ESTIMATING THE IMPACT OF MINIMUM WAGES ON EMPLOYMENT, WAGES AND NON-WAGE BENEFITS: The Case of Agriculture in South Africa

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ABSTRACT

Assessments of the impact of minimum wages on labour market outcomes in Africa are relatively rare. In part this is because the data available do not permit adequate treatment of econometric issues that arise in such an assessment. This paper attempts to estimate the impact of the introduction of a minimum wage law within the Agriculture sector in South Africa, based on 15 waves of the biannual Labour Force Survey (LFS), starting in September 2000 and ending in September 2007. The chosen sample includes six waves before the legislation's effective date (March 2003) and nine afterwards. All 15 waves are pooled and treated as repeated cross sections over time. In order to assess whether the changes experienced by farm workers are unique, we identify a control group that has similar characteristics to the treatment group. Our econometric approach involves using two alternative specifications of a difference-in-differences model. We test whether employers reduced employment, and whether they responded at the intensive margin by reducing hours of work. The law also required non-wage benefits to be implemented, and we track the response here in the form of one such provision, namely that of a written contract. The results suggest a significant reduction in employment in Agriculture from the minimum wage, an increase in wages on average, no significant change in hours worked and a sharp rise in non-wage compliance.

JEL Codes: J23, J31, J32, J38, J41, J43

Keywords: Minimum Wage, Agriculture, South Africa, Wage, Employment, Hours of Work

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CONTENTS

1. INTRODUCTION

The new minimum wage research of Card (1992), Card and Krueger (1994, 1995) and Neumark and Wascher (1992) generated extensive discussion around the specific effects of minimum wage policies in the developed and developing world. Debate was of course initially sparked by the provocative findings of David Card and Alan Krueger's (1994) seminal paper on the subject. A portion of subsequent research supports Card and Krueger's findings.[1] While such findings are compelling and have forced economists to reconsider long-held beliefs on the subject, they have not overturned the consensus that in almost all cases higher wages will reduce employment. The weight of accumulated evidence from subsequent work appears to favour a nuanced version of this traditional economic rationale. Neumark and Wascher (2007) conclude from their review that there are very few, if any, studies that provide convincing evidence of positive employment effects of minimum wages (Neumark and Wascher, 2007:121). In fact, evidence shows that negative employment effects are consistently apparent when a study does not restrict its focus to a narrow sub-group or single industry. The authors add that "studies [which] focus on the least-skilled groups provide relatively overwhelming evidence of stronger disemployment effects for these groups" (Neumark and Wascher, 2007:121).

In turn, there is an on-going and burgeoning research agenda in much of the developing world, on measuring the impact of minimum wages on employment, poverty and income distribution. Given that many developing countries (and indeed developed countries) have some sort of mandatory minimum wage laws, this is not surprising. Whilst the majority of published studies are drawn from Latin American economies[2] there are a sprinkling of studies for Asia and Africa[3].

Reliable economic research studying the effects of minimum wages in South Africa is limited and published work that compares with the international literature is even more so.[4] The most comprehensive research that is available has focused on the effects of the minimum wage on domestic workers. Unpublished papers by Hertz (2005, 2006) and more recently Dinkelman and Ranchhod (2010), examine the impact of the legislation on a number of observables in this sector. The authors use contrasting methodologies but their overall conclusions are comparable.[5] Immediate and significant increases in earnings are reported after the introduction of the law in both studies. The requirement for employers to establish a written contract with employees formed part of the new legislation and again both studies found that the number of domestic workers with such contracts increased significantly in the post-law period. Regarding employment, Dinkelman and Ranchhod (2010) present a model showing that the probability of employment for a typical domestic worker is unchanged after the law, while Hertz (2005) suggests that changes in employment experienced by domestic workers was no different to workers in other occupations. The results suggest that employment was not adversely affected by the law, even though wages rose. We employ methods of testing which incorporate the approaches used by both authors to examine the case of agricultural workers.

Two additional South African studies analyse the impact of minimum wages in the agricultural industry. Conradie (2004), using data from a survey of 190 grape farmers, shows that a wage increase of ten percent will decrease employment by between three and six percent, depending on the industry. Contrastingly, Murray and Van Walbeeck (2007) use data from a survey of 103 sugarcane farmers and report no large disemployment effect as a result of the law. The authors do suggest that decreases in the average number of hours worked have occurred due to the minimum wage, and that there was a move from labour to capital-intensive farming methods where possible.

[1] See Machin and Manning (1994), Bhaskar and To (1999), Houba and van Lomwell (2001), Petrakis and Vlassis (2004). The explanation for why minimum wages can increase employment relates to the specific market structure; see Card and Krueger (1994) for a full explanation.

[2] For Latin American studies see Alaniz, Gindling & Terrell (2011), Gindling & Terrell (2007) and Gindling & Terrell (2010), Lemos, S (2007), Neumark & Wascher (2007), Strobl & Walsh (2003),

[3] For African and Asian studies, outside of South Africa, see Andalon & Pages (2008) and Rama (2001).

[4] One reason for this may be the complex minimum wage schedule in South Africa which makes econometric analysis using the available household survey data very difficult.

[5] The most important methodological contrasts between the two papers are that Hertz (2005) employs a difference-in-differences approach similar to Card and Krueger (1995) and uses Magisterial Districts as the unit of analysis, while Dinkelman and Ranchhod (2010) use a difference-in-differences approach found in Lee (1999) with the Province as the unit of analysis.

We contribute thus to the above literature, with an application of the minimum wage promulgation in Agriculture, within an emerging market context, South Africa. The paper attempts in the first instance, to estimate the impact of the minimum wage on employment and wages within the Agriculture sector. We then assess whether employers responded at the intensive margin by reducing hours of work with the new law. The law also required non-wage benefits to be implemented, and we track the response here in the form of one such provision, namely that of a written contract.

2. METHODOLOGICAL APPROACH AND DATA

The primary data for this study are drawn from 15 waves of the South African Labour Force Survey (LFS), starting in September 2000 and ending in September 2007. These are bi-annual, rotating, panel surveys conducted in February/March and September each year and all data are self-reported. The chosen sample includes six waves before the legislation's effective date (March 2003) and nine afterwards. All 15 waves are pooled and treated as repeated cross sections over time[6]. The LFS covers approximately 30,000 households in each wave and this includes between 2,000 and 2,800 farmworkers per wave over the period. In order to evaluate which minimum wage applied to each individual, it was necessary to assign individuals to geographic areas. This was done by matching geographical information available in the LFS to areas A and B listed in the Sectoral Minimum Wage schedules.

In order to assess whether the changes experienced by farmworkers are unique, we identify a control group that has similar characteristics to farmworkers. The control group is made up of unskilled, non-unionised individuals of working age, who are not covered by another sectoral minimum wage which might interfere with the results. Here again, both the occupation and industry codes are used to identify this group. For clarity, this group includes occupations such as: street vendors, packers, construction workers, manufacturing and transport labourers, and elementary machine operators. The agricultural minimum wage law does not apply to them. Changes in the control group's wages, employment, contract coverage and hours worked give an indication of movements in the economy when the agricultural minimum wage was introduced. Monthly wages reported in brackets in the LFS are transformed into point estimates by random allocation to a uniform distribution within the bracket to maintain variation[7]. This accounts for between five and ten percent of the sample in each wave on average. All monthly wages are then combined and converted into hourly wages, and wages are deflated by the annual Consumer Price Index (CPIX).

The most relevant data limitation with this study is that it is impossible to capture any non-monetary income received by farmworkers such as housing, food, transport, utilities or any other in-kind transfers from employers. Importantly the legislation does restrict such non-monetary payments to ten percent of a worker's salary in the case of agriculture and this is taken into account where necessary. Nevertheless it is possible that increases in wages after the introduction of the law may have been a reallocation of non-pecuniary benefits offered in the pre-law period. This is the biggest challenge for analysing wage gains in the sector. Secondly, it may be that a common employer response to the law is the casualization of labour. Anecdotal evidence suggests that this may be the case in agriculture where temporary employment agencies are increasingly prevalent and coordinate less direct formal employment (DoL, 2011). There may be a correlation in South Africa between stricter wage legislation (higher minimum wages, restrictions on dismissal etc.) and the growth of temporary employment services in Agriculture. However, the LFS data on seasonal and contract workers within Agriculture does not appear to have changed significantly over the period and no data on temporary employment services in Agriculture is available.

Approach and Method

Two specifications are used. We first employ a standard difference-in-differences model analogous to Card and Krueger (1994):

$$Y_{ikt} = \beta_0 + \beta_1 POST_t + \beta_2 Farmworker_k + \beta_3 POST_t * Farmworker_k + \varepsilon_{ikt} \qquad (1)$$

[6] We do not use the standard LFS individual-level weights but rather those provided by Branson (2009). We continue to use the post-stratification unit (PSU) and district level weights from the LFS which adjust for the survey design.
[7] A new seed is set in STATA for each bracket calculation.

where, Y_{ikt} is the outcome of interest (wages, contracts, hours worked) for individual *i*, in group *k*, in period *t*. $POST_t$ is the time dummy which captures 'before-and-after' effects. $Farmworker_k$ is the dummy for whether an individual is in the treatment or control group (k=1, 2), which equals 1 if the individual is a farmworker and 0 if they are in the control group.[8] $POST_t * Farmworker_k$ is the difference-in-differences term which confirms that outcomes are not the result of economy-wide shocks. This ensures that the observed changes are not shared by similar workers to whom the law does not apply.

Secondly we specify a difference-in-differences model similar to Card & Krueger (1994) which tests to see whether wages increased more in areas where farmworker wages were lower in the pre-law period:[9]

$$Y_{ijt} = \alpha_0 + \alpha_1 POST_t + \alpha_2 WG_j + \alpha_3 POST_t * WG_j + \gamma X_{ijt} + v_{ijt} \quad (2)$$

where, Y_{ijt} is the outcome of interest for individual *i*, living in district *j*, in period *t*. $POST_t$ is the time dummy, and X_{ijt} controls for various worker characteristics such as Age, Education and Race. The wage gap (WG_j) is a constructed variable which identifies cross-sectional variation between District Councils in the pre-law period. The wage gap is represented by:

$$WG_j = log[median(w_j^*)] - log[median(w_j')] \quad (3)$$

where, w_j^* is the median wage of the control group in district *j* and w_j' is the median agricultural worker wage in district *j*. The wage gap is calculated using full-time wages in 2002. This identifies the gap in wages between the two groups of workers for each district, in the pre-law period, and captures the intensity of the law. Areas with a larger gap would be expected to experience greater increases in wages in the post-law period if the law was binding. Comparison with the chosen control group accounts for any changes in wages that affected all workers over the period and controls for wage differences that are linked to geography.

In equation (1) β_1 indicates the changes in the post-law period for both groups, β_2 gives the average difference between farmworkers and the control group over the full period, and β_3 shows the change for farmworkers in the post-law period relative to the control group. In equation (2) the parameter α_2 represents the average difference in outcomes for workers in low wage gap versus high wage gap areas across the entire period. α_3 is the difference-in-differences parameter and tells us how much more outcomes changed in the post-law period, in areas where the wage gap was largest. Lastly, α_1 is also of interest as it tells us how the variable of interest changed on average after the law. As in all such natural experiments we must assume that in the absence of the law, agricultural wages would be on the same general trend across districts as well as for both groups of workers.

3. DESCRIPTIVE STATISTICS

Despite contributing less than three percent to Gross Domestic Product (GDP) between 2000 and 2007, agriculture remains a real economy anchor for the South African economy in many respects. The sector accounts for almost ten percent of formal employment (StatsSA, 2008). A major purpose of the agricultural minimum wage law was to provide protection for workers in a sector which is poorly unionised and reports the lowest average wages in the country. In addition to setting a legal wage floor, the new law also outlined terms and conditions of employment for the farming sector which included maximum working hours and the establishment of a written employment contract for employees. The minimum wage law was published on the 2nd of December 2002 and came into effect on the 16th of December 2002[10]. Provisions related to the minimum wage, however, only came into effect on the 1st of March 2003. September 2003 is treated as the first wave where the impacts of the law should be evident. Two separate wage levels are prescribed for full-time farmworkers, according to geographic location: a higher minimum wage for those working within urbanised

[8] Recall that the control is made up of demographically similar workers not covered by the minimum wage law. Characteristics of the control group are presented in the following section and shown in Table 2.

[9] Dinkelman and Ranchhod (2010) have recently also applied a similar approach to Card and Krueger in their study of domestic workers.

[10] The initial legislation for the farming sector was outlined in Sectoral Determination 8 and then later updated by Sectoral Determination 13 (Department of Labour; 2002, 2006).

municipal areas (Area A) and a lower wage for predominantly rural areas (Area B).[11] In March 2003 when the law was introduced these were, Rands 800 and Rands 600 per month, respectively. The minimum wage is regularly updated for inflation through a formal government gazetting process which is publicly available on the Department of Labour's (DoL) website. These minima were set relatively high upon introduction, at around the 70th percentile of the wage distribution in both cases.

The introduction of minimum wages appears to have had some immediate and substantial effects for the farmworkers covered by the law. Table 1 provides an overview of workers in the agricultural sector by presenting key features of the sample over time. The typical demographic of a farmworker in South Africa is clear. Most individuals in the sample are African, male, have few years of education (less than six), and are engaged in full-time employment.

Table 1: Average Characteristics of Farmworkers (2000-2007)

Table 1. Average Characteristics of Farmworkers (2000 - 2007)

	2000	2001	2002	2003	2004	2005	2006	2007
N	2 773	2 429	2 732	2 037	2 398	2 439	2 452	2 359
Weighted	825 313	744 432	824 954	622 328	572 823	511 610	541 417	574 101
Area A	0.36	0.33	0.38	0.37	0.32	0.30	0.36	0.34
Age	35	36	36	36	36	36	35	36
Education	4.75	4.88	4.92	5.12	5.11	5.39	5.77	5.72
Male	0.70	0.73	0.74	0.71	0.70	0.73	0.69	0.72
African	0.71	0.69	0.73	0.68	0.75	0.75	0.72	0.78
Full-Time	0.87	0.95	0.91	0.97	0.95	0.95	0.96	0.94
Hours per Week	52	52	51	50	50	51	49	48
Mean Monthly Wage	543	548	571	732	779	898	977	1 083
Mean Hourly Wage	2.50	2.55	2.65	3.49	3.69	4.20	4.72	5.30
Fraction < Min. (Area A)	0.67	0.68	0.65	0.53	0.51	0.55	0.55	0.51
Written Contract	0.31	0.30	0.34	0.50	0.49	0.50	0.54	0.56

Source: Figures are calculated from the South African Labour Force Surveys (LFS) for September 2000 – September 2007.
Notes: 1. All statistics are weighted.
2. Full time workers are those working more than 27 hours per week.
3. The dashed red line indicates the timing of the law (March 2003).
4. The wage variables presented are medians for full-time workers.
5. Noncompliance before 2003 is based on the minima adjusted backwards using the formula contained in the Agricultural Sectoral Determination.

Table 2 provides an equivalent set of data for the chosen control group. The similarities of this group are immediately evident. These workers are also typically African, male, have between seven and eight years of education, and work full time.

[11] This demarcation was based on the average household income recorded for the municipal area concerned in the 1996 census, where:
A: Average income greater than Rands 24 000 per annum
B: Average income between Rands 12 000 and Rands 24 000 per annum.
Since 2009 this distinction between areas has been removed.

Table 2: Average Characteristics of the Control Group (2000-2007)

	2000	2001	2002	2003	2004	2005	2006	2007
N	4 121	3 773	3 603	3 379	3 781	4 455	4 456	4 228
Weighted	1 785 730	1 600 441	1 636 771	1 682 776	1 796 746	2 162 153	2 128 327	2 038 391
Area A	0.57	0.56	0.58	0.55	0.44	0.41	0.42	0.41
Age	38	41	40	40	38	44	46	41
Education	7.65	7.72	7.88	8.05	8.25	8.27	8.37	8.25
Male	0.62	0.59	0.62	0.56	0.62	0.58	0.58	0.61
African	0.83	0.85	0.84	0.85	0.84	0.86	0.85	0.86
Full-Time	0.87	0.88	0.90	0.89	0.90	0.89	0.90	0.89
Hours per Week	45	43	45	46	46	46	45	45
Mean Monthly Wage	1 321	1 210	1 307	1 367	1 441	1 492	1 736	1 961
Mean Hourly Wage	6.24	5.84	6.16	6.83	7.17	7.01	8.58	9.91
Fraction < Farm Min.*	0.34	0.37	0.33	0.30	0.33	0.36	0.32	0.28
Written Contract	0.46	0.50	0.55	0.60	0.63	0.57	0.60	0.64

Source: Figures are calculated from the South African Labour Force Surveys (LFS) for September 2000 – September 2007.
Notes: 1. All statistics are weighted.
2. Full time workers are those working more than 27 hours per week.
3. The dashed red line indicates the timing of the law (March 2003).
4. The wage variables presented are medians for full-time workers.
5. * The minimum used is for farmworkers in Area A.

Considering the first row of Table 1, it is evident that the number of farm workers sampled in each wave remains relatively stable over the period. This is reassuring and should increase the reliability of the weighted estimates. Changes in employment are the first area of interest. The figures in Table 1 show that the number of farmworkers falls by almost 200 000 between September 2002 and September 2003, which is a decrease of over 20 percent. Table 2 provides comparable data on the change in the number of workers in the control group, where a gradual increase in employment can be observed. This gives an initial indication that farmworker employment fell as a result of the law. The data shows that over the period, employment in the control group rises steadily over time while farmworker employment starts falling in March 2003 (the law was announced in December 2002) and does not recover. To rule out the possibility that this decrease may have been driven by economic conditions in the agricultural sector, Table 3 details average growth levels over the period. The growth in agricultural Gross Domestic Product (GDP) was approximately one percent and thus while employment losses may have come from increased capitalisation of farming activities, it is implausible that the sector was forced to shed jobs due to contracting output.

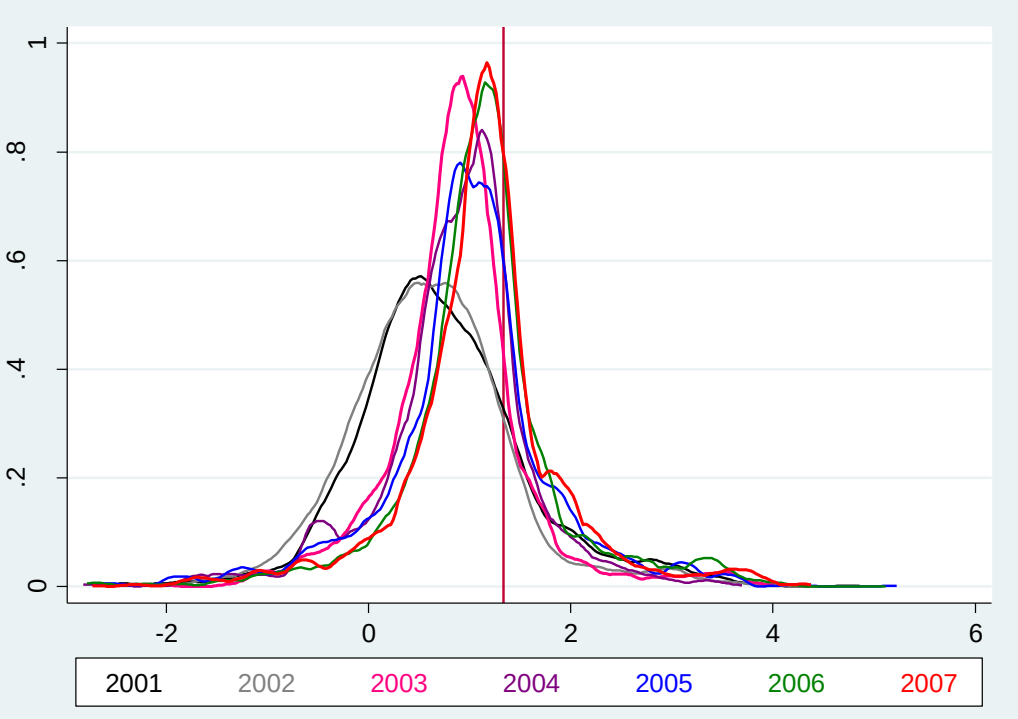
Table 3: Gross Domestic Product and Value added by Industry (Constant 2005 Prices)

	2000		2007		2000-2007
	R Million	Share	R Million	Share	Growth Rate
Primary Sectors					
Agriculture, forestry and fishing	34 787	3.0%	36 301	2.3%	1.2%
Mining and quarrying	99 069	8.6%	105 336	6.7%	0.6%
Secondary Sectors					
Manufacturing	222 579	19.2%	290 246	18.6%	4.4%
Electricity, gas and water	28 597	2.5%	35 294	2.3%	3.1%
Construction	26 410	2.3%	48 971	3.1%	8.8%
Tertiary Sectors					
Wholesale, retail, motor trade and accommodation	161 503	14.0%	217 607	13.9%	4.8%
Transport, storage and communication	102 874	8.9%	156 289	10.0%	6.4%
Finance, real estate and business services	216 747	18.7%	349 501	22.4%	6.6%
General government services	191 340	16.5%	223 618	14.3%	1.9%
Personal services	75 735	6.5%	98 247	6.3%	3.9%
Aggregate GDP	1 157 441		1 561 410		4.4%

Source: Own Calculations (StatsSA, 2011)

Figures 1 and 2 contain kernel density plots of hourly wages for September 2001 – September 2007. Each line is a smoothed plot of the log of real wages. The figures use data from the September waves of the LFS and therefore include two waves before the law's introduction and five thereafter. The vertical line represents the full-time urban minimum wage in 2007. Figure 1 presents hourly and monthly farmworker earnings, respectively. In the pre-law period (shown by the black and grey lines) there is no evidence that earnings are shifting in real terms; in fact the 2001 distribution is slightly to the right of the distribution in 2002 suggesting a slight decline in real earnings. However, the distribution shifts noticeably to the right in September 2003, ten months after the announcement of the law. The distribution then gradually moves to the right for all of the post-law years, with the final wave being most pronounced. Testing for distributional differences using the Kolmogorov-Smirnov tests shows that each of the post-law distributions is significantly different from those before the law was introduced, at the 5 percent level.

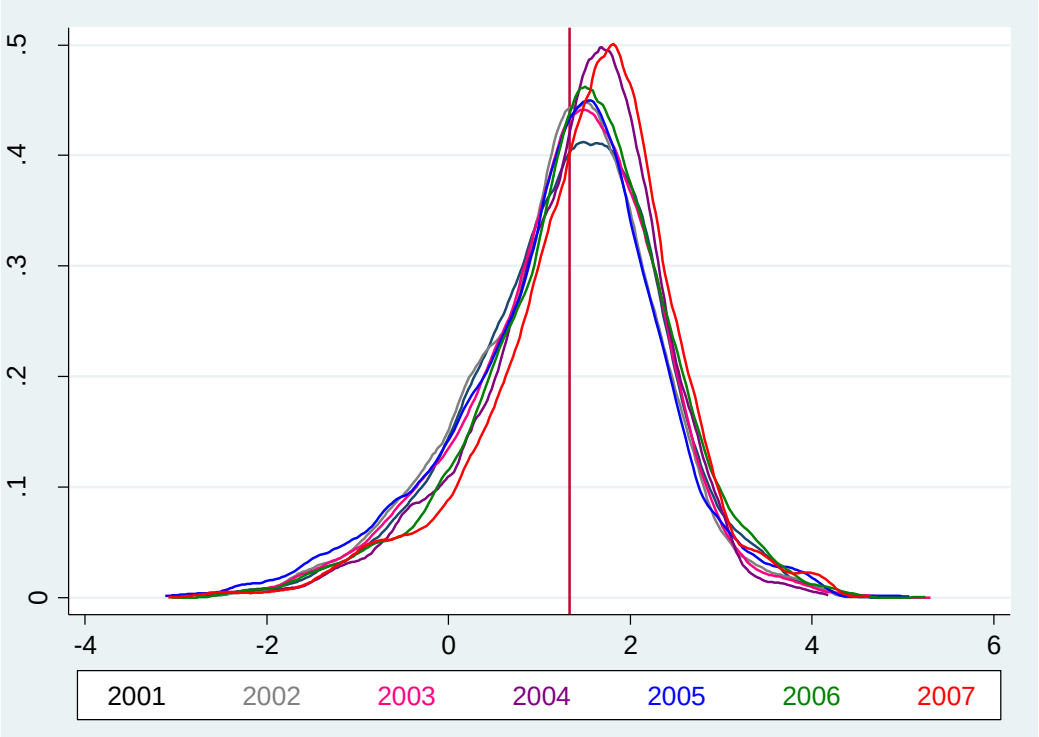
Figure 1: Distribution of Farmworker Log Real Hourly Wages (2001-2007)



Source: Data are from the September Waves of the LFS 2001-2007.
Notes: 1. The vertical line is the level of the full-time minimum wage in 2003.
2. Each wave of data contains between 1811 and 2417 observations.
3. Kolmogorov-Smirnov tests for equality of distributions are rejected at the 5% level for each pairwise comparison of waves in the before and after periods.

Figure 2 plots the distribution of real hourly wages for the control group. The kernel density plots suggest that no significant changes in wages have occurred for the control group over the period. Testing for this statistically, using the Kolmogorov-Smirnov test confirms that none of the post-law distributions are significantly different from the distributions in the period prior to the introduction of the law. As a comparison with the wage increases experienced by farmworkers, these figures suggest that the law had an observable and substantial impact in the agricultural sector.

Figure 2: Distribution of Control Group Log Real Hourly Earnings (2001-2007)



Source: Data are from the September Waves of the LFS 2001-2007.
Notes: 1. The vertical line is the level of the full-time minimum wage in 2003.
2. Each wave of data contains between 3801 and 4507 observations.
3. Kolmogorov-Smirnov tests for equality of distributions are not rejected at the 5% level for each pairwise comparison of waves in the before and after periods.

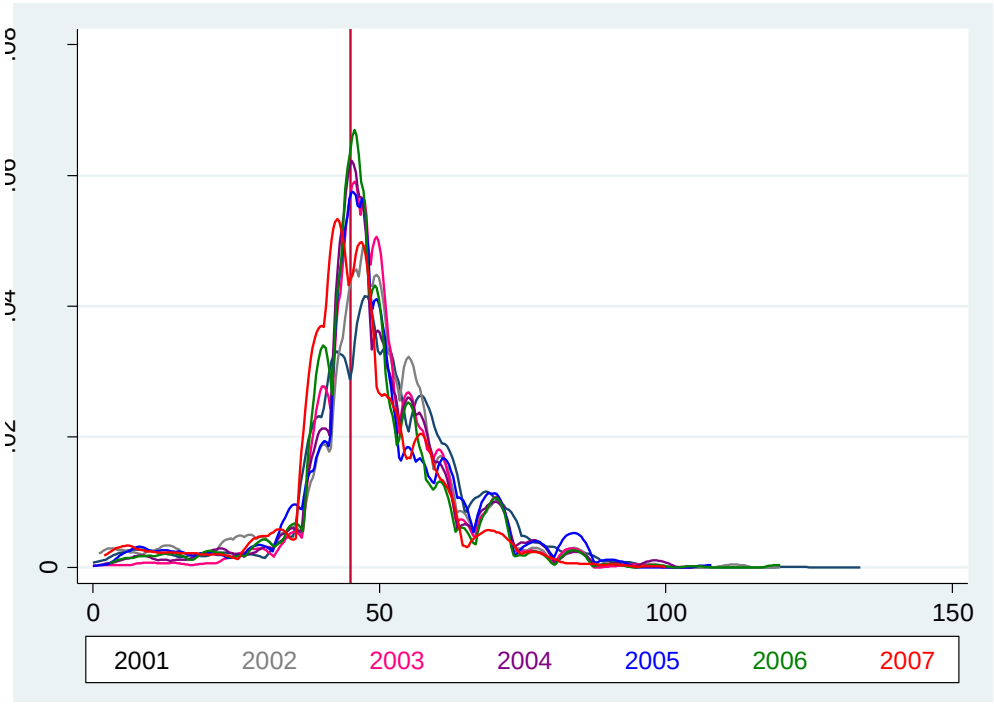
The third variable of interest in this study is the existence of a formal employment contract for farmworkers. Establishing such a contract was mandated by the new law and can be observed in the data. The final row of Table 1 provides information on the percentage of workers in the sector who hold such contracts. It is evident that this proportion rises considerably between September 2002 and September 2003; coverage increases by 17 percent over the 12 month period. It has almost doubled by September 2007. A significant portion of this increase appears to be a result of the legislation when the control group is used as a comparison. Although it is unclear what regulations govern the establishment of contracts for workers in the control group, the timing of the increase in Table 1 is informative when compared to the gradual changes observable in Table 2. The largest increase over a 12 month period in the control group is six percent.

The fourth and final variable of interest is the number of hours worked, which could be expected to change as a result of the law. In theory employers may reduce demand at the intensive margin in order to comply with the 45 hours per week maximum set out in the Minimum Wage schedule, or else simply to afford the higher wage. Hamermesh (1993) argued that, 'employers are quicker to alter hours in response to shocks than they are to change levels of employment' (p. 294). Further, if employers have to increase wages due to the law, they might require more productivity per hour from each worker and in this way be able to reduce demand at the intensive margin. Alternatively, it is a common stylized fact that full-time workers earn more than similar part-time employees. This suggests that full-timer workers produce more per hour. If this is true, firms may lengthen work-weeks rather than reduce them in response to a minimum wage increase (Brown, 1999). The theoretical effect of minimum wages on hours worked is therefore ambiguous. Hertz (2005) finds that the minimum wage reduced hours of work for domestic workers in South Africa. Contradicting this, Dinkelman and Ranchhod (2010) find no evidence that employers adjusted on the intensive margin to accommodate the minimum wage law for domestic workers. Expectations as to the Agricultural Sector's response in this regard are thus unclear.

In contrast to the changes observed in employment, wages, and contract coverage, Table 1 suggests that average hours of work in the agricultural sector remained unaffected by the law. No definite trend in hours worked can be isolated from the data. Similarly, average hours worked among individuals in

the control group appears relatively stable across the period. What is evident, is that on average farmworkers report working more than 45 hours per week for every year. To examine the changes in hours worked more critically, Figure 3 plots a kernel density function. The vertical line is placed at 45 hours per week. The density plot confirms that no significant changes in hours worked have taken place over the period. This result, together with the observed changes in employment and wages, suggests that perhaps employers adjusted at the extensive margin to afford the larger wage bill and thus the law had little impact at the intensive margin.

Figure 3: Usual number of hours worked per week



Source: Data are from the September Waves of the LFS 2001-2007.
Notes: 1. The vertical line is set at 45 hours.
2. Each wave of data contains between 1809 and 2381 observations.
3. Kolmogorov-Smirnov tests for equality of distributions are not rejected at the 5% level for each pairwise comparison of waves in the before and after periods.

4. ECONOMETRIC RESULTS

Table 4 (see Appendix) presents the difference-in-differences results for the probability of retaining employment as a farm worker with the onset of the minimum wage law. The binary dependent variable is whether an individual works as a farmworker (one) or not (zero), and the second column includes controls for individual worker characteristics. The sample includes farmworkers and all demographically similar individuals who are either employed or looking for work[12]. Using this sample allows for farmworkers to lose or switch jobs in the post-law period. If employment has in fact fallen for farmworkers due to the law, as the descriptive data shows, then one should see a decrease in the probability of farm employment after March 2003. The results show that the probability of an individual in the sample working as a farmworker has fallen by between 14-15 percent in the period after the law. Interestingly, the results indicate that the probability of agricultural employment is slightly higher in areas where the wage gap was bigger. This could simply be picking up districts with more farmworkers and therefore lower wages. The results also show that the probability of farm employment after the law is slightly lower in areas where the wage gap was largest. The coefficients are all significant. This result, together with the descriptive data which illustrates the trends in the number of farmworkers over time, provides compelling evidence that the minimum wage has had observable disemployment effects in the agricultural sector.

[12] The sample includes individuals of working age, in elementary occupations, who earn low wages, and hold education levels of no greater than matric.

Regarding earnings, we consider the descriptive data to be compelling evidence of a large shift in wages due to the introduction of the new law; the density plots in particular make this clear. In order though to isolate the effect of the law, the difference-in-differences approach tests whether farm workers experienced significant changes in wages in the post-law period when compared to a similar group of workers not covered by the law. The results from Table 5 (see Appendix) suggest that this does appear to be the case. It is also shown that districts with a higher wage gap experienced greater wage increases after the law.

Specifically then, column 1 of Table 5 compares the wage outcomes of farmworkers against wages of the control group, using equation 1, as specified above. Results show that wages in the post-law period have risen by approximately 28 percent, for all workers in the sample. The farmworker dummy variable indicates that, when compared to individuals in the control group, farmworkers earn significantly lower wages. On average farmworker wages are over 50 percent lower than the wages earned by similar workers in other occupations; over the entire sample period. Of principal interest is the difference-in-differences estimator which reveals how much wages have risen for farmworkers in the post-law period relative to those in the control group. The output shows that the estimated effect of the law on farmworker wages was an increase of 17.6 percent. This outcome controls for the difference between the two groups as well as possible biases emanating from trends over time.

The output in columns 2 and 3 of Table 5 use the approach outlined in equation 2 to see whether the wage increases for farmworkers were larger in districts where the wage gap was greater. Column 3 includes controls for education, age, and race. The pre-law wage gap is defined so that districts with lower farmworker wages (relative to the wage of the control group) result in a bigger wage gap. Examining the output one can see that an increase in wages of between 34-38 percent is evident in the post-law period. The results in column 1 revealed that approximately half of this increase (17 percent) can be attributed to the law. Inspecting the wage gap coefficients it is clear that farmworker wages are lower in districts where the gap is bigger. The coefficient on $POST_t * WG_j$ is large, significant and positive in both specifications. This suggests that areas with a bigger wage gap in the pre-law period saw greater increases in earnings after the law was introduced. Overall these are interesting findings; not only have farmworker wages risen in the post-law period relative to counterparts in other occupations, they have risen significantly more in District Councils where the gap between the control and treatment group wage was larger.

Regarding contract coverage, the difference-in-differences output clearly confirms the pattern observed in the descriptive statistics. Table 6 (see Appendix) presents the same set of regressions as for wages, where column 1 is based on equation 1 and columns 2 and 3 are estimates of equation 2. The dependent variable is whether an individual has a written employment contract or not. Column 1 shows a 12 percentage point increase in the fraction of farmworkers and control group workers who hold a written contract after the law, so contract coverage appears to have increased for both groups. It is also clear from the results that fewer farmworkers have written contracts than their counterparts in the control group (around 17 percent less). The interaction term is again of leading interest and indicates that employment contracts increased by 15.6 percent for farmworkers in the post-law period. Columns 2 and 3, which focus exclusively on the sample of farmworkers, also point out large and significant growth in contract coverage after the law. Additionally, these regressions show that districts with a larger wage gap in the pre-law period have fewer individuals with contracts, but that coverage increased by more in these areas after the law. These econometric results demonstrate that the formalisation of employment for farmworkers, from the point of contract coverage, has been positively affected by the legislation.

Lastly, Table 7 (see Appendix) presents results from the regression analysis on changes in hours worked from 2000-2007. The same set of three regressions is run. None of the coefficients are statistically different from zero. The exception is the farmworker dummy variable in column 1 which simply shows that on average across all waves, farmworkers work 1.6 hours more than their control group counterparts. The fact that no significant changes at the intensive margin are evident for farmworkers confirms the descriptive overview. It is possible that measurement error in reporting hours of work may have biased these results. However, apart from this possibility there is no statistical evidence indicating that employers have adjusted average hours of work to accommodate the large wage increases.

5. CONCLUSION

Our results suggest that the sectoral minimum wage law in Agriculture in South Africa had significant effects, as farmworker wages rose by approximately 17 percent as a result of the law. Examining the difference-in-difference results it was also clear that wages rose by more in districts where the wage gap, between farmworker wages and control group wages, was higher. In other words, districts where farmworker wages were far below the median wages of similar workers, experienced greater wage increases. This was evident despite the fact that approximately 60 percent of farmworkers still received sub-minimum wages in 2007. Regarding non-pecuniary benefits, the law also substantially increased contract coverage for farmworkers in South Africa. The number of workers with a written employment contract increased to reach 57 percent in 2007.

In examining the effect that the minimum wage had on employment, this paper shows that while no adjustments at the intensive margin were observed, employment fell significantly in response to the law. This was evident in the descriptive statistics, particularly when employment changes are compared to those experienced by the control group. Additionally the probability of employment as a farmworker was shown to have fallen by approximately 13 percent in the post-law period. Such effects are largely supported by the new minimum wage literature where Neumark and Wascher (2007) emphasise that disemployment effects are more likely when aggregate data is analysed – particularly for unskilled workers.

Finally, a key caveat to the study is that the data covers a relatively short period of time after the introduction of the law. In the longer term, as the agricultural sector responds to this legislation, the effects observed here may change. Future studies may find valuable insight in examining the fluctuating nature of agricultural employment to see how employers respond to the legislation over time both at the extensive and intensive margin.

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APPENDIX

Table 4: Probability of working as a Farmworker

VARIABLES	(1)	(2)
POST	-0.1528***	0.13676***
	(0.00161)	(0.00155)
Wage Gap	0.0364***	0.0229***
	(0.00222)	(0.00215)
Wage Gap*POST	-0.0418***	-0.0327***
	(0.0027)	(0.00261)
Controls for Education, Age, African	NO	YES
Constant	0.0580***	0.378***
	(0.00128)	(0.00272)
Observations	320,171	320,171
R-squared	0.002	0.072

Notes: 1. Robust standard errors in parentheses.
2. All regressions are weighted. *** p<0.01, ** p<0.05, * p<0.1.
3. The dependent variable is whether the individual is employed as a farmworker (1) or not (0).
4. The sample includes individuals of working age who are unemployed or searching for work who have no more than 12 years of education.
5. POST = 1 after March 2003 and 0 otherwise.
6. The Wage Gap is the district level difference between the log of median farmworker wages and the log of median wages for the control group.

Table 5: Log Hourly Wages, Difference-in-Differences

VARIABLES	(1)	(2)	(3)
POST	0.284***	0.340***	0.388***
	(0.0084)	(0.0624)	(0.0530)
Farmworker	-0.548***		
	(0.0118)		
Farmworker*POST	0.176***		
	(0.0157)		
Wage Gap		-0.154*	-0.1394*
		(0.0811)	(0.0708)
Wage Gap*POST		0.221**	0.1751**
		(0.101)	(0.0907)
Controls for Education, Age, African		NO	YES
Constant	1.338***	0.871***	0.687***
	(0.00666)	(0.0495)	(0.056)
Observations	90,986	33,892	33,575
R-squared	0.063	0.068	0.228

Notes: 1. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
2. All regressions are weighted. Regression 1 is run on the sample of farmworkers and the control group. Regressions 2 and 3 include only farmworkers. Regressions have the 'Log of Hourly Wages' as dependent variables.
3. POST = 1 after March 2003 and 0 otherwise.
4. The Wage Gap is the district level difference between the log of median farmworker wages and the log of median wages for the control group.

Table 6: Contract Coverage, Difference-in-Differences

VARIABLES	(1)	(2)	(3)
POST	0.124***	0.140***	0.169***
	(0.00475)	(0.0145)	(0.0144)
Farmworker	-0.170***		
	(0.00613)		
Farmworker*POST	0.0561***		
	(0.00801)		
Controls for Education, Age, African		NO	YES
Wage Gap		-0.178***	-0.132***
		(0.0189)	(0.0188)
Wage Gap*POST		0.0876***	0.0331
Constant	0.496***	0.421***	0.443***
	(0.00382)	(0.0108)	(0.0128)
Observations	69,743	31,218	31,017
R-squared	0.040	0.038	0.064

Notes: 1. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
2. All regressions are weighted. Regression 1 is run on the sample of farmworkers and the control group. Regressions 2 and 3 include only farmworkers.
3. The dependent variable is whether the individual has a written employment contract (1) or not (0).
4. POST = 1 after March 2003 and 0 otherwise.
5. The Wage Gap is the district level difference between the log of median farmworker wages and the log of median wages for the control group.

Table 7: Usual Hours of Work, Difference-in-Differences

VARIABLES	(1)	(2)	(3)
POST	0.1807	0.0268	0.19
	(0.132)	(1.078)	(1.075)
Farmworker	1.642***		
	(0.189)		
Farmworker*POST	0.106		
	(0.0911)		
Controls for Education, Age, African		NO	YES
Wage Gap		1.085	1.096
		(1.670)	(1.650)
Wage Gap*POST		-0.455	-0.579
		(1.897)	(1.881)
Constant	47.53***	48.60***	50.21***
	(0.105)	(0.892)	(0.939)
Observations	95,399	34,560	34,231
R-squared	0.003	0.000	0.004

Notes: 1. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
2. All regressions are weighted. Regression 1 is run on the sample of farmworkers and the control group. Regressions 2 and 3 include only farmworkers.
3. The dependent variable is whether the individual has a written employment contract (1) or not (0).
4. POST = 1 after March 2003 and 0 otherwise.
5. The Wage Gap is the district level difference between the log of median farmworker wages and the log of median wages for the control group.

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