measuring the severity of violation (Kanbur, 2007; Foster-Greer-Thorebecke, 1984).

However, Kanbur (2007) raises an important issue, noting that it is not clear why the whole distribution of wage earners should be the denominator in the expression for minimum wage violation. If all wages are included in the expression and all wage earners in the denominator, the measure of violation is affected by the wages of those individuals who earn above the statutory minimum w_m. An alternative measure would consider only those wages that are below w_m. If this argument is accepted, then for example, when $\alpha = 0$, the index of violation V_0 becomes the number of wage earners below the minimum wage divided by the number of wage earners at or below the minimum wage. The universe of relevant wage earners is now only those individuals who are now earning wages equal to or below the official minimum w_m. However, Kanbur (2007) notes the tendency in the literature using the FGT poverty measures to normalize by the entire distribution. Hence, although not ideal, for the sake of consistency with the literature, this study uses the entire distribution of wage earners as the basis for normalization in the measurement of violation.

III c: Datasets and Variable Construction

Labour market data in the post-apartheid period is primarily available from two nationally representative household survey series, the October Household Surveys (OHSs) and the Labour

Force Surveys (LFSs)[8]. The OHSs collected labour market and other data annually for the period between 1995 and 1999. The OHS was replaced in 2000 by the LFS, which until 2007 was conducted biannually. While desirable, comparisons between the OHSs and LFSs are inadvisable, since questions relating to the individual's employment status changed in the cross-over from the OHS to the LFS. Furthermore the LFS provides a far more detailed explanation of what constitutes work, and therefore captures irregular and informal work activities more comprehensively than the OHS (Casale *et al.* 2004). In addition, changes within the OHS series itself, including methodological improvements, make accurate comparisons between different years of OHS data complicated (Casale *et al.* 2004).

Given these comparability and compatibility issues, the analysis of enforcement in the South African labour market below uses September LFS data from 2001 and 2007[9], the latter being the last September edition of the biannual LFSs. The use of this survey allows us to control for survey design in measuring changes over time, since the survey instruments have been largely unchanged since the introduction of the survey.

The Income and Expenditure Survey (IES) 2000 (StatsSA) was also used where appropriate. The 1995 IES was a detailed national survey that accompanied the OHS 1995 survey, which collected information on income from sources other than employment, combined with a detailed profile on expenditure by at least 1000 product categories. This was followed by the 2000 IES. The IES samples were drawn on the same sample frame as the LFSs of the same years. The 2000 IES contains data by magisterial district and this information was used during our mapping of local municipalities, magisterial districts, and district councils (DC)[10]. Furthermore, information

[8] From 2008, the LFSs were replaced by Quarterly Labour Force Surveys (QLFSs).

[9] Unfortunately, the QLFS does not contain information on income and hence estimates for 2008 could not be included in this analysis.

[10] The demarcation of the boundaries of geographical areas units in South Africa is conducted by the Demarcation Board. The Municipal Demarcation Board was established under the Local Government: Municipal Demarcation Act of 1998 in order to determine and re-determine municipal boundaries in South Africa. Prior to the elections in 2000, South Africa was divided into 843 municipalities (771 local municipal areas, 42 district councils and 6 metropolitan areas with 24 substructures). After the elections, the number of municipalities was reduced. Currently, South Africa consists of 6 metropolitan municipalities which act as both district and local municipalities (these are also known as Category A

on the number of covered workers by magisterial district from the 2000 IES was used in order to assign DCs to a single area type (A, B or C) in cases where a DC was comprised of local municipalities of two or more area types.

As noted above, the sectoral minima issued are specific to the location of the workers. More In particular though, the DoL has designated the local municipalities to areas A, B, and C for the different sectoral determinations. This demarcation was conducted on the basis of the average household income recorded for the municipal area concerned in the 1996 census. The three areas were as follows:

A – Average income greater than R24, 000 per annum

B – Average income between R12, 000 and R24, 000 per annum

C – Average income less than R12, 000 per annum (DoL, 2005)

Generally, A areas are urban, B areas are semi-urban, and other areas (C or D) are rural areas. The wages in area A are the highest, followed by area B, while area C and other areas have the lowest wages. It is important to note that the area designations A, B, and C are inconsistent across different sectoral determinations. For example, some local municipalities classified as Area A for farm workers fell under Area B in the retail sector. Hence, the area types were determined separately for each sectoral determination

In the absence of detailed information on area of work in the LFS, it was necessary to assume that the area in which the individual resided was the same as where he/she worked. However, it is worth emphasizing that the possibility that individuals work outside of the area in which they live renders this an imperfect measure.

In order to assign individuals to area types, it was first necessary to match the geographical information available in the LFS 2001 and 2007 to the areas listed under the sectoral

municipalities), 46 district municipalities which contain more than one local municipality (Category C municipalities), with their contained local municipalities known as Category B municipalities. Within the local municipalities are the magisterial districts. There are currently 366 magisterial districts in South Africa (Website of the Municipal Demarcation Board of South Africa. Available from: http://www.demarcation.org.za [Accessed September 2009]).

determinations. The sectoral determinations issued by the ECC list the local municipalities comprising each area type. Generally magisterial districts are the smallest area unit contained within local municipalities, which are in turn contained within DCs. However, the boundaries of these different area units may overlap so that it is not always possible to conclusively assign each magisterial district to a single local municipality, and each local municipality to a single district council.

The geographical units used in the various LFSs are not consistent. While the LFS 2000 contained information by magisterial district, the 2001 LFS provides only province and area type (rural/urban). For the 2001 LFS, the magisterial district was derived from the codes in the unique number (the first three digits). The magisterial districts were then mapped to local municipalities, which were then assigned to areas A, B, C etc. on the basis of the information provided in the sectoral determinations. The LFSs from 2004 onwards contain locational information only by DCs and not by magisterial districts or local municipalities. For the September 2007 LFS, local municipalities were assigned to DCs. This allowed for the DCs to be designated to area A, B, C, etc. Our proposed mapping of DCs to areas A, B, etc. for the different sectoral determinations is included in the appendix.

It is worth noting that the mapping presented here should be approached with caution. In certain cases assigning a whole DC to a single area A, B or C, was problematic. For instance, in some cases a DC contained local municipalities falling under more than one area type. The mapping of the cross-frontier municipalities (e.g. Sekhukune, Southern District Municipality DC40, Lydenburg, and Mapulaneng), which crossed provincial boundaries, was especially difficult for this reason. We attempted to resolve this problem using information from the IES 2000 on the number of workers covered by ECC legislation in each magisterial district. For instance, if certain areas within a DC fell within area A while the others fell within area B, the DC was assigned to either area A or B by determining whether there were more people covered by ECC minimum wage legislation in A areas or B areas in the magisterial districts within that DC.

Another issue was the adjustment of the published minima to the required time period, as well as to account for the number of hours worked by the individual. Using 2000 as the base year, the published minimum wages were adjusted to obtain minima for the required year (2001 and 2007 respectively) using the formula below of the ECC:

$$w_t^M = w_{t-1}^M + \dot{p} + 2\% \tag{3}$$

where w_t^M is the minimum wage for the period, w_{t-1}^M is the previous year's wage and $\dot{p}$ is the inflation rate based on the CPIX[11]. Hence, estimates presented in this paper for 2001 have been computed using minima in 2001 prices and nominal wages in that year, whilst the 2007 estimates have been obtained using 2007 prices (with 2000 as the base year for adjustment of the minima in both cases).

Another issue worth noting is that the monthly minima published by the ECC are all based on a 45-hour work week. Workers working longer (or shorter) hours would therefore be paid a higher (or lower) wage than the published average. Consequently, the applicable minimum wages were adjusted according to the hours worked by each individual. Specifically, we derive an adjusted minimum wage (w_m^a) as the product of the stipulated minimum wage (w_m) and the individual's hours worked (h), divided by 45[12].

$$w_m^a = \frac{w_m * h}{45} \tag{4}$$

[11] The CPIX used by the ECC is the Consumer Price Index, excluding interest rates on mortgage bonds for metropolitan and other urban areas as reported by Statistics SA six weeks before the increases become effective.

[12] The reported 'hours worked' variable is truncated at 84 hours to avoid a situation where this adjustment leads to very high minimum wages for people who work very long hours. This implies truncation at or around the 98th or 99th percentile of the 'hours worked' variable.

IV. Results

This section presents the results of the analysis. First, we provide a descriptive analysis of the various measures of violation presented in this study, notably V_0, V_1, and V_2. Next, a multivariate approach is used to investigate the determinants of violation.

IV a: Measuring Regulatory Violation-A descriptive Overview

As a point of departure, a graphical approach is used to investigate the distribution of wages around the stipulated minima across the nine sectoral determinations. Below kernel density plots[13] are presented for 2001 and 2007 of the log of monthly wages for each of the different sectoral determinations. The location of the minima for 2001 and 2007 are represented by the vertical lines. The mapping in this analysis makes it possible to control for area type (A, B, C, etc.) within each sectoral determination.

Since all of the sectoral determinations were first implemented between 1999 and 2002, comparison of the wage distributions of 2001 with 2007 may be used to see whether the introduction of the ECC sectoral determinations have had an impact on worker wage distributions in South Africa. If there is enforcement of legal minimum wages in a particular sector, one would expect to see the distribution of wages censored from below the level of the minimum wage, with none or very few workers earning below the minimum.

If compliance with minimum wage legislation was high, one would expect the mode of the wage distribution – that is, the point where probability distribution function takes its maximum value – to lie at the minima. By 2007, this mode should have shifted to the right and closer to the minima. A spike at the minimum wage indicates enforcement of minimum wages within that sector. In some sectors 'multiple spikes' may be observed around the specific minimum wage levels within that determination. However, since the minimum wage levels are fairly close

[13] The kernel density function approximates the probability density function $f(x)$ from observations on a random variable x. The Kernel density approximation of an independently and identically distribution random sample ($x_1, x_2, \ldots . x_n$) may be expressed by the following equation:

$$\hat{f}_h(x) \frac{1}{nh} \sum_{i=1}^{n} K\left[\frac{x - x_i}{h}\right]$$

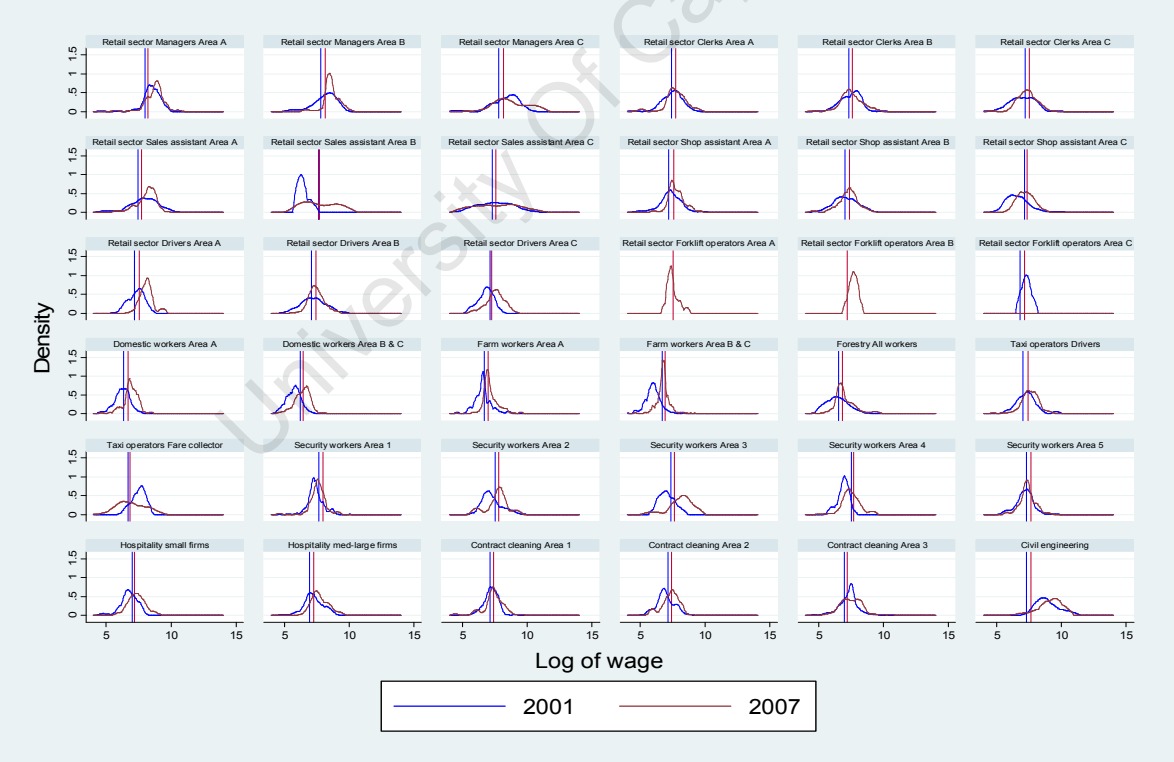
where the function K, which determines the weights, is named the "kernel," and h is a smoothing parameter known as the 'bandwidth.' (Maloney & Nuñez, 2003).

together and wages are distributed fairly smoothly across the spectrum, these spikes are obscured in most of the post-minimum wage distributions (Basu, Chau and Kanbur, 2009; Andalón and Pagés, 2008).

The two vertical lines represent the natural logarithm of the mean adjusted minimum wage in 2001(blue) and 2007 (red) respectively. Under full compliance one would expect that the wages of all workers covered by the respective sectoral determinations to lie at the vertical line, causing a single 'spike' at this point in the wage share distribution (Basu, Chau and Kanbur, 2009; Andalón and Pagés, 2008).

The basic visual evidence provided in figure 2 below would seem to suggest that significant spiking at the respective minima is not evident for many of the sector-occupation-area cells under review here. Put differently, this is initial evidence of relatively weak enforcement of sectoral minimum wage laws in South Africa.

Figure 1: Kernel Density Estimates of wages, 2001 and 2007



Source: Authors' calculations using LFS September 2001 and 2007 (StatsSA) and ECC sectoral determinations.
Notes: The kernel density estimates of the wages of Forklift Operators in Areas A and B for 2001 are not shown due to insufficient sample. The blue line represents the mean minimum wage (logged) in 2001, and the red line the log of the mean minimum wage in that sectoral determination for 2007.

In examining the kernel density plots above, it appears that most of the distributions for 2001 peak slightly to the left of the normalised minimum wage level. Only the wage distributions of the Civil Engineering sector and of Managers in the Retail sector lie significantly to the right of the location of the minima in both years, indicating that employees in those sectors generally earn above the stipulated minima and are thus better off than their counterparts in other sectors. By 2007, some of the distributions appear to have shifted to the right, and closer to the minima, suggesting that the sectoral determinations may have had influenced wage levels in these cases. This is especially evident in the wage distribution for Domestic workers (all areas), which peaks to the left of the minima in 2001 and by 2007 has a spike located to the right of the minima. This may point to effective enforcement of sectoral determinations in the Domestic Worker sector since 2001, perhaps due to increased targeting of that sector as a vulnerable sector by labour inspectors during this time.

However, while a slight shift to the right is visible in some of the sectors, the sectoral determinations do not seem to have had a significant impact on the wage distributions in other sectors. The wage distributions of 2001 and 2007 appear to be similar for several sectors, in some cases almost overlapping one another (for example, the wage distributions of Retail sector Sales Assistants and Clerks). This is preliminary evidence that the ECC sectoral determinations have not had a substantial impact on wage distributions in those sectors, possibly an indication of lax enforcement in those sectors engendering non-compliance with minimum wage levels.

As the kernel density estimates of the wage distributions presented above seemed to suggest, there is a problem of low enforcement of minimum wages in South Africa, with large proportions of workers in some sectors earning sub-minimum wages. We now attempt to use a more numerical approach in order to measure the lack of enforcement of minimum wage legislation in the South African labour market. Table 1 therefore presents estimates of Kanbur's index of violation for South Africa based on equations 1 and 2 above, in an attempt at being more rigorous in our measure of compliance with these sectoral minima by employers. Using the

LFS for September 2001 and 2007 then, V_0 represents the fraction of individuals earning below the minimum, that is, when $\alpha = 0$. V_1 in turn (when $\alpha = 1$) is the wage gap, that is, the gap between the actual wage and the official minimum wage, as a fraction of the minimum wage. V_1, as noted above, provides a measure of how far below the minima an individual earns, and is a measure of the extent and depth of violation (or lack of compliance) amongst South African employers. Increasing the value of the parameter α to 2 yields V_2, the squared wage gap, affording a measure of the severity of violation.

The estimates in the last row of Table 1 show that in South Africa V_0 was 55% in 2001 and 45% in 2007. This suggests that in 2001 55 % of employers were not complying with minimum wage legislation, or in other words, 55% of employees were violated and receiving sub-minimum wages. By 2007, the overall rate of violation had subsided to 45%. The figures for V_1 were 25% in 2001 and 16% in 2007. Hence, in 2001, employees who were violated received, on average, wages that were 25% below their average sectoral determination minima. In 2007, this estimate was 16%, indicating that non-complying employers paid wages that were on average 16% short of the legislative minima in that year. The estimates for V_2 show that, on average, the gap between wages paid by non-complying employers and the stipulated minima, squared, was 15% and 8% in 2001 and 2007 respectively.

The headline result here is that absolute levels of violation in South Africa are disturbingly high, both in terms of the number and percentage of individuals violated, with the estimates of V_0 reaching more than 50 % in several sectors. Indeed, in some sectors, V_0 soars to over 65%, a deeply worrying result. The high estimates for V_0 are reflective of a significant number of employers in South Africa who are violating minimum wage laws across all sectoral determinations. On average, the data suggest that in 2007, 45 % of all workers ostensibly covered by sectoral determinations were not being paid the legal minimum. This ranged from a low of 9 % in the Civil engineering sector to a high of 67 % among Security workers.

An second interesting trend in the violation estimates presented here is that there seems to have been a significant decline in violation across several sectors (at the 5 % level) between 2001 and 2007, both in terms of the number of individuals violated (as measured by V_0) and in the depth and severity of violation (as approximated by V_1 and V_2 respectively). This decline was most notable amongst Domestic and Farm workers, who both experienced a significant decline in the numbers of workers violated of between 50 and 60 percentage points respectively in the 2001 to 2007 period. The data show that whilst 63% of all Domestic workers were earning below the minimum in 2001, by 2007 the V_0 measure of violation for this cohort had subsided to 39%. The figures for Farm workers in turn yield a decline in violation from 78% to 55%. Indeed, when examining the depth of such violation, the positive impact of legislation is clear. Hence, whilst Domestic workers were on average being paid 30% below the minimum in 2001, by 2007 this estimate had fallen to 13%. For Farm workers, the depth of violation declined by 21 percentage points, that is, from 38% to 17%, during this time. Viewed collectively then, the data for South Africa suggests that although non-compliance levels of employers with minimum wage legislation, or in other words, violation, remain high, there is some evidence to suggest that enforcement improved slightly during the 2001 to 2007 period. The proportion of violated workers fell from 76% to 72%, and the mean gap between their wages and the minima declined from 21% to 13% during this time. All changes noted here are significant at the 5 % level. Despite the positive trend of declining levels of violation, the notion of particularly high levels of violation, at above 70% for instance, amongst South African employers in vulnerable sectors should not be lost in considering these data.

Table 1: Estimates of the Index of Violation, LFS September 2001-2007

	2001			2007			Change 01-07		
Sectoral Determination	V_0	V_1	V_2	V_0	V_1	V_2	V_0	V_1	V_2
Retail Sector									
Managers Area A	0.20	0.07	0.05	0.16	0.04	0.02	-0.04	-0.03	-0.03
Managers Area B	0.23	0.10	0.06	0.08	0.03	0.02	-0.15	-0.07	-0.04
Managers Area C	0.32	0.12	0.07	0.36	0.14	0.06	0.04	0.02	-0.01
Clerks Area A	0.35	0.14	0.07	0.42	0.15	0.08	0.07	0.01	0.01
Clerks Area B	0.36	0.14	0.08	0.56	0.22	0.12	0.20	0.08	0.04
Clerks Area C	0.51	0.27	0.18	0.56	0.25	0.14	0.05	-0.02	-0.04
Sales Assistant Area A	0.30	0.12	0.06	0.26	0.11	0.06	-0.04	-0.01	0.00
Sales Assistant Area B	1.00	0.62	0.47	0.51	0.31	0.21	-0.49*	-0.31	-0.26
Sales Assistant Area C	0.40	0.24	0.15	0.32	0.26	0.21	-0.08	0.02	0.06
Shop Assistant Area A	0.40	0.16	0.09	0.41	0.10	0.04	0.01	-0.06	-0.05
Shop Assistant Area B	0.45	0.21	0.13	0.53	0.22	0.12	0.08	0.01	-0.01
Shop Assistant Area C	0.67	0.39	0.26	0.54	0.23	0.13	-0.13	-0.16*	-0.13
Drivers Area A	0.24	0.10	0.05	0.17	0.04	0.02	-0.07	-0.06	-0.03
Drivers Area B	0.51	0.19	0.10	0.49	0.15	0.07	-0.02	-0.04	-0.03
Drivers Area C	0.78	0.26	0.13	0.23	0.11	0.06	-0.55	-0.15	-0.07
Forklift operators Area A	0.39	0.12	0.04	0.65	0.15	0.04	0.26	0.03	0.00
Total Retail Sector	**0.40**	**0.18**	**0.11**	**0.39**	**0.14**	**0.07**	**-0.01**	**-0.04**	**-0.04***
Domestic workers									
Area A	0.54	0.22	0.12	0.31	0.09	0.04	-0.23*	-0.13*	-0.08*
Area B & C	0.72	0.38	0.23	0.51	0.19	0.10	-0.21	-0.19*	-0.13*
Total Domestic Workers	**0.63**	**0.30**	**0.17**	**0.39**	**0.13**	**0.06**	**-0.24***	**-0.17***	**-0.11***
Farm Workers									
Area A	0.60	0.20	0.10	0.41	0.10	0.04	-0.19*	-0.10*	-0.06*
Area B & C	0.85	0.46	0.29	0.65	0.21	0.10	-0.20*	-0.25*	-0.19*
Total Farm Workers	**0.78**	**0.38**	**0.23**	**0.55**	**0.17**	**0.07**	**-0.23***	**-0.21***	**-0.16***
Forestry Workers	**0.55**	**0.25**	**0.15**	**0.53**	**0.16**	**0.07**	**-0.02**	**-0.09**	**-0.08**
Taxi workers									
Taxi operators Drivers	0.31	0.13	0.07	0.45	0.18	0.09	0.14	0.05	0.02
Taxi operators Fare collector	0.16	0.03	0.01	0.64	0.24	0.14	0.48*	0.21	0.13
Total Taxi operators	**0.29**	**0.12**	**0.06**	**0.47**	**0.18**	**0.09**	**0.18***	**0.06**	**0.03**
Security Workers									
Area 1	0.62	0.27	0.14	0.69	0.29	0.15	0.07	0.02	0.01
Area 2	0.58	0.28	0.15	0.50	0.23	0.14	-0.08	-0.05	-0.01
Area 3	0.69	0.27	0.14	0.10	0.08	0.07	-0.59*	-0.19	-0.07
Area 4	0.87	0.36	0.18	0.63	0.25	0.12	-0.24	-0.11	-0.06
Area 5	0.51	0.21	0.12	0.67	0.28	0.14	0.16*	0.07	0.02
Total Security workers	**0.58**	**0.25**	**0.13**	**0.67**	**0.28**	**0.14**	**0.09**	**0.03**	**0.01**
Hospitality Workers									
Hospitality small firms	0.51	0.25	0.15	0.37	0.16	0.09	-0.14	-0.09	-0.06
Hospitality med-large firms	0.35	0.13	0.06	0.25	0.08	0.04	-0.10	-0.05	-0.02
Total Hospitality Workers	**0.41**	**0.17**	**0.09**	**0.29**	**0.10**	**0.05**	**-0.12***	**-0.07***	**-0.04***
Contract cleaners									
Area 1	0.38	0.13	0.06	0.50	0.17	0.09	0.12	0.04	0.03
Area 2	0.65	0.27	0.14	0.52	0.19	0.10	-0.13	-0.08	-0.04
Area 3	0.27	0.11	0.06	0.35	0.13	0.07	0.08	0.02	0.01
Total Contract cleaners	**0.36**	**0.13**	**0.07**	**0.44**	**0.16**	**0.08**	**0.08**	**0.03**	**0.01**
Civil engineering	**0.02**	**0.00**	**0.00**	**0.09**	**0.04**	**0.02**	**0.07**	**0.04**	**0.02**
Total	**0.55**	**0.25**	**0.15**	**0.45**	**0.16**	**0.08**	**-0.10***	**-0.09***	**-0.07***

Source: Authors' calculations using LFS September 2007 (StatsSA) and ECC sectoral determinations.
Notes: * indicates that change between 2001 and 2007 was statistically significant at 5 %.

Further scrutiny of the results above reveals that, across the sectors, Security Workers are clearly the most violated cohort, and this holds under all three violation indices. 67 % of Security workers earn sub-minimum wages, which is the highest estimate amongst all sectors. On average, the estimated depth of violation measure, V_1, suggests that Security workers earned 25% below the minima in 2001, which worsened to 28% by 2007. This depth of violation is 7 times higher than that found amongst Civil Engineers, who record the lowest levels of violation.

In Table 2 below, the estimates for the three indices have been ranked, starting with the highest level of violation. For instance, a rank of 1 for Forklift Operators within area A in the Retail sector suggests that this is the most violated cohort within this sector in terms of the numbers of individuals earning sub-minimum wages. However, we observe a rank reversal between indices for some sectors. For example, in 2007 although Forklift Operators are the worse off in the Retail sector relative to other occupation groups, they are not the worst off cohort in terms of the shortfall of their wages from the minimum (only 15 %). In this respect, the worst off cohort in the Retail sector are Sales Assistants in Area B, who are the farthest away from the legal minima (31%).

Table 2: Rank of the Index of Violation, LFS September 2001- 2007

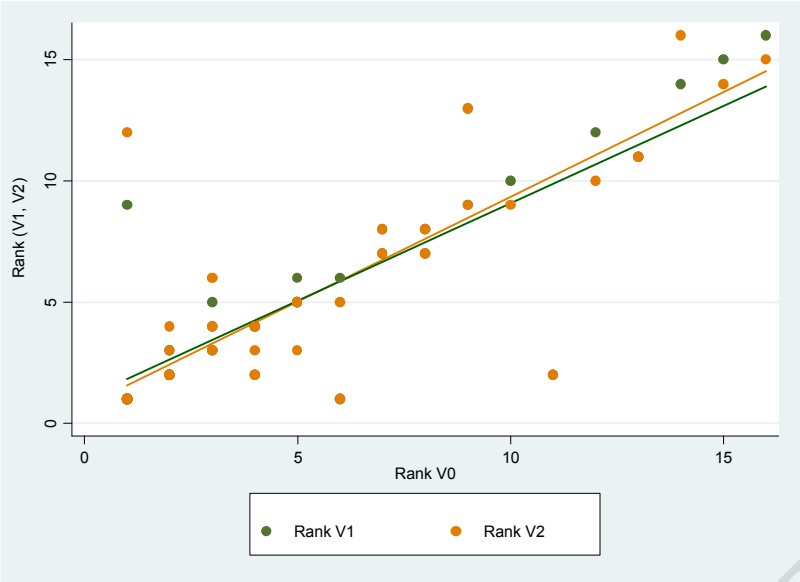
	2001			2007		
Sectoral Determination	**V_0**	**V_1**	**V_2**	**V_0**	**V_1**	**V_2**
Retail and Wholesale sector	6	5	5	6	6	5
Domestic Workers	2	2	2	7	7	7
Farm Workers	1	1	1	2	3	4
Forestry Workers	4	4	3	3	4	6
Taxi Operators	8	8	8	4	2	2
Security Workers	3	3	4	1	1	1
Hospitality Workers	5	6	6	8	8	8
Contract Cleaners	7	7	7	5	5	3
Civil engineering	9	9	9	9	9	9

Source: Authors' calculations using LFS September 2001 and 2007 (StatsSA) and ECC sectoral determinations.

The figure below shows the relationship between the ranks on the three indices for the different sectors, in order to shed some light on whether there is a relationship between the number of violated individuals in a sector and the degree of violation. The results below suggest

a linear relationship between the rank of the violation indices, (V_0; V_1), (V_0; V_2) and (V_1; V_2), barring a few outliers.

Figure 2: Relationship between rank of violation indices, 2007



Source: Authors' calculations using LFS September 2007 (StatsSA) and ECC sectoral determinations.

In order to ascertain the robustness of the three indices in measuring violation, notably V_0, V_1, and V_2, Spearman's rank correlation coefficients are estimated below to evaluate the degree to which these three measures of violation produce a similar ranking between sectors. The table below shows the rank correlation coefficients between the three indices. All correlation coefficients were significant at the 1 % level. A higher value for the rank correlation coefficient indicates that a stronger correlation was present between the ranks of the violation measures used.

Table 3: Spearman's Rank Order Correlation Coefficients between Violation Indices, 2001-2007

Index	Coefficient	
	2001	2007
V_0 and V_1	0.9699*	0.8071*
V_0 and V_2	0.9496*	0.7667*
V_1 and V_2	0.9909*	0.9865*

Source: Authors' calculations using LFS September 2001 and 2007 (StatsSA) and ECC sectoral determinations
Note: * indicates significance at 1%.

In both 2001 and 2007, the correlations between V_0, V_1, and V_2 are all very high, ranging from about 77% to 99%. Thus, the rankings of violation according to the three indices used are very similar in both years. However, it is worth noting that the correlation between V_0 and the

other two indices, namely (V_0; V_1), and (V_0; V_2), has declined significantly between 2001 and 2007.

The correlation coefficient between the V_0 and the V_1 index is lower than that between the V_0 and the V_2 index in both 2001 and 2007, suggesting that the headcount of violated individuals and the degree of violation may be more closely related than the share of violations is with the degree of violation squared. The lower correlation between these two indices may reflect the fact that the changes in them are driven by different underlying factors. On the other hand, the high correlation coefficients between the rankings of the depth of violation, V_1, and the squared depth of violation, V_2, (0.99 in both years) are an unsurprising result, recalling that the latter measure is simply the square of the former.

Another measure of relevance here is the Kaitz index, which provides a measure of the rigidity or 'toughness' of the minimum wage set (Andalón and Pagés, 2008). The Kaitz ratio is usually estimated as the ratio of the minimum wage, w_m, to the mean wage, $\overline{w}$. However, according to the literature (Andalón and Pagés, 2008) in countries with substantial levels of wage inequality, or if the minimum wage is suspected to influence the mean wage, it is preferable to use the median wage to estimate the Kaitz ratio instead of the mean. Following the literature, in the calculations here of the Kaitz index for South Africa, the median wage was used as the denominator. However, given that the minimum wage in South Africa is specific to sector, occupation, and location, another important question arises. It is unclear whether the Kaitz index should be calculated as the ratio of the minimum wage to the sector-occupation-location specific median wage, or instead estimated using the median wage for all salaried employment. According to Andalón and Pagés (2008), the latter measure is preferred from a methodological point of view since it serves to control for reverse causality. If , for instance, there is a higher share of informal employment or self-employment in total employment, a lower estimate may be obtained for the mean wage in a given sector-occupation-location category, thereby yielding a higher ratio of the minimum to mean wage, or in other words, a higher Kaitz estimate. Given this issue, two

types of measures of the Kaitz index are included in the analysis below. The first (K_1) is the ratio of the mean adjusted minimum wage (in the respective sector-occupation-location group) to the median wage in overall salaried employment, whilst the second measure (K_2) is the ratio of the mean minimum wage in that category relative to the median wage in each sector-occupation-location group. For the reasons noted above, the preferred index is the one estimated using the median for overall employment, namely K_1. A study by Levin-Waldman (1997) suggests that the minimum wage be set at the level of the median wage for the unskilled. Therefore, a third measure has been included, which provides the ratio of the minimum wage within each group to the median wage for unskilled workers (that is, Domestic workers and workers engaged in Elementary occupations).

Table 4 below presents estimates of the Kaitz ratio for South Africa for 2001 and 2007 by sector. The two specifications of the Kaitz index, K_1 and K_2, were approximated for each of the sectoral determinations by their respective sector-occupation-location categories. A summary of the Kaitz estimates for each sector is shown here, and the complete table is included in the appendix (Table A4). The indices have been ranked, starting from the highest value to the lowest. The ranks of the indices have been shown in parentheses in the table. For instance, the rank of the K_1 Kaitz index for the Security sector was 1 in both 2001 and 2007, reflecting that the Kaitz index for Security workers was the highest among all other sectors in both years.

The median wage for overall salaried employment was R1 600 in 2001 and R2 500 in 2007 respectively. In 2001, the K_1 Kaitz ratio for South Africa, estimated as the ratio of the mean minimum wage to the overall median wage, was 0.70, and subsided to 0.61 in 2007. Comparing the Kaitz estimates for South Africa with other developing countries indicates that these countries also yield high measures of the ratio of the minimum to the median wage. The Kaitz index for Kenya stood at 0.76 for general workers during 1998 to 1999 (Andalón and Pagés, 2008), while the Kaitz index in Columbia also found to be high at 0.68, with a number of

minimum wages in the more skilled occupations set at above two-thirds of the median (Maloney and Nuñez, 2003).

The K_2 Kaitz estimates have been estimated using the ratio of the minimum wage to the median in each sector-occupation-location group. For instance, an estimated Kaitz ratio of 0.55 for Retail Sector Managers in Area A in 2007 represents the ratio of the mean adjusted monthly minimum wage for Retail Sector Managers in Area A (R 3 826) to the median wage in that sector-occupation-location category (R7 000). Similarly, the Kaitz ratio for the Retail sector represents the ratio of the mean monthly adjusted minimum wage in the Retail sector to the median wage of salaried workers in the Retail sector. In 2007, the mean adjusted minimum wage for Retail sector works was R 2 304, while the median wage of covered workers in that sector was 2 500, yielding a Kaitz ratio of 0.92. Several sectors record a K_2 ratio of above 1 in both years, namely Farming, Forestry and Security. What is clear from the estimates below is that the ratio of the minimum wage to the median is quite high in South Africa in several sectors, irrespective of whether the overall median or the group-specific median is used.

Table 4: Estimates of the Kaitz Index, 2001 and 2007

Sectoral Determination	2001						2007					
	K_1 (w_M/ median salaried)		K_2 (w_M/ $w_{median\ group}$)		w_M/ median unskilled		K_1(w_M/ median salaried)		K_2 (w_M/ $w_{median\ group}$)		w_M/ median unskilled	
Retail	1.03	(2)	1.07	(5)	4.43	(2)	0.92	(2)	0.92	(5)	2.30	(2)
Domestic	0.40	(9)	1.60	(2)	1.57	(9)	0.33	(9)	0.96	(4)	0.82	(9)
Farm workers	0.53	(7)	1.87	(1)	2.06	(7)	0.43	(7)	1.13	(2)	1.07	(7)
Forestry	0.44	(8)	1.18	(4)	1.84	(8)	0.38	(8)	1.06	(3)	0.96	(8)
Taxi	0.72	(6)	0.76	(8)	3.37	(4)	0.70	(4)	0.88	(7)	1.75	(4)
Security	1.18	(1)	1.26	(3)	5.12	(1)	1.06	(1)	1.40	(1)	2.66	(1)
Hospitality	0.72	(5)	0.96	(6)	2.79	(6)	0.58	(6)	0.73	(8)	1.45	(6)
Contract cleaning	0.75	(4)	0.81	(7)	3.03	(5)	0.63	(5)	0.91	(6)	1.57	(5)
Civil engineering	0.99	(3)	0.26	(9)	3.94	(3)	0.82	(3)	0.22	(9)	2.05	(3)
Total	**0.70**	...	**1.48**	...	**2.93**	...	**0.61**	...	**1.17**	...	**1.52**	...

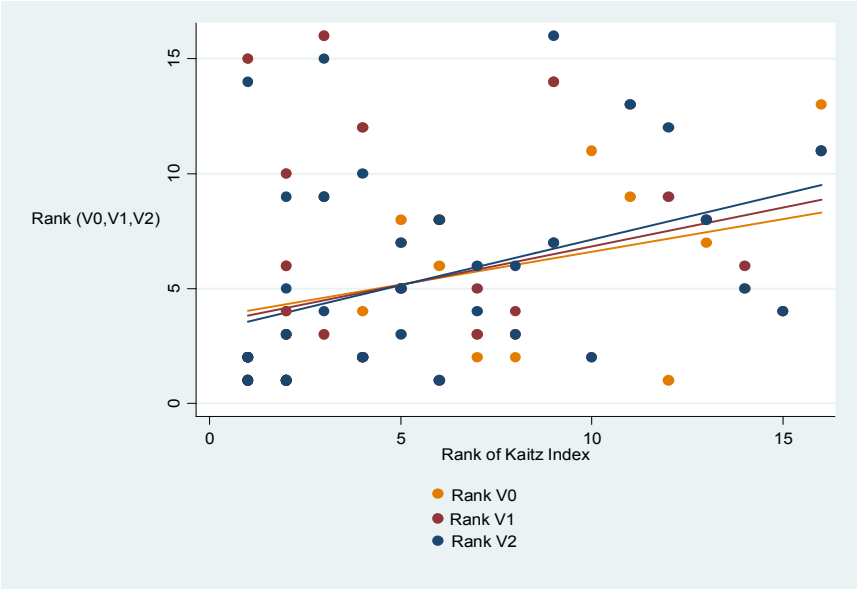
Source: Authors' calculations using LFS September 2001 and 2007 (StatsSA) and ECC sectoral determinations.
Notes: 1. The Kaitz ratio is computed as the ratio of the mean adjusted minimum wage in each sector-occupation-location cell to the median wage of all salaried workers (that is, excluding self-employed workers). The ratio of the minimum wage to the group median is the ratio of the minimum wage by sector, occupation, and location to the median wage in each sector-occupation-location category.
2. Unskilled workers include Elementary workers and Domestic workers.
3. All estimates are for the weighted sample.
4. Ranks are shown in parentheses.

Comparison of the estimates for the K_1 and the K_2 Kaitz indices uncovers two interesting trends. Firstly, using the overall median wage to estimate the Kaitz index, that is K_1, yields lower estimates of the toughness of the minima set than when the group-specific median is employed (K_2). In both years, the K_1 estimates are lower than those for K_2, barring the estimates for the Civil Engineering sector, which yields a substantially larger K_1 estimate than K_2 in both years, and the Retail sector, for which identical estimates for K_1 and K_2 in 2007 (0.92) are obtained. The second trend to be noted is that there seems to be a decline in the estimated Kaitz ratios between 2001 and 2007 in all sectors, with the exception of the 2007 K_2 estimates for the Taxi, Security and Contract Cleaning sectors, which increased during this period.

The results from the third measure included in the table, that is, the ratio of the minimim wage to the median wage for the unskilled, are also interesting. This ratio is generally above 1 in both years, signifying that the minimum wage in South Africa is set very high relative to the median wage for unskilled employment. For instance, in 2001 the minimum for Retail Sector workers was more than four times higher than the median for the unskilled. By 2007, although this ratio had declined, it remained high, the minimum wage within this sector standing at more than double the median for the unskilled. Compared with the Kaitz measures, K_1 and K_2, The ratio of the minimum to the median of the unskilled is generally higher. Whilst the gap between the sectoral minima and wages in unskilled employment became smaller across all sectors during the 2001 and 2007 interval, they still remained high.

A graph of the rank of the K_1 index, which is the preferred measure of here, versus the ranks of the violation measures (V_0, V_1, and V_2) confirms the positive association between the rigidity of the minimum wage and violation.

Figure 3: Relationship between Ranks of Violation indices and Kaitz index



Source: Authors' calculations using LFS September 2001 and 2007 (StatsSA) and ECC sectoral determinations.
Notes: The Kaitz index here is the Kaitz 1 index estimated using the median of overall salaried employment.

In order to investigate whether there is indeed a correlation between the size of the violation indices (V_0, V_1, and V_2) and the level at which the minimum wage is set relative to the median wage (the Kaitz index), Spearman's rank order correlation coefficients between the ranks of the two Kaitz measures presented above and the three violation indices were estimated. The correlations between the ranks of the Kaitz measures, K_1 and K_2, were positive and significant at 1% in both years (0.45 and 0.46 in 2001 and 2007 respectively). The significant rank correlation coefficients for the two indices suggest that they are both robust measures for the ratio of the Kaitz index since there are similarities in the rankings of the sectors under the two indices. Table 5 overleaf presents estimates of the rank order correlation coefficients between the Kaitz index measures (K_1 and K_2) and the violation indices (V_0, V_1, and V_2) respectively. All estimated correlation coefficients were statistically significant at either the 1% or 5% level, suggesting that there is a significant relationship between the ranks of the Kaitz measures and those of the indices of violation.

Table 5: Spearman's Rank Order Correlation between Kaitz index and Violation Indices, 2001-2007				
	Coefficient Kaitz 1 (w_M/median salaried)		Coefficient Kaitz 2 ($w_M/w_{median\ group}$)	
	2001	2007	2001	2007
V_0 and Kaitz	0.3786**	0.4408*	0.9183*	0.8897*
V_1 and Kaitz	0.3851**	0.4905*	0.9168*	0.8939*
V_2 and Kaitz	0.3959**	0.5231*	0.8837*	0.8677*

Source: Authors' calculations using LFS September 2001 and 2007 (StatsSA) and ECC sectoral determinations.
Note: * indicates statistical significance at 1*, ** indicates statistical significance at 5%, *** indicates statistical significance at 10%.

As seen in the estimates above, the rank correlation coefficients between the K_2 index and the violation indices are very high. For instance, the 2007 estimate of the rank correlation between V_0 and K_2 is 89%, suggesting that the sectoral rankings according to the K_2 index are very similar to the rankings according to the violation index V_0. An interesting trend in the data is that there seems to be a slight increase in the correlation coefficients between the violation indices and the first Kaitz index, K_1, between 2001 and 2007, whilst the correlation coefficients between the measures of violation and the K_2 index decreased during this period. On the basis of this result then, one can infer that the similarity in rankings according to the K_1 index and the violation indices became more similar between 2001 and 2007, while the correlation between the K_2 index and the violation measures decreased. This provides some support for the choice of the K_1 index as the preferred specification of the Kaitz index in terms of explaining violation.

In summary, the rank correlation coefficients above suggest a significant correlation between the level, depth, and severity of non-compliance (as measured by V_0, V_1, and V_2 respectively) and the level of the minimum wage relative to the median wage within the sector-occupation-location categories. The sign of the coefficients reflect a positive relationship between ranks of the level of the sectoral determination (that is, the minimum wage, w_m) relative to the median wage, and violation (non-compliance). This result is consistent with the conclusions of the Andalón and Pagés (2008) study discussed earlier in the literature review, specifically that the Kaitz index (essentially, the rigidity of the minima set) is positively correlated with non-compliance.

So far, the analysis has concentrated on providing a descriptive overview of the sectoral minima in South Africa, and some key measures associated with violation. The discussion now turns, in the following section, towards an econometric investigation of the various determinants of violation in South African labour market, and attempts to isolate their simultaneous impact on violation.

IV b: The Determinants of Violation in South Africa

For the analysis of the determinants of individual violation, we first use a probit[14] model to investigate the determinants of the probability of an individual being violated, or in other words, receiving a wage below the stipulated minimum. The probit model is used to determine whether these factors do indeed change the likelihood of an individual being paid a wage below the minimum, as well as to quantify the marginal effects of the variables. Here, the dependent variable V_0 is a categorical variable, taking on a value of 1 if the individual's wage is below their respective minimum or 0 if their wage is at or above the minimum. The violation probit is estimated for the full sample of employed individuals (excluding the self-employed since they pay their own wages) who are covered by the DoL sectoral determinations. Next, for the reduced sample of violated individuals (V_0=1) only, the determinants of the depth of violation (as measured by V_1) are estimated by means of OLS regression[15]. Hence V_1 was estimated for each individual and used as the dependent variable in the regression[16].

[14] A probit model estimates the factors that influence the probability that an event A may occur, where $0 \leq P(A) \leq 1$. The equation we wish to estimate takes on the following form:

$$\Pr(Y = 1 \mid X = x) = \phi(x'\beta)$$

where Y is the binary dependent variable V_0 equal to 1 for violated individuals earning wages below the statutory minimum and 0 for their non-violated counterparts, X is a vector of explanatory variables, β are the parameters to be estimated, and ϕ is the standard normal cumulative distribution function (McCullagh and Nelder, 1989).

[15] The OLS equation for the depth of violation V_1 takes on the generic form:

$Y_i = a + b\,X_i + u_i$

where the Y_i refers to the measure of violation V_1 for the worker *i* as being a function of the *kx1* vector, ***X*** of relevant explanatory variables of violation, while *b* is the *1xk* vector of parameters. The disturbance term and the constant are captured by *ui* and *a* respectively. The OLS method is used to estimate the mean effect of the various explanatory variables on the dependent variable V_1 (Cassella & Berger, 2002).

[16] V_1 was measured as the individual wage gap using the following formula:
$(w^M - w_i)/w^M$ where w^M is the minimum wage for the individual and w_i is the individual's wage.

A variety of explanatory variables were included in the analysis such as demographic, firm-level, contractual, and spatial/geographic characteristics. One interesting innovation in this paper is to provide a set of spatial and density variables to proxy for the probability of an employer being 'enforced' upon. Initially, a number of spatial level variables were constructed and investigated, which were then narrowed down to a preferred specification. Some of the relevant variables constructed in this context included workers per square kilometre (the ratio of the number of employed in the district council to the area of the district council in square kilometres[17]), the unemployment rate in the district council, the number of labour inspectors weighted by the proportion of employed in the district council, employment density (the ratio of the number of employed in the district council to the population of the DC), and the unemployment ratio (the ratio of the number of unemployed to the population in the DC[18]). Due to some of these spatial variables being correlated with each other, only s subset of these variables was included in the probit equations. The spatial variables that were eventually selected to be included in the analysis were the log of the workers per square kilometre, the log of the inspectors per DC weighted, and the unemployment rate in the district council.

In order to investigate whether the results obtained from the OLS regression analysis hold not only at the mean, but also across the entire distribution of violated individuals, a quantile regression approach is next employed. The results from this analysis will enable us to examine whether the determinants of violation differ depending on whether the depth of violation is high or low. The approach for generating 'regression quantiles' was first introduced by Bassett and Koenker (1978). They proposed the least absolute error (LAE) as a more efficient measure than the least squares estimator in any linear model for which the median is a superior measure than the mean as an estimator of location (Basset and Koenker, 1978). The θth regression quantile,

[17] The area of each district council was available from the website of the Municipal Demarcation Board of South Africa. <www.demarcation.org.za>.

[18] Note the distinction between the unemployment rate and the unemployment ratio. The unemployment ratio measures the share of the population in the DC who is unemployed, while the unemployment rate is the share of the labour force (working age individuals only) that is unemployed in the DC.

where θ ranges from 0 to 1, may be obtained by solving the minimization problem of the LAE estimator as follows:

$$min_{b \in R^K} \left[\sum_{t \in \{t: y_t \geq x_t b\}} \theta |y_t - x_t b| + \sum_{t \in \{t: y_t < x_t b\}} (1-\theta) |y_t - x_t b| \right]$$

where $\{y_t : t = 1, \dots, T\}$ is a sample of random variables on the regression $\mu_t = y_t - x_t \beta$, with a distribution function F, $\{x_t : t = 1, \dots, T\}$ is a set of K-vectors, and b are the regression parameters. When $\theta = 0.5$, the solution to the minimization problem of the LAE estimator is that for the median quantile (Koenker and Bassett, 1978; Koenker and Hallock, 2001).

The regression results are now discussed. The estimation of the violation probit started with the full sample of employed[19] salaried workers whom are covered by the ECC sectoral determinations. Next, in the OLS regression on the determinants of the depth of violation, V_1, the sample was reduced to cover only violated workers, that is, workers for whom $V = 1$. The violation probit excludes the self-employed and wage earners not covered by the ECC minimum wages, whilst the OLS regression of on the depth of violation exclude those wage earners whose wages are at or above the statutory minimum. Hence, the estimates derived by the violation probit and the depth of violation function may be biased due to the fact that they are both based on non-random, truncated versions of the original sample of covered workers (Bhorat and Liebbrant, 2001). Thus, in all versions of our modelling, the Heckman two-step approach was used to control for the possible presence of a sample selection bias[20] (Bhorat and Liebbrant, 2001).

[19] The working age population was assumed as 15 to 65 years old. The broad definition of employment was used, that is, including discouraged workseekers.

[20] After the violated probit was estimated, the estimates were used to derive an estimate for the inverse Mills ratio (lambda) to be included in the OLS and quantile regressions on V_1 and V_2. The derived depth of violation function is therefore conditional on the individual characteristics of the employed receiving wages below the minimum as well as conditional on the fact that these earners are a subsample of all employed covered by minimum wage legislation.

Results

For the covariates which are dummy variables, the following are the referent variables:

Race: African

Age: 16-24 years

Area type A: other area type (B, C, D, or E)

Sectoral determination: Domestic workers

Union status: Non-union member

Firm size: Large firms

Contract: Non-written, non-permanent

Sector: Informal, non-public.

The key results for the violation probit, and the OLS and quantile regressions on V_1 for 2007 are presented in Tables 5 through 7 below.

Table 5 below presents the results from the probit on individual violation. Four specifications are shown. Due to the presence of collinearity between some of the provincial dummies and the spatial density variables (which are measured for each of the district councils within a province, and are hence correlated with some of the provincial dummy variables), the provincial dummies and the spatial density variables could not be included in the specifications at the same time. In Specification I, only the provincial dummies are included while the spatial density variables were omitted. In the second specification, the individual characteristics (race, gender, age, education) were excluded while the spatial/density variables were included. In Specification III, individual characteristics as well as the spatial density variables, while the provincial dummies have been left out. This is our preferred specification, since it contains a full range of spatial density variables and individual characteristics, and yields a relatively high goodness of fit. In Specification IV, the covariates were chosen using a stepwise regression

model[21]. It is worth noting here, however, that while the stepwise regression technique is useful in obtaining an additional specification of the model, the results must be treated with caution. The stepwise regression approach has been much criticized in the literature as resulting in biased estimates of regression coefficients, as well as underestimating the variability of the regression coefficients in the final model (Steyerberg, Eijkemans, and Habbema, 1999). Furthermore, in small datasets, stepwise regression has been shown to leave out important variables (Steyerberg, Eijkemans, and Habbema, 1999). Therefore, although the results from the stepwise estimation are included here in Specification IV, it is not the preferred specification (The preferred specification is the third specification in which a full range of spatial density covariates are included).

A preliminary analysis of the results in Table 5 suggests that there are a wide range of variables impacting on the probability of violation, such as individual, sectoral, enterprise, contractual and spatial characteristics. Specification III is our preferred specification, and explains 16.46% of the variation in the dependent variable.

[21] Stepwise selection is a method allowing for the selection of independent variables for inclusion in a regression model. One type of stepwise selection is forward selection which starts by assuming a regression model with only one explanatory variable, X_1:

$y = \beta_1 X_1 + e$

where y is the dependent variable, β_1 is the coefficient of the explanatory variable X_1, and e is the error term. The hypothesis that $\beta_1 = 0$ is then tested by means of an F-test, where the F-statistic is denoted by:

$F_s = \frac{SS_1}{(SST - SSR_q/(n-q))}$

where $SSR_q$is the total regression sum of squares due to q variables at the qth step in the stepwise process, and $SS_1 = SSR_q - SSR_{q-1}$ is the 'additional' regression sums of squares due to the qth variable. If the F_s value is significant at the selected level of significance, the qth variable is included in the regression equation, and the hypothesis that the coefficient of the qth variable in the regression is zero is rejected. Each time a new variable is inserted into the model, the F-statistic is re-estimated for all the variables in the model, and any variable that leads to an insignificant F-statistic is removed. When an F-statistic testing for the inclusion of a new variable is insignificant, the process ends and that variable and all subsequent variables are omitted form the model. Backward selection is a second type of stepwise regression. It employs a similar technique except that the number of variables included in the model starts with the full set, k, at the first step. Variables are removed if they yield insignificant F-statistics, until the last variable is reached (Thompson, 1978). The stepwise procedure employed here used both backward and forward selection, and identical results were obtained under both methods.

Table 5: Results from violation probit, 2007

Dependent variable: Probability of being violated			Specifications I		II		III		IV	
		Variables	M. effect	x-bar	M. effect	x-bar	M. effect	x-bar	M. effect	x-bar
Individual	Race	White	-0.357*	0.054	...	...	-0.356*	0.054	-0.510*	0.054
		Coloured	-0.070**	0.123	...	...	-0.065**	0.123	-0.051	0.123
		Asian	-0.141	0.023	...	...	-0.141	0.023	-0.152	0.023
		Female	0.138*	0.494	...	...	0.136*	0.494	0.136*	0.494
	Education	Speaks English	-0.194**	0.062	...	...	-0.199**	0.062	-0.219*	0.062
		Can read	-0.247**	0.886	...	...	-0.243**	0.886	...	...
		Can write	0.145	0.885	...	...	0.148	0.885	...	...
		None-Grade 8	-0.011	6.580	...	...	-0.011	6.580	-0.020*	6.580
		Grade 9-11	-0.006	1.444	...	...	-0.007	1.444	-0.003	1.444
		Grade 12	-0.075	0.285	...	...	-0.075	0.285	-0.078	0.285
		Diploma	-0.173*	0.042	...	...	-0.175*	0.042	-0.192**	0.042
		Degree	-0.069	0.014	...	...	-0.057	0.014	-0.056	0.014
	Age	25-34 years	0.026	0.352	...	...	0.027	0.352	0.026	0.352
		35-44 yrs	-0.055	0.267	...	...	-0.054	0.267	-0.056	0.267
		45-54 years	-0.116*	0.203	...	...	-0.113*	0.203	-0.115*	0.203
		55-65 years	-0.064	0.093	...	...	-0.060	0.093	-0.060	0.093
Sectoral		Farm workers	0.263*	0.151	0.212*	0.150	0.262*	0.151	0.235*	0.151
		Retail Sector	0.284*	0.199	0.080	0.199	0.288*	0.199	0.256*	0.199
		Forestry	0.240*	0.015	0.168*	0.015	0.230*	0.015	0.201*	0.015
		Taxi Sector	0.260*	0.044	0.090	0.044	0.260*	0.044	0.232*	0.044
		Private Security	0.542*	0.091	0.426*	0.091	0.542*	0.091	0.585*	0.091
		Hospitality Sector	0.089	0.067	-0.027	0.066	0.089	0.067	0.062	0.067
		Contract Cleaning	0.275*	0.142	0.221*	0.142	0.278*	0.142	0.248*	0.142
		Civil Eng.	0.156	0.005	-0.154	0.005	0.162	0.005	0.135	0.005
Firm/Contractual		Union Workers	-0.119*	0.218	-0.122*	0.218	-0.119*	0.218	-0.123*	0.218
		Written Contract	-0.150*	0.653	-0.149*	0.653	-0.153*	0.653	-0.142*	0.653
		Permanent/Fixed	0.030	0.775	0.010	0.775	0.030	0.775	...	...
		Tenure (logged)	-0.043*	1.448	-0.055*	1.450	-0.044*	1.448	-0.042*	1.448
		Formal	-0.023	0.578	-0.021	0.578	-0.021	0.578	...	...
		Semi Formal	-0.006	0.657	-0.015	0.656	-0.010	0.657	...	...
		Small firms	0.074**	0.255	0.089*	0.255	0.075**	0.255	0.076*	0.255
		Medium Firms	0.148*	0.147	0.147*	0.146	0.149*	0.147	0.147*	0.147
		Medium-Large	0.042	0.158	0.043	0.158	0.040	0.158	0.039	0.158
		Public sector/SOE	-0.193*	0.066	-0.187*	0.066	-0.190*	0.066	-0.193*	0.066
Spatial	Geographic	Area A	0.009	0.732	-0.012	0.732	0.015	0.732	...	...
		Western Cape	-0.058	0.137		...	...	...	...	...
		Eastern Cape	0.171*	0.092		...	...	...	...	...
		Northern Cape	0.114**	0.029		...	...	...	...	...
		Free State	0.163*	0.071		...	...	...	...	...
		KwaZulu Natal	0.121*	0.179		...	...	...	...	...
		North West	0.134*	0.067		...	...	...	...	...
		Mpumalanga	0.055	0.081		...	...	...	...	...
		Limpopo	0.249*	0.075		...	...	...	...	...
	Density	Workers/km^2	...	...	0.001	3.290	-0.007	3.289	...	...
		Inspectors	...	...	-0.041*	4.895	-0.032*	4.896	-0.035*	4.896
		Unemployment	...	...	0.737*	0.379	0.664*	0.379	0.685*	0.379
Observed probability			0.416		0.416		0.416		0.255	
Predicted probability (x-bar)			0.386		0.405		0.386		0.157	
Number observed			6934		6968		6934		6934	
Chi-squared			555.45*		348.55*		547.6*		504.85*	
Pseudo R-squared			0.1661		0.1026		0.1646		0.1631	

Source: Own calculations using LFS September 2007, StatsSA.

Notes: * Significant at the 1% level ** Significant at the 1% level*** Significant at the 1% level. Robust standard errors used. Specification IV is a Stepwise regression using backward selection. Significance level for removal from the model was set at 0.2. The regressions were repeated using forward selection. However, the results obtained were the same as when the backward selection method was used.

Since one of the key novelties in this analysis is the construction of the set of spatial/ density variables we will discuss the results from these variables first. The first spatial variable was a dummy variable for workers in areas that fell under 'A' type areas. As noted earlier, these areas are generally non-rural and are specific to the various sectoral determinations. The Area A dummy variable was included in all specifications (barring the stepwise regression where the variable is dropped during the backward selection process). This variable was however, not found to be statistically significant in any of the specifications at the 10% level, suggesting that living in an area classified as an 'A' area as opposed to a less urban area did not significantly alter the probability of a wage earner being violated in 2007. The remaining spatial/density variables were included in specifications II, III and IV[22], namely the log of workers per square kilometre by district council[23], the number of inspectors per district council (logged)[24], weighted by the proportion of the employed in that area, and the unemployment rate in the district council. These density variables are preferred to the provincial dummy variables since they are more specific and provide information by district council, which is the smallest area unit provided by the 2007 LFS. The results show that while the employment density, as captured by the log of the number of workers per square kilometre, was not a significant determinant of the probability of individual violation, the density of inspectors and the unemployment rate in the district council were significant at the 1% level. In all three specifications, namely specifications II, III, and IV, the results from the inspector density variable are negative and statistically significant at the 1% level. This is a powerful result, suggesting that the intensity of enforcement, as proxied for by the number of inspectors in an area, is a key predictor of whether an employer will violate minimum wage regulations or not. A larger presence of inspectors in an area possibly acts as a deterrent to

[22] The log of workers per square kilometre however, gets dropped out during the selection process in the stepwise regression estimation procedure.

[23] The area by district council was available from the website of the Municipal Demarcation Board of South Africa. Available from: http://www.demarcation.org.za.

[24] Estimates for the number of labour inspectors by province for 2009 were obtained from the DoL. In order to control for the size of provinces, the mean number of inspectors per district council was estimated by taking the average of the number of labour inspectors over the number of district councils in the respective province.

employers considering violating the minimum wage, given the larger probability of being caught and penalized. This result has important implications for policy makers wishing to increase compliance with minimum wage legislation. The unemployment rate was also found to be a significant determinant of the probability of an individual being violated by their employer. The coefficient for the unemployment rate in the district council was positive and highly significant (1% level of significance) in all the specifications where included, indicating that a higher unemployment rate in the district council results in a larger probability of violation. This finding is consistent with the Ronconi (2008) paper, which found unemployment to be positively correlated with noncompliance in Argentina. This result can be understood if we think of a larger number of unemployed in an area as resulting in a higher probability of workers willing to work for sub-minimum wages, and in turn a higher likelihood that employers will violate the statutory minima, knowing that surplus labour is will be supplied at sub-minimum rates.

The second innovation in this analysis is the inclusion of a number of enterprise-specific characteristics, as well as characteristics of the type of employment contract. These characteristics were included in all three specifications. In all four specifications, the coefficients for small and medium-sized firms are positive and statistically significant. The results show that the size of an enterprise[25] is a key predictor of the probability of individual violation. Employees in small and medium-sized enterprises (less than 20 workers) were more likely to be violated than those in large firms with 50 employees or more. In other words, according to the results, employers in larger firms are more likely to be enforced upon. Or rather, given their visibility, employers in large enterprises are less likely to want to engage in practices which violate the minimum wage. Another possibility is that large firms are more likely to be unionized than smaller firms. A dummy variable was included equal to 1 if a worker was part of a union, and equal to 0 for non-union members. As expected, the coefficient was negative and statistically

[25] Small firms are those with less than 9 employees, medium firms are those with less than 19 employees, medium-large firms refers to enterprises with less than 50 employees, and large firms are those with 50 employees or more. The self-employed were excluded.

significant in all four specifications, suggesting that union workers are less likely to be violated by employers than their counterparts who are not part of a union. The key result here, however, is that large firms are less likely to violate even when controlling for the unionization of workers.

Formal firms were defined as those who were registered and paid VAT, semi-formal firms were defined as those that met one of the above criteria, while informal firms were defined as those that neither reported themselves as registered nor as paying VAT. However, the formal and semi-formal coefficients were not found to be statistically significant at 10 % in any of the specifications in which they were included. In the stepwise regression, these variables were dropped out by the backward selection technique. While the degree of formality of a firm does not seem to impact on whether or not employees are paid sub-minimum wages, whether a firm is located in the public sector or the private sector is a key determinant. Individuals employed in public sector firms or in State owned enterprises (SOEs) were significantly less likely to be violated than those employed in the non-public sector, as evidenced by the negative and significant coefficient for the public sector dummy in all four specifications.

In all four specifications, the dummy variable for a written contract yields a negative and statistically significant coefficient. Employees with a written contract are less likely to be violated than those with no contract or an informal contract. The dummy variable for a permanent/fixed period contract, however, was not statistically significant in any of the specifications, suggesting that individuals possessing a permanent or fixed period contract have the same likelihood of being violated as temporary, casual or seasonal workers. However, the duration of employment is a significant predictor of the probability of being violated. The tenure variable was derived using information in the LFS on the year the individual started working with the current employer. The variable was estimated as the log of the number of years of employment with the present employer. This coefficient was significant and negative in all specifications, indicating that a longer tenure is associated with a significantly lower probability of being violated.

The individual characteristics included in Specifications I and III of the analysis were race, gender, age, ability to read and write, English as the home language, and education. From the results, it is clear that both race and gender are highly significant in determining whether or not an individual is violated and is paid a wage below his/her stipulated minima. The dummy variables for Whites and Coloureds have coefficients that are significant and negative, suggesting that these population groups have a lower probability of being violated than their African counterparts, controlling for spatial and sectoral characteristics. The coefficient for the dummy variable for females was positive and significant, suggesting that female workers are more likely to be violated than their male counterparts.

The coefficients for the age variables are generally not statistically significant, barring the 45-54 years old age group, which has a lower probability of being violated relative to those in the 15 to 25 years old referent group.

The results indicate that the literacy variables are important predictors of minimum wage violation. Individuals who can read and who speak English as a home language are less likely to be paid wages that fall below the stipulated minima. Examining the results from the educational splines however, we note that only the coefficient for Diploma is statistically significant. The coefficient is negative, suggesting that possession of a Diploma as opposed to a Matric education or lower reduces the likelihood of an individual being violated.

From these results, it is clear that individual characteristics play an important role in determining the likelihood of an individual being violated by an employer. The addition of individual variables to specification II in the third specification increases the value of R-squared from 0.1026 to 0.1646. Hence, the goodness of fit of the model increases by 6.2%, evidencing the importance of individual variables in explaining violation.

The results for the sectoral dummies are interesting. Barring the Hospitality sector and Civil Engineering, all coefficients were positive and statistically significant at 1%. This suggests that

workers employed in the Farm worker, Retail, Forestry, Taxi, Security, and Contract Cleaning sectors all had a lower probability of being violated. This result may seem surprising, given that the Domestic worker sector is generally deemed to be among the more vulnerable sectors, and may be a reflection of the larger presence of enforcement measures or labour inspectors in the Domestic worker sector.

Due to collinearity, either provincial dummy variables or the density variables were included in a particular specification, but not both. The first specification includes the provincial dummy variables, whilst leaving out the density variables. The referent province was Gauteng. Barring Mpumalanga and the Western Cape, the coefficients for all the provinces were positive and significant at 1%. Hence, relative to individuals employed in Gauteng, those in other provinces were more likely to experience non-compliance by employers.

Having investigated the determinants of the probability of individual violation, we now turn to an analysis of the factors that influence the depth of this violation. Table 6 shows the results from the OLS regressions on V_1 for the same specifications as above. The lambda derived from the violation probit was included in the specifications (barring specification IV, where the lambda was dropped during the process of backward selection of the stepwise function). The lambda coefficient was statistically significant in Specification II at 5 %, suggesting that selection bias was present, which was corrected for. However, for the other two specifications (I and III) there was no apparent selection bias and the coefficient was insignificant.

From the results in Table 6, we firstly note that although demographic characteristics were important in determining the probability of violation, they do not seem to be important in predicting the size of this violation. Put differently, while race and gender play a significant role in determining whether an individual is violated or not, they are irrelevant in determining the extent and degree of this violation (as measured by V_1 and V_2 respectively). The coefficients for race and gender were statistically insignificant in all the specifications where they were included.

The results suggest that the depth of violation seems to be driven more by sectoral, enterprise, contractual and spatial characteristics rather than demographic characteristics.

Table 6: Results from regression on V_1

	Dependent variable: V_1		Specifications			
	Variables		I	II	III	IV
Individual	Race	White	-0.1897	...	-0.0005	...
		Coloured	-0.0128	...	0.0158	...
		Asian	0.0464	...	0.0786	...
	Gender	Female	0.0346	...	-0.0078	...
	Literacy	Speaks English	-0.1850**	...	-0.1040**	-0.0686**
		Can read	-0.0493	...	0.0169	0.0136
		Can write	-0.0575	...	-0.0914	-0.0884
	Education splines	None-Grade 8	0.0021	...	0.0048	0.0050
		Grade 9-11	-0.0310*	...	-0.0297*	-0.0294*
		Grade 12	0.0203	...	0.0418	0.0392
		Diploma	-0.1489**	...	-0.0816**	-0.0799*
		Degree	0.0025	...	0.0405	0.0423
Sectoral	Age	25-34 years	-0.0892*	...	-0.0937*	-0.0946*
		35-44 yrs	-0.0789**	...	-0.0604**	-0.0598**
		45-54 years	-0.0898**	...	-0.0491	-0.0495
		55-65 years	-0.0518	...	-0.0247	-0.0249
		Farm workers	0.1547**	0.1004*	0.0771*	0.0793*
		Retail Sector	0.2733*	0.1733*	0.1933*	0.1934*
		Forestry	0.1279***	0.0922**	0.0571	0.0561
		Taxi Sector	0.2374*	0.1418*	0.1633*	0.1727*
		Private Security	0.4381*	0.2421*	0.2622*	0.2677*
		Hospitality Sector	0.1886*	0.1484*	0.1662*	0.1643*
		Contract Cleaning	0.2564*	0.1855*	0.1768*	0.1774*
		Civil Engineering	0.3993*	0.2776*	0.3620*	0.3728*
Firm/Contractual		Union Workers	-0.0722**	-0.0387**	-0.0338***	-0.0335***
		Written Contract	-0.0881**	-0.0423**	-0.0452**	-0.0470*
		Permanent	-0.0244	-0.0477**	-0.0319***	-0.0320***
		Tenure (logged)	-0.0368*	-0.0118	-0.0239*	-0.0234*
		Formal	-0.0393**	-0.0385**	-0.0323***	-0.0345***
		Semi Formal	-0.0755*	-0.0786*	-0.0755*	-0.0773*
		Small firms	0.0231	0.0026	0.0030	...
		Medium Firms	0.0232	-0.0177	-0.0181	...
		Medium-Large firms	-0.0009	-0.0107	-0.0133	...
		Public sector	-0.0624	0.0165	0.0072	...
Spatial	Geographic	Area A	-0.0276**	-0.0226***	-0.0252**	-0.0241**
		Western Cape	-0.0199**	...	...	...
		Eastern Cape	0.1043	...	...	...
		Northern Cape	-0.0098**	...	...	...
		Free State	0.0968	...	...	...
		KwaZulu Natal	0.0437**	...	...	...
		North West	0.0627	...	...	...
		Mpumalanga	0.0345	...	...	...
		Limpopo	0.1248***	...	...	...
	Density	Log workers/sq km	...	-0.0018	0.0020	...
		Inspectors	...	-0.0178**	-0.0118***	-0.0119***
		Unemployment	...	0.1624**	0.1689**	0.1497**
Lambda			0.1902	-0.000003**	0.00001	...
Constant			0.3347**	0.4095*	0.4969*	0.5051*
Number observed			2994	3004	2994	2994
F-statistic			8.25*	18.02*	8.37*	10.7*
Adjusted R-squared			0.1656	0.1090	0.1591	0.1570

Source: Own calculations using LFS September 2007, StatsSA.

Notes: * Significant at the 1% level** Significant at the 1% level*** Significant at the 1% level.
Robust standard errors used.

The results above for the first set of covariates, the individual characteristics, show firstly that the race and gender effect observed in determining the probability of violation disappear when analysing the depth of this violation. The English as a home language variable however retains its significance in all the specifications. The negative and significant coefficient shows that individuals who speak English as a home language whom are violated by their employers experience a violation between 6.9 and 18.5 % lower than non-English speakers. The coefficients for the literacy variables (ability to read and write) were not found to be statistically significant in any of the specifications. Education, however, is an important determinant of the depth of violation experienced. The coefficients for the splines for Grades 9-11 and Diploma were significant and negative. Hence, individuals whom have competed Grades 9 to 11 experience a violation approximately 3 % smaller than their lesser educated counterparts with less than Grade 9 education. Violated individuals with a Diploma qualification are between 8 and 14.9% closer to their respective minima than those possessing only a Matric qualification.

The coefficients for the various age groups indicate that there is a youth bias among violating employers. Individuals in the 25-34 years and 35-44 years cohorts experience a lower depth of violation than individuals aged between 15 and 24, as evidenced by the negative and significant coefficients for the first two age splines in all four specifications. In specification I, the coefficient of the 45-54 years age group was also significant and negative. Hence, there is a clear age effect in determining the depth of violation of an individual, with younger individuals worse off than their older counterparts.

The results for the sectoral dummies were all significant and positive in the four specifications, with the exception of the coefficient for Forestry workers in Specifications III and IV that was insignificant. Hence, relative to Domestic Workers, violated workers in all sectors covered by ECC minimum wage legislation experience a higher depth of violation, that is, their wages lie farther below their respective minima.

Union workers have a significantly lower depth of violation than non-union workers, as suggested by the negative and significant coefficient for union workers in all specifications. Examining the contractual variables, we note that a written contract results in a significantly lower violation than a non-written contract. An interesting result is that although the possession of a permanent contract was not a significant determinant of the likelihood of violation, it is significant in determining the depth of violation. The coefficient for permanent contract is negative and significant in all four specifications and suggests that permanent contract holders who are violated have a depth of violation between 2 and 5% lower than individuals with temporary or other contract types. The coefficient of the tenure variable is significant and negative in all specifications, except for specification 2. A 1% increase in tenure may reduce the depth of violation by up to 3.7 %.

It is interesting to note that while individuals employed in formal and semi-formal firms were found to be equally likely to be violated, employed in formal and semi-formal firms is associated with a significantly smaller depth of violation. In all specifications, the coefficients for the formal and semi-formal firms were negative and statistically significant.

The size of the enterprise, which was found to be a significant determinant of the probability of being violated, was not found to have a significant impact o the depth of violation. The public sector/SOE variable was also not found to be statistically significant in influencing the depth of violation of an individual.

We now turn to the last set of covariates, that is, the geographic and spatial variables. An interesting result is that the coefficient for the Area A dummy variable, which was not significant in determining the likelihood of violation, has a significant impact in determining the depth of violation. In all four specifications, the area A dummy yields a negative and significant coefficient, suggesting that workers in A type areas experience a depth of violation of between 2 and 3 % smaller than those in other areas. This may be a reflection of the fact that A type areas

may be less remote than more rural areas, and hence may be more easily accessed by labour inspectors and enforced upon. Hence, the provincial dummy variables included in Specification I suggest that violated workers in the Western Cape and Northern Cape provinces experience a smaller depth of violation than those in the KwaZulu Natal and Limpopo provinces. Examining the results for the spatial density variables, we note that the presence of labour inspectors in the district council not only significantly reduces the likelihood for violation, but also results in a significantly lower depth of violation. The coefficients for the inspector density variable were negative and significant in all the regressions, and show that a 1% increase in the density of labour inspectors significantly lowers the depth of violation by 1.2% for the individual. Another interesting result is that the local unemployment density has the effect of significantly increasing the severity of violation. A 1% increase in the local unemployment rate is associated with an increase in the size of violation by 15 to 16.9 %. Hence, workers in district councils with high rates of unemployment are worse off than those in areas with low unemployment rates.

The results above showed that there are a range of variables impacting on the depth of violation of an individual, including individual characteristics such as education and age, as well as sectoral, contractual, and spatial characteristics. However, it seems that there are two classes of variables driving the depth of violation, V_1. On the one hand, firm-level and contractual factors seem to play an important role, notably the term of contract, union membership, the length of tenure, and the formality of the firm. On the other hand, spatial variables play a significant role. Two key results here are the significance of the labour inspectorate deployed on the size of the violation, as well as the local unemployment rate. However, one of the important issues which arises from the above, is that we are only measuring the impact of the different covariates at the mean, while there may be different 'behaviour patterns' in the coefficients when examining different points in the conditional distribution of the depth of violation V_1. In order to probe this question, we re-estimate the determinants of V_1 at different percentile intervals in its distribution using a quantile regression approach.

Quantile regression

Having examined the determinants of the depth of violation at the mean of the distribution, we now use the quantile regression approach outlined above in order to analyse this relationship across the entire distribution of the depth of violation, V_1. Quantiles were formed around the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles of violation. Quantile 1 thus contains the least violated 10 % of individuals, quantile 2 the next 15 %, and so on. We can think of individuals in the top two quantiles as being the most violated, that is, their wages lie the farthest below the respective minima. Quantile 50 denotes the median quantile (the default quantile in Stata). Bootstrapped standard errors were estimated but are not shown here[26].

Table 7 presents a summary of the quantile regression results. They suggest that the size of the impact of the determinants of violation is sensitive to the choice of quantile. The results from the OLS estimation of the preferred specification have also been included in the table. In comparing the OLS results with the quantiles, we are effectively comparing the coefficients at the mean with those at other points in the conditional distribution of the dependent variable V_1.

[26] The bootstrap technique particularly useful in obtaining estimates of the standard errors of quantile-regression coefficients. Stata performs quantile regression and obtains the standard errors using the method suggested by Koenker and Bassett (1978, 1982). Rogers (1992) reports that while these standard errors are satisfactory in the homoskedastic case, bootstrapped standard errors should be estimated in cases where heteroskedasticity is suspected.

Table 7: Results from quantile regression V_1

				Quantile(θ)=				
Dependent variable : V_1			**OLS**	**q(0.10)**	**q(0.25)**	**q(0.50)**	**q(0.75)**	**q(0.90)**
Individual	**Race**	White	-0.0005	0.013	-0.015	-0.024	-0.036	0.136
		Coloured	0.0158	-0.014***	-0.018***	-0.026	-0.009	-0.001
		Asian	0.0786	0.124	0.102***	-0.050	-0.013	-0.161
	Gender	Female	-0.0078	0.006	-0.012	-0.010	0.010	-0.008
	Literacy	Speaks English	-0.1040**	-0.005	-0.051	0.022	0.041	0.087
		Can read	0.0169	0.029	-0.092	-0.091	-0.199	-0.183
		Can write	-0.0914	-0.044	0.071	0.065	0.164	0.136
	Education splines	None-Grade 8	0.0048	-0.002	-0.002	-0.002	-0.003	-0.003
		Grade 9-11	-0.0297*	-0.004	-0.013**	-0.015***	-0.008	0.002
		Grade 12	0.0418	0.006	0.008	-0.013	-0.018	-0.021
		Diploma	-0.0816**	-0.002	-0.042	-0.051	-0.033	-0.051
		Degree	0.0405	-0.024	-0.011	0.045	0.051	0.169***
Sectoral	**Age**	25-34 years	-0.0937*	-0.044*	-0.049*	-0.058*	-0.076*	-0.069*
		35-44 yrs	-0.0604**	-0.036*	-0.028	-0.025	-0.045**	-0.044***
		45-54 years	-0.0491	-0.025	-0.020	-0.018	-0.031	-0.040
		55-65 years	-0.0247	-0.030	-0.017	-0.016	0.019	0.030
		Farm workers	0.077*	0.051**	0.067*	0.090*	0.098*	0.067**
		Retail Sector	0.193*	0.066**	0.175*	0.237*	0.283*	0.209*
		Forestry	0.057	0.012	0.056	0.101*	0.134*	0.097**
		Taxi Sector	0.163*	0.054	0.141*	0.170*	0.192*	0.162*
		Private Security	0.262*	0.125*	0.2308	0.291*	0.252*	0.168*
		Hospitality Sector	0.166	0.075*	0.1208	0.179*	0.167*	0.134*
		Contract Cleaning	0.177*	0.063*	0.132*	0.171*	0.191*	0.137*
		Civil Engineering	0.362*	0.410**	0.392**	0.352**	0.225**	0.010
Firm/Contractual		Union Workers	-0.034***	-0.007	-0.036*	-0.044**	-0.036**	-0.023
		Written Contract	-0.045**	-0.017***	-0.033*	-0.065*	-0.054*	-0.051**
		Permanent	-0.032***	-0.015***	-0.021**	-0.028***	-0.036*	-0.011
		Tenure (logged)	-0.024*	-0.005***	-0.009***	-0.021*	-0.023*	-0.017**
		Formal	-0.032***	-0.040*	-0.044**	-0.046**	-0.037***	-0.014
		Semi Formal	-0.075*	-0.020	-0.046**	-0.074*	-0.098*	-0.107*
		Small firms	0.003	-0.001	-0.014	-0.011	-0.015	0.013
		Medium Firms	-0.018	0.004	-0.011	-0.015	-0.015	-0.009
		Medium-Large	-0.013	-0.005	-0.007	-0.027***	-0.046*	-0.058**
		Public sector	0.007	-0.029	-0.030	-0.016	0.025	0.090***
Spatial	**Geographic**	Area A	-0.0252**	0.006	-0.008	-0.021	-0.014	-0.018
	Density	Log workers/ km^2	0.0020	-0.0001	0.0027	0.0029	0.0076	0.0082
		Inspectors	-0.0118***	-0.007	-0.019*	-0.017*	-0.020**	-0.004
		Unemployment	0.1689**	0.113*	0.198*	0.220*	0.3228*	0.223**
Lambda			0.00001	0.00003	0.00001	0.00010	0.00012***	0.00024*
Constant			0.497*	0.146*	0.293*	0.457*	0.572*	0.677*
Number observed			2994	2994	2994	2994	2994	2994
R-squared			0.1591	0.0418	0.0795	0.1026	0.1119	0.0863

Source: Own calculations using LFS September 2007, StatsSA.
Notes: * Significant at the 1% level** Significant at the 5% level*** Significant at the 10% level

The dummy variables for race and gender remain insignificant across the distribution (barring the Asian and Coloured dummies at the lower percentiles). This suggests that race and gender do not significantly impact on the degree of violation at any point of the distribution. On

examining the coefficients for the literacy variables, we note that the ability to read and to write do not have a significant impact on the depth of violation at the mean nor across the entire distribution. The coefficient for the English as a home language dummy variable was found to be statistically significant at 5 % in the OLS regression, but was not statistically significant across the quantiles considered. This suggests that whilst speaking English as a home language was found to have a significant and negative impact on the depth of individual violation at the mean, this result does not hold true across the distribution of violated workers.

The results from the educational splines are mixed. The coefficient for No education-Grade 8, as well as Grade 12 are significant at the mean, but not across the rest of the distribution, implying that education did not significantly impact on the depth of violation for these workers. On the other hand, the coefficient for Grade 9-11 is only significant at the 25th percentile and at the median of the distribution. The coefficient is negative, suggesting that having an education of Grade 9 up till Grade 11 resulted in workers in the 25th and median percentiles experiencing a lower depth of violation than those who had completed less than a Grade 9 education.

The results for age indicate that individuals aged between 25 and 34 years experienced a significantly lower depth of violation than the youngest age cohort aged between 15 and 24 years. This result is true at the mean as well as across all percentiles of the distribution. For those in the 25 to 44 years age category, age becomes significant only when the depth of violation is high, that is, at the 75th and 95th percentiles. In other words, when the depth of violation is high, individuals in this age cohort experience a lower degree of violation than their younger counterparts aged between 15 and 24 years.

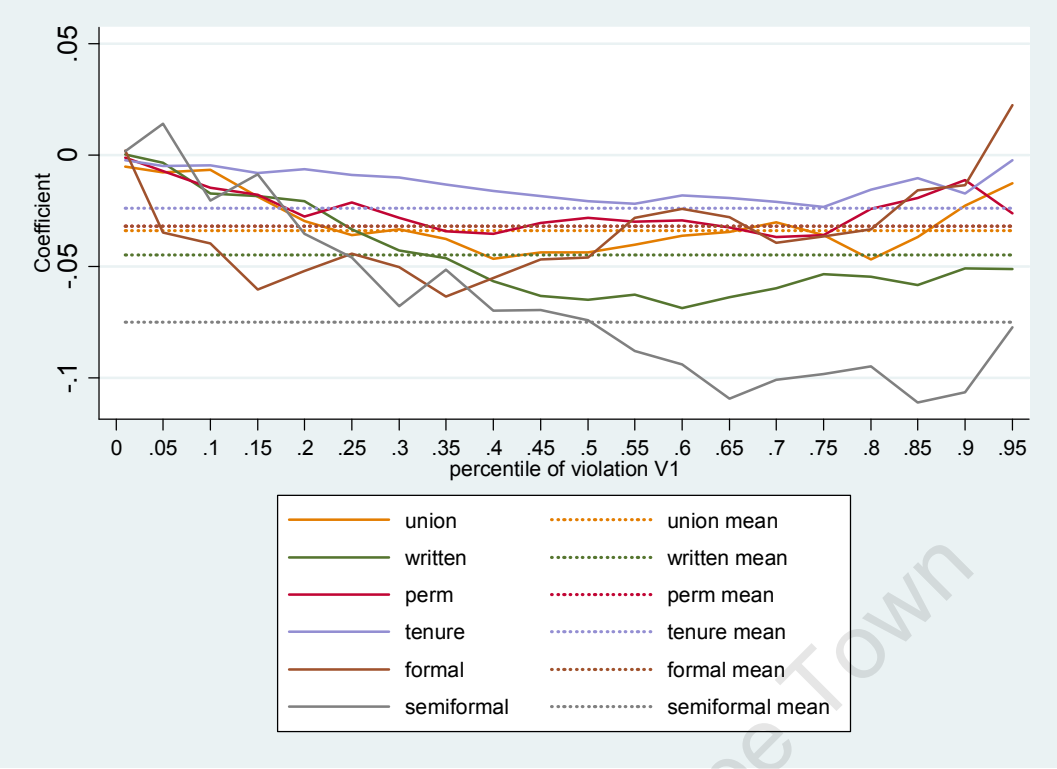
Workers in the Farm, Retail and Contract Cleaning sectors experienced a higher depth of violation than Domestic workers at the mean as well as across all percentiles of the distribution. For these sectors, the magnitudes of the coefficients increase across the distribution, declining at the 95th percentile. Hence, the ratio of the depth of violation of these workers relative to

Domestic workers increases as the depth of violation increases until the 95th percentile of violation is reached.

As with the OLS results presented earlier on, the results from the quantile regressions confirm the importance of spatial/density variables in influencing the depth of violation of workers in South Africa. A higher density of labour inspectors results in a lower depth of violation at the mean of the distribution as well as at all regression quantiles considered. The magnitudes of the coefficients for the inspector density variable vary between 0.004 and 0.02 across the distribution, suggesting that a 1% increase in the density of inspectors leads to a decline in the depth of violation between 0.4 and 2%. . The unemployment rate is also clearly a robust variable in that it is highly significant not only at the mean, but also across all percentiles in the distribution.

Given the importance of the firm/contractual and spatial variables, we now attempt to tease out the effects of these variables at different points of the depth of violation, $V_{1,}$ distribution. The derived coefficients (if statistically significant) for the contractual/firm (union worker, permanent, tenure, formal and semi-formal) and spatial (inspectors and unemployment rate) variables at different points in the distribution for 2007 are shown in Figures 4a and 4b respectively. In addition, we also display the mean OLS estimates. In all cases, these OLS coefficients are represented by the relevant horizontal dotted lines. The coefficients for the size of the enterprise are not significant across the distribution and are thus not included among the firm-level variables presented. Similarly, the coefficients for Area A and the log of workers per square kilometre have also been omitted from the spatial variables presented in figure 4b, since they do not yield coefficients that are statistically significant across the depth of violation distribution.

Figure 4a: Estimates of the Impact of Firm/Contractual Characteristics on the Depth of Violation V_1 by percentile, 2007.



Source: Own calculations using LFS September 2007, StatsSA.

The first of the firm-level/contractual characteristics investigated was union membership of the employed individual. The variable that captures union membership yields a significant and negative coefficient at the mean estimate of the depth of violation, as well as across most percentiles, barring the tails of the distribution. As seen in the figure above, the size of the coefficient of the union membership dummy variable fluctuates around the mean OLS estimate. The line representing the size of the union coefficient falls below the mean at the 20th percentile, and rises above the mean OLS line again at the 65th percentile. Interestingly enough, the percentiles where the graph of the union coefficient lies below the mean OLS estimate corresponds to the percentiles where the coefficient is statistically significant. For these percentiles, the size of the coefficient varies between -0.03 and -0.05. Therefore, we can infer that at these percentiles, union membership significantly reduced the depth of violation of an individual by between 3 and 5%.

Turning to the results for the contractual variables, a written contract resulted in a negative and significant coefficient for all percentiles estimated, except at the lower end of the distribution (that is, below the 20th percentile). The line representing the size of the coefficient for the written contract dummy crosses the mean OLS estimate of the coefficient at approximately the 30th percentile, and thereafter lies below the mean estimate. Therefore for wage earners at all percentiles of violation above the 30th percentile, the magnitude of the effect of a written contract on the depth of violation is larger than for wage earners at the mean estimate of violation depth, V_1. For workers at the mean of the distribution, a written contract reduces the depth of violation by 4.5 percentage points, whereas for workers above the 30th percentile of violation, a written contract can result in a reduction in V_1 of between 5% and 7 %. The coefficients of the dummy variable for permanent contract-holders were found to be negative and significant at all percentiles between the 20th and the 80th percentiles of violation. The results show that permanent employees at those percentiles enjoyed a depth of violation that was between 2.1% and 3.7% lower than their non-permanent counterparts. Interestingly, the magnitudes of the coefficients for the permanent dummy variable are lower than those of the written contract dummy. This suggests that the possession of a written contract in 2007 was more influential in determining the depth of violation than the duration of the contract.

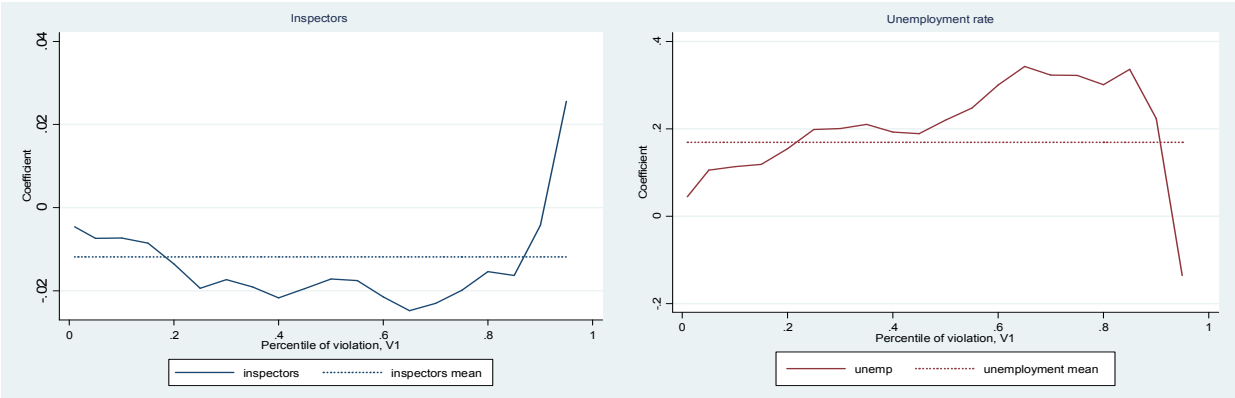
The years of tenure of an employee is clearly also an important determinant of the magnitude of individual violation observed. The coefficient for the log of tenure of the individual is significant not only at the mean but also across the length of the distribution, barring the tails. The size of the coefficient of the tenure variable seems to be fairly stable across the distribution, lying above the mean OLS estimate for the entire distribution. The coefficient is significant and negative for all estimated percentiles in the distribution except at the very bottom (1st percentile) and the top (85th percentile onwards). For those percentiles where the coefficient is significant, the absolute value of the coefficient oscillates between -0.005 and 0.023, indicating that a 1%

increase in the tenure of an employee was associated with a reduction in their depth of violation of between 0.5% and 2.3% in 2007.

The results for the formal and the semiformal dummy variables indicate that the sector in which a firm s located is an important determinant of the depth of violation both at the mean of violation, as well as across the distribution. The coefficient for the formal sector dummy variable was significant from the 5th percentile until the median of the distribution is reached. Individuals in those percentiles whom were employed in formal enterprises therefore experienced a significantly lower depth of violation than their counterparts engaged in informal sector employment in 2007. The coefficient for semiformal firms is significant over the entire distribution, with the exception of the first 30 percentiles. The coefficient for the semiformal variable is of the highest magnitude relative to the other firm-level/contractual characteristics investigated. Workers in Firms that were classified as semiformal enjoyed a depth of violation of up to 11% lower than their counterparts in firms that were neither registered for income tax or VAT in 2007. The magnitude of the coefficients suggests that the gap between the depth of violation semiformal firms and firms in the informal sector was larger than the formal-informal gap.

Figure 4b below sheds light on the effect of the number of labour inspectors and the unemployment rate on V_1 by percentile. Each variable has been plotted separately so that more variation may be observed.

Figure 4b: Estimates of the Impact of Spatial/Density Characteristics on the Depth of Violation V_1 by percentile, 2007.



Source: Own calculations using LFS September 2007, StatsSA.

A closer examination of the results for the coefficients of the inspector density variable reveals that the density of labour inspectors in an area is statistically significant at the mean and median of the distribution but not at the tails. The coefficient for the density of labour inspectors is statistically significant across the distribution of the depth of violation, V_i, but not at the very bottom (5th, 10th and 15th percentiles) or at the very top (90th and 95th percentiles) of the distribution. This implies that for very low or very high degrees of violation, the density of labour inspectors does not significantly influence the depth of violation, V_i. For the remaining points in the distribution of violated workers, the coefficients are negative and significant at the 1% level, barring the 80th and 85th percentiles, where the coefficients are negative and significant at the 10% level. Hence, for these percentiles, a higher density of labour inspectors in the locality resulted in a significantly reduced depth of violation. For the length of the distribution where the inspectors variable is statistically significant, that is, between the 15th and 90th percentiles, a 1 % increase in the density of labour inspectors results in a decrease in the depth of violation of between 1.4 and 2.5%.

The coefficients for the unemployment rate variable are significant and positive across the distribution with the exception of the 95th percentile. The estimated coefficients indicate that a higher unemployment rate in an area results in a significantly higher depth of violation. Until the 95th percentile is reached, all coefficients are highly significant, at the 1% level, with the exception of the 1st percentile coefficient, which is significant at 10 %. The size of the coefficient increases with percentile. For the lower percentiles, the coefficient lies below the horizontal line that represents the mean OLS estimate, and rises above the OLS estimate as the 20th percentile is approached. This indicates that the impact of the unemployment rate increases with the depth of violation. A 1% rise in the unemployment rate results in an increase in the depth of violation of between 4.4% (at the lowest percentile), to 33.7 % (at the 85th percentile). The coefficients for the unemployment variable are of a magnitude much larger than for the variable measuring the density of inspectors, indicating that unemployment exerted a larger influence on the depth of

violation in 2007. The key result here is that the coefficients for the unemployment rate in the regressions on the depth of violation are of the largest magnitude relative to the other variables (barring some sector dummies). This is a powerful result and suggests that regional or local labour market dynamics are crucial to understanding compliance and enforcement.

V. Conclusion

The results in this thesis are an important value-added to previous research on enforcement of minimum wages in developing countries, and constitute, as far as the author is aware, the first attempt to empirically estimate the effect of government enforcement on compliance with minimum wage legislation in South Africa. Analysis of the minimum wage regulatory environment in South Africa, as measured by the level, depth and extent of violation of minimum wages (violation indices V_0, V_1, and V_2 respectively), reveals that non-compliance levels of employers in the country with minimum wages are disturbingly high. The results from the multivariate analysis showed that there are a variety of factors impacting on the probability and depth of violation, including individual, sectoral, firm-level/contractual, and spatial/density characteristics. While individual characteristics such as race and gender were significant markers of whether an employee was violated or not, they were shown to be insignificant in determining the depth of violation. The key variables that emerged throughout the multivariate analysis as the crucial determinants of the level and depth of violation were the intensity of enforcement, as measured by the number of inspectors, and the local unemployment rate. Using quantile regression techniques, these results were found to be significant across all quantiles of the distribution of violated individuals. The unemployment rate was found to exert the largest influence on the depth of violation. This is an important result, indicative of the extent to which labour market dynamics can influence compliance with minimum wage laws.

The results from this analysis carry important policy implications for South Africa. There are two decisions facing a planner setting minimum wage policy, specifically setting the minimum wage, and choosing the intensity of enforcement. One of the key results obtained is that the strength of enforcement, as measured by the number of labour inspectors, significantly reduces the level and depth of non-compliance. While individual characteristics, such as race, gender, and age, are beyond policy control, the government can control the strength of enforcement. One policy lever would be to allocate a larger number of labour inspectors to sectors and areas

where compliance rates are the lowest. Another important implication for policy is the legislated wage floor. The evidence presented in this paper shows that minimum wages in South Africa are set very high relative to the median wage in several sectors, as well as well above the median wage for unskilled labour. Preliminary evidence presented here suggests a positive correlation between the Kaitz index (the ratio of the minimum wage to the median) and the three measures of violation proposed, namely V_0, V_1, and V_2. A noteworthy example is the Security sector which recorded the highest measures for violation in 2007, and ironically also the highest Kaitz values. High minimum wages paired with lax enforcement in South Africa engender high levels of non-compliance, leaving ample room for policy to intervene.

Appendix

Table A1: Sectoral determinations and adjusted minima

Sectoral determination	Year published	Area Type		Adjusted minima 2001	Adjusted minima 2007
Farm Workers	**2002**	**A**		762.12	1,041.00
		B		724.05	989.00
Domestic Workers	**2002**	**A**	**>27 hrs**	781.03	1,066.83
			<27hrs	633.66	865.54
		B	**>27 hrs**	553.53	756.09
			<27hrs	449.06	613.39
Private Security	**2001**	**A**		1,772.40	2,420.98
		B		1,623.60	2,217.73
		C		1,469.40	2,007.10
		D		1,368.60	1,869.41
		E		1,227.60	1,676.82
Taxi	**1999**	**Drivers**		1,093.30	1,493.37
		Taxi fare collector/other		765.32	1,045.37
Retail	**2002**	**Managers**	**A**	2,861.33	3,908.38
			B	2,287.83	3,125.02
			C	2,173.44	2,968.77
		Clerks	**A**	1,805.05	2,465.58
			B	1,457.26	1,990.52
			C	1,384.40	1,890.99
		Sales	**A**	1,805.05	2,465.58
			B	1,457.26	1,990.52
			C	1,384.40	1,890.99
		Shop Assistant	**A**	1,428.36	1,951.04
			B	1,151.60	1,573.01
			C	1,094.02	1,494.36
		Driver	**A**	1,376.08	1,879.63
			B	1,091.64	1,491.11
			C	1,037.06	1,416.55
		Forklift operator	**A**	1,296.13	1,770.43
			B	1,027.06	1,402.90
			C	975.71	1,332.76
		Security	**A**	1,217.72	1,663.32
			B	1,159.29	1,583.51
			C	1,101.33	1,504.34
Contract Cleaner	**1999**	**A**		1,321.95	1,805.70
		B		1,321.95	1,805.70
		C		1,056.42	1,443.00
Forestry	**2001**			665.28	908.73
Hospitality	**2000**	**Small firms (<10 employees)**		984.91	1,345.32
		Large firms (>10 employees)		1,098.04	1,499.85
Civil Engineering	**2001**	**A**		1,583.21	2,162.55
		B		1,466.14	2,002.65

Source: LFS 2001 and 2007, StatsSA; Own calculations.

Notes: 1. Security workers min wage calculated as average of grade officers since not enough info in LFS to classify security workers by grade type. Assumed first year of employment.

2. 45 hours per week used as the default.

Table A2: Final Mapping of LFS District Councils to Area codes in DoL Sectoral Determinations

	Farm	Domestic	Retail	Security	Contract Cleaners	Civil engineers
DC1	A	A	A	E	C	A
DC2	A	A	A	E	C	A
DC3	A	A	A	E	C	A
DC4	A	A	A	D	C	A
DC5	B	B	B	E	C	A
DC6	A	A	B	E	C	B
DC7	B	B	B	E	C	B
DC8	A	A	A	E	C	B
DC9	B	B	B	B	C	B
DC10	B	B	B	E	C	A
DC12	B	B	A	E	C	A
DC13	B	B	B	E	C	A
DC14	B	B	C	E	C	A
DC15	B	B	C	E	C	A
DC16	B	B	B	E	C	B
DC17	A	A	A	B	C	A
DC18	B	B	B	C	C	B
DC19	B	B	B	E	C	B
DC20	B	B	B	E	C	B
DC21	B	B	C	D	B	B
DC22	B	B	A	E	B	B
DC23	B	B	B	E	B	B
DC24	B	B	C	E	B	B
DC25	B	B	B	D	B	B
DC26	B	B	C	E	B	B
DC27	B	B	C	E	B	B
DC28	B	B	C	D	B	B
DC29	B	B	C	D	B	B
DC30	B	B	C	E	C	B
DC31	A	A	C	E	C	A
DC32	B	B	C	E	C	B
DC33	B	B	C	E	C	B
DC34	B	B	C	E	C	B
DC35	B	B	B	E	C	B
DC36	B	B	B	E	C	B
DC37	B	B	C	E	C	B
DC38	B	B	B	E	C	B
DC39	B	B	C	E	C	B
DC40	B	B	C	B	A	A
DC42	A	A	A	A	A	A
DC43	B	B	B	E	B	B
DC44	B	B	C	E	C	A
CBDC1	B	B	B	E	C	B
CBDC2	A	A	A	E	C	A
CBDC3	B	B	C	E	C	B
CBDC4	B	B	C	E	C	B
CBDC8	A	A	B	A	A	A
Cape Town	A	A	A	A	A	A
Port Elizabeth	A	A	A	A	A	A
Durban	A	A	A	A	B	A
East Rand	A	A	A	A	A	A
Johannesburg	A	A	A	A	A	A
Pretoria	A	A	A	A	A	A

Table A3: Rank of the Index of Violation, LFS September 2001- 2007

Sectoral Determination		2001			2007		
		V_0	V_1	V_2	V_0	V_1	V_2
Retail Sector	Managers Area A	16	16	14	15	15	14
	Managers Area B	15	15	13	16	16	15
	Managers Area C	12	12	11	10	10	9
	Clerks Area A	11	10	10	8	7	7
	Clerks Area B	10	9	9	3	5	6
	Clerks Area C	4	3	3	2	3	3
	Sales Assistant Area A	13	13	12	12	12	10
	Sales Assistant Area B	1	1	1	6	1	1
	Sales Assistant Area C	7	5	4	11	2	2
	Shop Assistant Area A	8	8	8	9	13	13
	Shop Assistant Area B	6	6	6	5	6	5
	Shop Assistant Area C	3	2	2	4	4	4
	Drivers Area A	14	14	15	14	14	16
	Drivers Area B	5	7	7	7	8	8
	Drivers Area C	2	4	5	13	11	11
	Forklift operators Area A	9	11	16	1	9	12
Total Retail Sector		**6**	**5**	**5**	**6**	**6**	**5**
Domestic workers							
Area A		2	2	2	2	2	2
Area B & C		1	1	1	1	1	1
Total Domestic Workers		**2**	**2**	**2**	**7**	**7**	**7**
Farm Workers							
Area A		2	2	2	2	2	2
Area B & C		1	1	1	1	1	1
Total Farm Workers		**1**	**1**	**1**	**2**	**3**	**4**
Forestry Workers		**4**	**4**	**3**	**3**	**4**	**6**
Taxi workers							
Taxi operators Drivers		1	1	1	2	2	2
Taxi operators Fare collector		2	2	2	1	1	1
Total Taxi operators		**8**	**8**	**8**	**4**	**2**	**2**
Security	Area 1	3	4	3	1	1	1
	Area 2	4	2	2	4	4	3
	Area 3	2	3	4	5	5	5
	Area 4	1	1	1	3	3	4
	Area 5	5	5	5	2	2	2
Total Security workers		**3**	**3**	**4**	**1**	**1**	**1**
Hospitality Workers							
Hospitality small firms		1	1	1	1	1	1
Hospitality med-large firms		2	2	2	2	2	2
Total Hospitality		**5**	**6**	**6**	**8**	**8**	**8**
Contract cleaners							
Area 1		2	2	2	2	2	2
Area 2		1	1	1	1	1	1
Area 3		3	3	3	3	3	3
Total Contract cleaners		**7**	**7**	**7**	**5**	**5**	**3**
Civil engineering		**9**	**9**	**9**	**9**	**9**	**9**

Table A4: Estimates of Kaitz Index, 2001 and 2007.

	Sectoral Determination	2001				2007			
		K_1	Rank	K_2	Rank	K_1	Rank	K_2	Rank
Retail Sector	Managers Area A	1.93	1	0.62	13	1.53	1	0.55	16
	Managers Area B	1.56	2	0.66	12	1.38	3	0.69	12
	Managers Area C	1.54	3	0.41	16	1.52	2	0.95	10
	Clerks Area A	1.10	7	0.88	9	0.92	5	1.05	7
	Clerks Area B	0.96	8	0.77	11	0.83	7	1.15	4
	Clerks Area C	0.93	9	1.24	5	0.81	8	1.35	2
	Sales Assistant Area A	1.12	6	0.51	14	0.93	4	0.58	14
	Sales Assistant Area B	1.34	4	4.28	1	0.88	6	1.69	1
	Sales Assistant Area C	0.92	10	0.49	15	0.79	10	0.66	13
	Shop Assistant Area A	0.89	11	0.95	8	0.78	11	0.97	9
	Shop Assistant Area B	0.76	16	1.11	6	0.68	14	1.13	5
	Shop Assistant Area C	0.83	13	1.85	3	0.65	15	1.26	3
	Drivers Area A	0.86	12	0.80	10	0.79	9	0.57	15
	Drivers Area B	0.78	15	1.04	7	0.69	13	1.01	8
	Drivers Area C	0.79	14	1.40	4	0.59	16	0.73	11
	Forklift operators Area A	1.18	5	1.89	2	0.73	12	1.08	6
Total Retail Sector		**1.03**	**2**	**1.07**	**5**	**0.92**	**2**	**0.92**	**5**
Domestic workers Area A		0.42	1	1.36	2	0.46	1	0.87	2
Area B & C		0.37	2	2.00	1	0.29	2	1.15	1
Total Domestic Workers		**0.40**	**9**	**1.60**	**2**	**0.33**	**9**	**0.96**	**4**
Farm workers Area A		0.51	2	1.08	2	0.44	1	1.01	2
Area B & C		0.54	1	2.14	1	0.42	2	1.22	1
Total Farm Workers		**0.53**	**7**	**1.87**	**1**	**0.43**	**7**	**1.13**	**2**
Forestry Workers		**0.44**	**8**	**1.18**	**4**	**0.38**	**8**	**1.06**	**3**
Taxi operators Drivers		0.75	1	0.79	1	0.72	1	0.91	2
Taxi operators Fare collector		0.51	2	0.41	2	0.41	2	1.13	1
Total Taxi operators		**0.72**	**6**	**0.76**	**8**	**0.70**	**4**	**0.88**	**7**
Security	Area 1	1.39	1	1.48	3	1.17	1	1.47	1
	Area 2	1.18	3	1.51	2	1.01	2	0.97	4
	Area 3	1.02	4	1.30	4	0.84	5	0.7	5
	Area 4	1.24	2	1.98	1	0.92	3	1.35	3
	Area 5	0.97	5	1.19	5	0.86	4	1.43	2
Total Security workers		**1.18**	**1**	**1.26**	**3**	**1.06**	**1**	**1.4**	**1**
Hospitality small firms		0.74	1	1.36	1	0.56	2	0.93	1
Hospitality med-large firms		0.71	2	0.87	2	0.59	1	0.73	2
Total Hospitality		**0.72**	**5**	**0.96**	**6**	**0.58**	**6**	**0.73**	**8**
Contract cleaners Area 1		0.82	2	0.94	2	0.67	1	1.04	2
Area 2		0.83	1	1.32	1	0.67	1	1.11	1
Area 3		0.70	3	0.70	3	0.58	2	0.72	3
Total Contract cleaners		**0.75**	**4**	**0.81**	**7**	**0.63**	**5**	**0.91**	**6**
Civil engineering		**0.99**	**3**	**0.26**	**9**	**0.82**	**3**	**0.22**	**9**
Total		**0.70**	**...**	**1.48**	**...**	**0.61**	**...**	**1.17**	**...**

References

Andalon, A. and Pagés, C. (2008), 'Minimum Wages in Kenya', IZA Discussion Papers 3390, Institute for the Study of Labor (IZA).

Basu, A., Chau, N. and Kanbur, R. (2009), 'Turning a Blind Eye: Costly Enforcement, Credible Commitment, and Minimum Wage Laws', Forthcoming in *Economic Journal.*

Bhorat, H. (2000), 'Are Minimum Wage Adjustments an Effective Mechanism for Poverty Alleviation? Some Simulations for Domestic and Farm Workers,' Paper presented at the Trade *and International Policy Secretariat (TIPS) 2000 Annual Forum*, Development Policy Research Unit (DPRU).

Bhorat, H. and Leibbrandt, M. (1996), 'Understanding Unemployment. The Relationship between the Employed and the Jobless.' In *Against the Current. Labour and Economic Policy in South Africa,* edited by Baskin, J. Randburg: NALEDI.

Bhorat, H. and Leibbrandt, M. (2001), 'Modelling Vulnerability and Low Earnings in the South African Labour Market.' In: Bhorat, H. et. al. (eds.), *Fighting Poverty Labour Markets and Inequality in South Africa*. Cape Town: UCT Press.

Bhorat, H. and Oosthuizen, M. (2008), 'Determinants of Grade 12 Pass Rates in the Post-*Apartheid* South African Schooling System' *Journal of African Economics*, Vol. 14(4), pp. 634-666.

Casella, G. and Berger, R. (2002), *Statistical Inference*, 2nd Edition, Duxbury.

Casale, D., Muller, C., Posel, D. (2004), 'Two Million Net New Jobs. A Reconsideration of the rise in Employment in South Africa, 1995 – 2003,' *South African Journal of Economics*, Vol. 72:5.

Card, D. and Krueger, A. (1995), Myth and measurement: The new economics of the minimum wage, Princeton University Press, Princeton.

Department of Labour (2003), Report of the Employment Conditions Commission. Department of Labour (DoL), Pretoria.

Fields, G., and Kanbur, R. (2007), 'Minimum Wages and Poverty with Income Sharing'. Revised version published in *Journal of Economic Inequality*. Forthcoming, August, 5:2, pp. 135-147.

Freeman, R. (1996), 'The Minimum Wage as Redistributive Tool'', *Economic Journal,* 106(436).

Foster, J., Greer, J. and Thorbecke, E. (1984). 'A Class of Decomposable Poverty Measures,' *Econometrica,* Vol. 52(3), pp. 761-66.

Hertz, T. (2005), 'The Effect of Minimum Wages on the Employment and Earnings of South Africa's Domestic Service Workers', Development Policy Research Unit Working Paper 05/99.

Kanbur, R. (2007), 'An Index of Minimum-Wage Violation, with Application to South Africa.' Incomplete draft paper.

Koenker, R. and G. Bassett, Jr. (1978), 'Asymptotic theory of least absolute error regression,' *Journal of the American Statistical Association*, Vol. 73 (363), pp. 618-622.

Koenker, R. and G. Bassett, Jr. (1978), 'Regression Quantiles,' *Econometrica*, Vol. 46(1), pp. 33-50.

Koenker, R. And Hallock, F. (2001), 'Quantile Regression,' *Journal of Economic Perspectives*, Vol. 15 (4), pp. 143-156.

Levin-Waldman, O. (1997), 'Linking the Minimum wage to Productivity, The Jerome Levy Economics Institute Working Paper No. 219.

Murray, J. and Van Walbeek, C. (2007), 'Impact of Sectoral Determination for Farm Workers on the South African Sugar Industry: Case Study of the KwaZulu Natal North and South Coasts,' CSSR Working Paper 181.

Rogers, W. H. (1992), sg11: Quantile regression standard errors. *Stata Technical Bulletin* 9: 16-19. Reprinted in *Stata Technical Bulletin Reprints*, Vol. 2, pp. 133-137.

Ronconi, L. (2008), 'Enforcement and Compliance with Labour Regulations,' Institute for Research on Labour and Employment, Working Paper, University of California, Berkeley. Available from:http://www.irle.berkeley.edu/cwed/ronconi/enforcement_compliance.pdf [Accessed September 2009]

Maloney, W. and Nunez, J. (2003), Measuring the impact of minimum wages: evidence from Latin America'. In *Law and Employment. Lessons from Latin America and the Caribbean* edited by J. Heckman and C. Pagès. Cambridge, MA: NBER.

McCullagh, P. and Nelder, J. (1989), *Generalized Linear Models*. London: Chapman and Hall.

Municipal Demarcation Board of South Africa. Available from: http://www.demarcation.org.za. [Accessed online September 2009].

Murray, J. and Van Walbeek, C. (2007), Impact of Sectoral Determination for Farm Workers on the South African Sugar Industry: Case Study of the KwaZulu Natal North and South Coasts, CSSR Working Paper 181.

Saget, C. (2001), Minimum Wage – Does it Cut Poverty? Report from the Conditions of Work and Employment Programme (TRAVAIL), ILO.

Steyerberg, E., Eijkemans, M., and Habbema, J. Dik. (1999), 'Stepwise Selection in Small Data Sets: A Simulation Study of Bias in Logistic Regression Analysis.' *Journal of Clinical Epidemiology,* Vol. (52(10), pp. 935-942.

Strobl, E. and Walsh, F. (2003), 'Minimum Wages and Compliance: The Case of Trinidad and Tobago'**.** *Economic Development and Cultural Change*, 51(2), pp. 427-450.

Thompson, M. (1978), 'Selection of Variables in Multiple Regression: Part 1. A Review and Evaluation.' *International Statistical Review*, Vol. 46(1), pp. 1-19.

Vedder, R. and Galloway, L. (2001), Does the Minimum Wage Reduce Poverty? Report from Employment Policies Institute.