

## Agricultural producer responses to minimum wage changes

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### Abstract

In 2013, South Africa's agricultural sector experienced a substantial 52% increase in minimum wages. This paper employs a rigorous difference-in-differences methodology to examine the strategies employed by farm owners to accommodate the additional wage costs incurred. While existing literature on South African minimum wages has predominantly focused on employment outcomes due to limited access to micro firm-level data, we adopt a more comprehensive approach. Utilizing administrative tax data, we expand the analytical framework, resulting in a larger sample size and increased precision compared to traditional survey methods. Our empirical findings reveal that farms with initially lower wage levels responded to the wage hike by raising their average wages, concurrently reducing their levels of employment. Importantly, our analysis does not yield conclusive evidence in favor of capital-labor substitution. Notably, sales revenues remained unchanged, suggesting that this adjustment in labor costs may have been accompanied by improvements in overall production efficiency. These findings contribute to a deeper understanding of the labor market dynamics in the South African agricultural sector following minimum wage policy changes.

**Keywords:** South Africa, agricultural sector, minimum wage, firm-level margins, administrative tax data, employment, efficiency, capital-labour substitution.

**JEL Classification:** C21, C23, J23, J38

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## 1. Introduction

The discourse surrounding the effects of minimum wages on low-wage employment has been at the forefront of economic debates since the seminal work of Card and Kruger in 2000. While empirical studies have produced diverse findings, a notable evolution in the economic consensus regarding the employment consequences of minimum wages has emerged (Geide-Stevenson & La Parra-Perez, 2022). However, the empirical evidence in the context of developing nations, marked by nuances such as legislative non-compliance that can attenuate employment effects (Bhorat et al., 2017), remains limited. Furthermore, firms faced with minimum wage increases make intricate decisions that encompass adjustments to employment levels, alterations in production techniques, and considerations of capital-labour trade-offs.

This study delves into the response of agricultural enterprises in South Africa, a relatively underexplored area within developing economies, to shifts in minimum wages. Existing literature broadly divides into supply-side and demand-side perspectives. Supply-side research predominantly relies on household-level data and generally concludes that minimum wages bolster earnings at the lower end of the wage scale. Empirical accounts vacillate between indicating potential job losses (Brown et al., 1982; Paredes and Riveros, 1989; Chacra Orfali, 1990) and more neutral, occasionally favourable, outcomes (Card and Krueger, 1993; Martinez et al., 2001; Miranda, 2013). In contrast, demand-side literature, though rare due to data accessibility challenges, offers a more comprehensive view, exploring firm-level implications including employment, profit margins, and revenue. However, these insights are primarily derived from industrialized economies and seldom extend to emerging economies, and when they do, they are typically confined to the manufacturing sector.

Our research addresses this gap and advances in two significant ways: first, by broadening the scope beyond mere employment considerations in the South African context, and second, by innovatively harnessing administrative tax data, which, despite its inherent challenges, offers the promise of precision, comprehensive samples, and unfiltered insights rarely attainable through conventional survey methods. It is important to note, however, that our analysis inadvertently excludes the bustling informal sector, which largely operates outside the realm of minimum wage regulations (Bhorat et al., 2017).

Building on insights from Harasztosi and Lindner (2019) and employing the fraction of workers per firm affected by minimum wages as our evaluative metric, we dissect the ramifications of a substantial 50% real minimum wage increase in 2013 within South Africa's agricultural sector. Preliminary findings highlight wage

inflation, significant reductions in employment, yet paradoxically, no discernible impact on revenue and profit metrics for lower-wage farms, suggesting the possibility of increased labor productivity.

The subsequent sections are organized as follows: Section 2 provides the background of the study; Section 3 reviews relevant theoretical and empirical literature; Section 4 outlines our identification strategy; Section 5 presents an overview of our data sources and offers summary statistics; Sections 6 and 7 present our key findings and robustness tests, respectively; and Section 8 concludes the study.

## **2. Background**

Prior to the implementation of a National Minimum Wage in 2019, South Africa's wage regulations followed a sectoral approach. Specifically, Sectorial Determinations 8 and 13 governed wage floors and broader employment conditions within the agricultural sector. These agricultural minimum wages were initially introduced in 2003 and were subject to annual adjustments in line with inflation rates. However, a significant transformation occurred after 2012, driven by farmworker strikes, primarily in the Western Cape region. Effective March 1, 2013, the daily minimum wage increased from ZAR 70 to ZAR 105. This substantial rise provides a fertile context for examining the consequences of wage increases, and we exploit this shift to investigate its ripple effects on various firm-level indicators.

On the supply side, previous studies have examined the employment implications of the 2013 wage hike, revealing noticeable trends of reduced employment (Bhorat et al., 2014; Garbers et al., 2015; van der Zee, 2017; Piek & von Fintel, 2019, Piek et al., 2020). However, the scarcity of firm-specific data in South Africa has limited exploration into the demand-side analysis. A lone study addressing this aspect suggests that the 2013 wage increase led to significant increases in labour costs, with consequential effects spreading across firms intertwined in agricultural supply chains (Tan, 2021). This inquiry distinguishes itself as the first endeavour to unravel the multifaceted strategies adopted by farmers in response to the wage augmentation.

## **3. Theory and evidence on minimum wage adjustment channels**

A spectrum of theoretical frameworks provides valuable insights into the intricate relationship between minimum wages and firm behaviour, shedding light on various labour market assumptions and their corresponding predictions. Key among these are the neoclassical competitive model, the monopsony model, institutional perspectives, and search-theoretic models (Bhaskar and To, 1999; Herr et al., 2009; Schmitt, 2013; Gorry, 2013). These frameworks illuminate diverse strategies that firms may employ in response to a

binding minimum wage, including adjustments in employment levels, reductions in non-labour costs, enhancements in efficiency, or potential price increases for their end-products. It is important to note that the effectiveness of these mechanisms is contingent on robust legislative enforcement, as weak monitoring or reluctance to pass on cost increases to consumers can mitigate these effects (Bhorat et al., 2017; Goraus-Tanska and Lewandowski, 2019; Weil, 2005).

The neoclassical competitive perspective envisions a frictionless labour market where minimum wage increases typically lead to reductions in employment, among other possible responses (Lester 1960, Hirsch et al. 2015, among others). These responses may encompass not only workforce reductions but also adjustments in working hours, reductions in non-wage benefits, or decreased investments in training for less skilled labour. Under fixed output prices, firms may transmit adjustments in prices, contingent on the elasticity of their products, with non-tradable sector entities having more flexibility in this regard compared to those exposed to global competition.

In contrast, search and monopsony models, grounded in market imperfections, offer a more nuanced view (Cahuc 2014, Flinn 2006, Ashenfelter et al., 2010, among others). These models depict scenarios where minimum wages could stimulate employment through increased job searches or by altering a firm's upward-sloping labour supply curve.

The institutional model, distinct from the neoclassical framework, allows for the possibility of enhanced economic efficiency (Kaufman 2010, Hirsch et al. 2015, among others). Firms, under this paradigm, may offset higher wage costs through efficiency gains, which could include more flexible work arrangements, increased effort levels, or intensified worker training.

Empirically, the impact on employment remains a subject of ongoing debate. While Geide-Stevenson and Perez's (2022) study suggests a declining consensus regarding negative employment effects, more recent research underscores adverse implications, particularly for less skilled labor (Neumark & Washer, 2006; Neumark et al., 2014). Evidence on price pass-through is bolstered by works such as Wadsworth (2010) and Harasztosi and Lindner (2019), with the latter revealing a robust 75% pass-through rate. Studies like Card and Krueger (1995) and Hirsch et al. (2015) reaffirm these inflationary tendencies.

Conversely, the relationship between minimum wages and productivity remains a topic of divergence. While earlier assessments, such as Acemoglu and Pischke (2003), found limited productivity impacts, more recent evaluations, including Hirsch et al. (2015) and Riley and Bondebene (2015), highlight increases in productivity.

Lastly, the adverse consequences on revenues and profitability can be potentially existential if firms are unable to adjust effectively. Although empirical literature on profitability is limited, it suggests that profit declines can jeopardize firm viability, as exemplified by Draca, Machin, and van Reenen (2011) and Luca and Luca (2019).

#### 4. Empirical strategy

To discern the effects of the minimum wage increase on agricultural enterprises, our empirical analysis employs a robust difference-in-differences framework, building upon the pioneering work of Harasztsosi and Lindner (2019). Our model is expressed as follows:

$$\frac{y_{it} - y_{i2013}}{y_{i2013}} = \alpha_t + \beta_t FA + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

In this equation,  $y_{it}$  represents the outcome of interest for firm  $i$  at time  $t$ . The variable  $FA$  delineates the proportion of workers impacted—a constant across firms throughout the examined span. The vector  $X$  includes a comprehensive set of firm-level control variables, such as firm size, foreign ownership status, and the pre-policy capital-labor ratio. Furthermore, we incorporate three-digit industry fixed effects to enhance the granularity of our analysis.

The left-hand side of the equation captures the relative change in the outcome variable from 2013, the final fiscal year preceding the wage shift, to year  $t$ . The coefficient  $\beta$  quantifies the discernible impact of the wage increment on the variable of interest. It is essential to note that in this configuration, both time-specific effects and firm-specific attributes exhibit temporal flexibility, consistent with the framework developed by Harasztsosi and Lindner (2019).

This analytical framework enables us to systematically assess the effects of the minimum wage increase on various firm-level metrics by comparing the trajectories of treated and control entities, while controlling for important covariates and industry-specific factors.

## 5. Data and variables

Our empirical analysis relies on anonymized tax records from South Africa, allowing us to investigate the firm-level consequences of the minimum wage increase. We leverage two primary datasets: the Corporate Income Tax (CIT) records and the payroll tax certificates contained within the IRP5 dataset.

The crucial treatment variable in our study, representing the fraction of affected workers, originates from the IRP5 records. These records provide detailed information on individual employment durations and annual incomes. After calculating both the workforce size on each farm and the proportion of laborers in 2012 whose earnings fell below the forthcoming 2013 minimum wage threshold, we transform the IRP5 data into a firm-level perspective. Employing unique identifiers present within the IRP5 dataset, we subsequently integrate this information with the CIT dataset.

The additional outcome metrics used in our analysis are extracted from the CIT records, which offer comprehensive balance sheet insights for each farm. We narrow our focus exclusively to the agricultural sector using two-digit SIC7 industry codes. It is important to note that not all farms listed in the CIT data can be matched with IRP5 certificates. Out of the 30,553 farms documented in the CIT data, only 15,037, or just under 49%, have corresponding entries in the IRP5 dataset. Consequently, our analytical efforts are limited to those farms registered in CIT data that can be linked to IRP5 documentation. As presented in Table 1, the harmonized dataset primarily includes larger farming enterprises. To address any potential bias towards more substantial entities, we employ a reweighting scheme based on farm size.

**Table 1: Mean comparison between matched and unmatched samples**

Tax year	Labour cost (ZAR)		Capital Expenditure (ZAR)		Sales Revenue (ZARZ0)	
	Matched	Unmatched	Matched	Unmatched	Matched	Unmatched
2010/2011	3,833,521	1,859,318	11,396,921	7,638,598	40,090,864	10,092,924
2011/2012	4,172,529	1,807,241	14,041,518	7,972,111	43,295,332	10,518,447
2012/2013	4,077,651	2,454,689	15,389,129	10,590,323	42,449,404	14,309,355
2013/2014	4,936,624	2,497,485	18,700,073	10,723,606	51,079,534	16,974,225
2014/2015	5,689,800	2,429,357	22,056,752	11,287,229	57,516,251	17,171,298
2015/2016	6,282,174	3,786,944	25,890,801	12,779,931	66,298,197	27,159,031
2016/2017	6,973,257	2,775,420	29,383,460	12,627,818	72,352,202	20,442,980

Notes: Table 1 shows the means values in ZAR of the key CIT variables for matched and unmatched farms. We only use the matching farm in the final sample.

Source :Authors computations from own datasets (CIT) based on National Treasury and UNU-WIDER (2021)

**Table 2: Time series values of labour cost, employment, capital and revenue**

Tax year	Labour cost (ZAR)	Farm Employment (ZAR)	Capital Expenditure (ZAR)	Sales Revenue (ZAR)
2010/2011	1,003,962,564,608	210,841	2,981,089,247,232	10,507,942,625,280
2011/2012	1,093,059,870,720	243,54	3,674,502,332,416	11,340,643,041,280
2012/2013	1,185,175,175,168	241,826	4,466,417,860,608	12,357,276,270,592
2013/2014	1,252,043,915,264	239,65	4,737,278,148,608	12,947,473,563,648
2014/2015	1,312,030,982,144	258,086	5,079,629,824,000	13,254,987,350,016
2015/2016	1,296,707,223,552	253,486	5,328,326,885,376	13,666,644,656,128
2016/2017	1,262,382,219,264	265,705	5,314,899,869,696	13,093,870,501,888

Notes: Table 2 shows the time series values, from our final matched sample, of the critical variables across the tax years covered in the sample. The values are reported in the South African Rand (ZAR)

Source :Authors computations from own datasets (CIT and IRP5) based on National Treasury and UNU-WIDER (2021)

The "fraction affected" metric quantifies the proportion of workers on a farm, in the period preceding the policy change, whose earnings were below the impending minimum wage. Using data from the pre-policy period spanning 2011-2013, we construct this metric by calculating the mean share of these workers. This measure, which remains time-invariant for individual farms, varies between 0 and 1. Farms with minimal exposure to the wage shift tend to have values towards the lower end of this spectrum, while those most affected are positioned towards the higher end.

A more detailed depiction of this distribution is presented in Table 3 and Figure 1. Notably, over 15% of farms had already compensated all their labor above the prospective minimum wage threshold prior to its formal implementation, rendering them unaffected by the direct implications of the policy change. In contrast, nearly 5% of farms predominantly employed a workforce earning below the new wage benchmark. At the median, approximately 65% of farm workers were earning wages below this newly established threshold.

**Table 3: Percentiles of Fraction of affected workers**

	1%	5%	10%	25%	50%	75%	90%	95%	99%
<b>Fraction affected</b>	0	0	0	.27	.65	.83	.94	.99	1

Notes : Table 3 shows the distribution of our treatment variable, a fraction of affected workers.

Source :Authors computations from own datasets (IRP5) based on National Treasury and UNU-WIDER (2021)

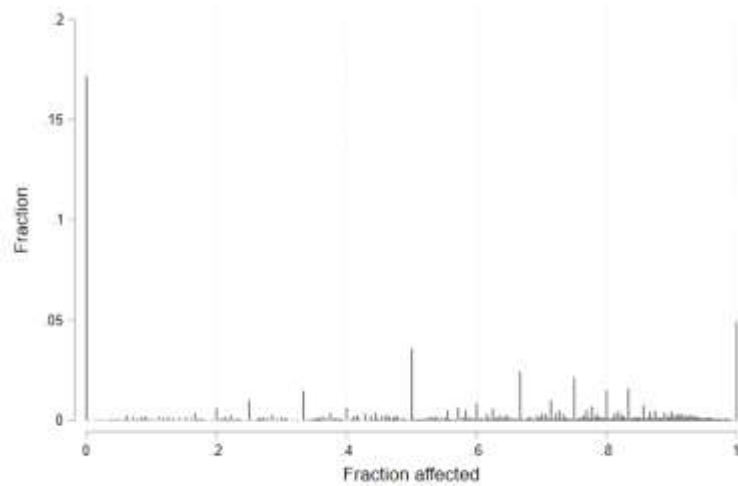


Figure 1 : Spike plot showing the distribution of the treatment variable (fraction of affected workers)

As depicted in Figure 2, our analysis reveals a positive yet modest correlation between the "fraction affected" metric and the total number of workers employed on the farm. This observation suggests that farms with larger workforces do not necessarily correspond to low-wage farms.

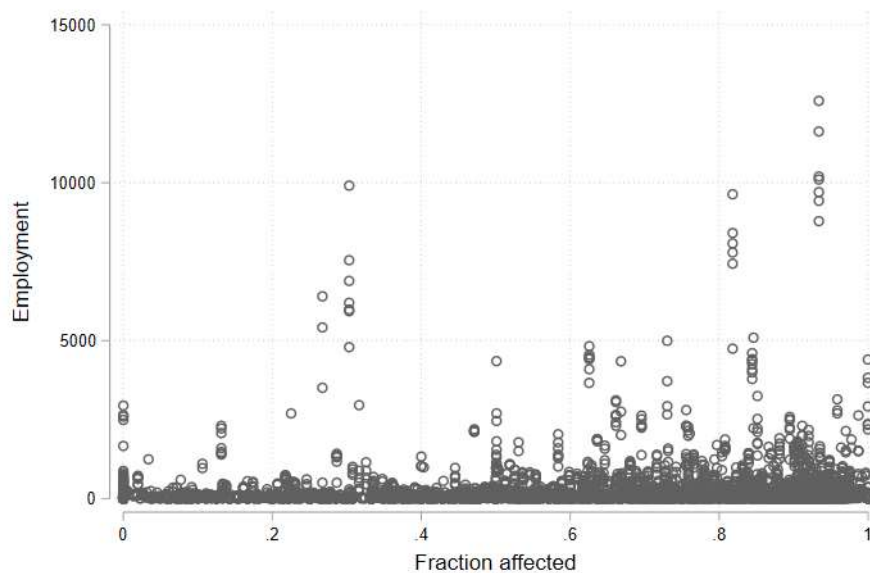


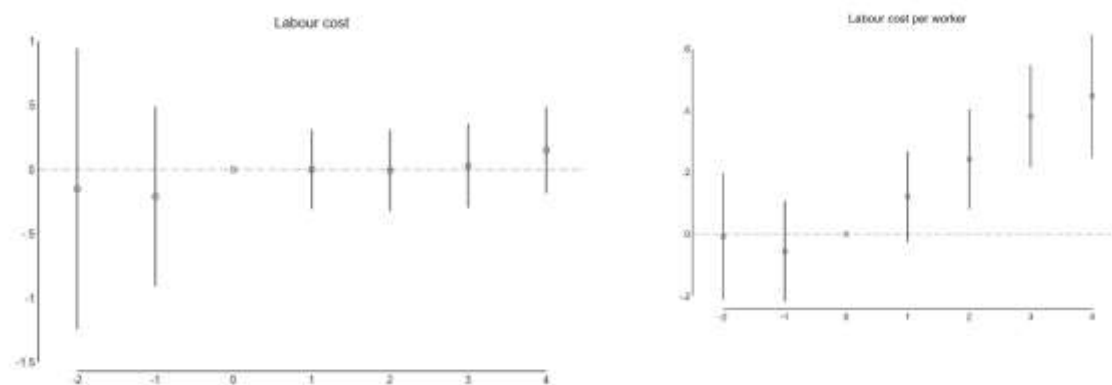
Figure 2 : Scatter plot showing the relationship between employment and fraction of affected worker  
Source: Authors computations from own datasets (CIT and IRP5) based on National Treasury and UNU-WIDER (2021)

## 6. Results and Discussion



This section presents the outcomes derived from our estimation of Equation 1. Detailed regression tables that underlie the coefficient plots presented here are available in Appendix A. As demonstrated in Figure 3, the implementation of the minimum wage legislation appears to have noticeable effects on both the overall labour expenditure and the per-employee labour cost for farms that primarily employ low-wage workers. While the total labour expenditure remains unchanged after the policy's introduction, a distinct increase is evident in the per-employee labour cost for these farms. This rise in per-employee cost, coupled with a static total labour expense, suggests potential reductions in employment. The intricacies of this phenomenon merit further in-depth examination, which we undertake in the subsequent discussion.

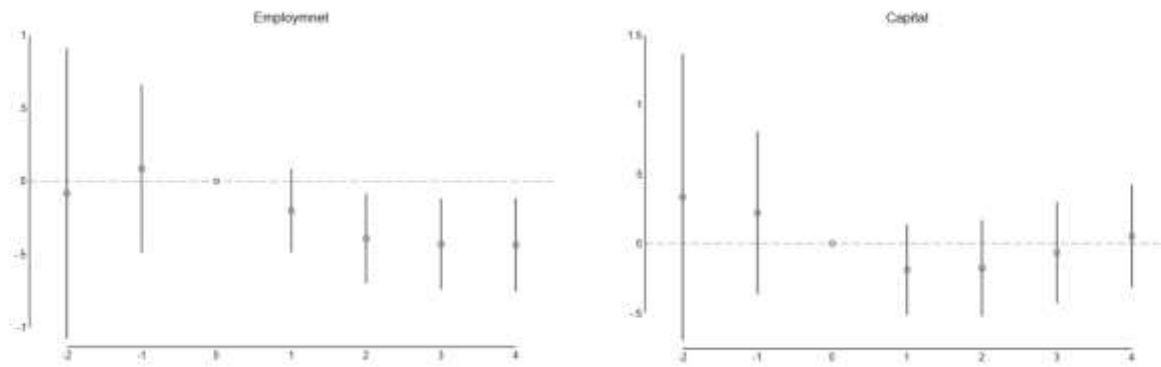
Figure 3: Effect of minimum wage hike on Labour cost per worker



**Notes:** Figure 3 shows the results of the evolution of total labour cost after the minimum wage increase. A firm's total labour cost consists of wage and non-wage components. The non-wage component may include group life insurance, Unemployment Insurance Fund (UIF) contribution, employee training expenditure etc.

**Source:** Authors computations from own datasets (CIT and IRP5) based on National Treasury and UNU-WIDER (2021).

Figure 4: Effect of minimum wage hike on employment and capital



**Notes:** Figure 4 shows the evolution of employment and capital after the minimum wage hike. The results are weighted by farm size. See the regression table in Appendix A to compare the results from the weighted and unweighted models.

**Source:** Authors computations from own datasets based on National Treasury and UNU-WIDER (2021)

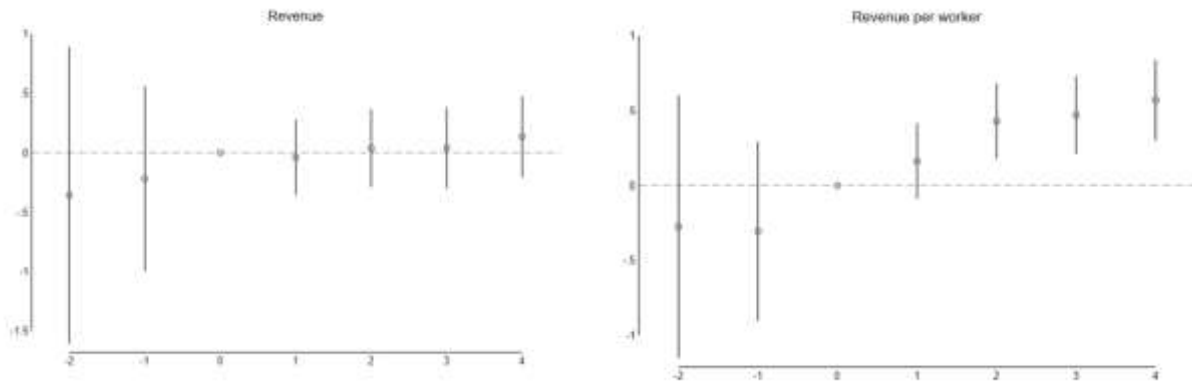
The left panel of Figure 4 elucidates the employment trends among affected farms following the minimum wage increase. The visual representation suggests a gradual reduction in employment on these farms in response to the wage hike, with these reductions intensifying over time. This decline in employment contributes to the observed increase in per-employee labour costs. Consequently, the data does not unequivocally demonstrate that the wage increase led to higher aggregate labour expenses on impacted farms. Instead, it suggests that farms with a substantial proportion of minimum-wage workers downsized their workforce after the wage policy adjustment, effectively redistributing their compensation among a smaller labour force.

The corresponding panel on the right side of Figure 4 reveals a stable capital trend following the wage increase. This finding dismisses significant capital-labour trade-offs in response to the policy change.

Given the dynamics depicted in Figure 4, one might anticipate a decline in production levels on these low-wage farms, which could subsequently impact revenues and profitability. However, contrary to such expectations, Figure 5 highlights the relative lack of impact of the wage hike on revenue streams. Despite having a reduced workforce and an unchanged capital investment, these farms remarkably maintained their revenue levels from the pre-policy period. The increased revenue per labour unit suggests an improvement in labour efficiency among these farms. One plausible mechanism behind this enhanced operational

efficiency could be a strategic adjustment of the workforce—retaining highly productive workers while letting go of less efficient ones.

Figure 5: Effect of minimum wage hike on revenue and revenue per worker



**Notes:** Figure 5 shows the evolution of sales revenue and revenue per-workers after the minimum wage hike. The results are weighted by farm size. See the regression table in Appendix A to compare the results from the weighted and unweighted models.

**Source:** Authors computations from own datasets based on National Treasury and UNU-WIDER (2021)

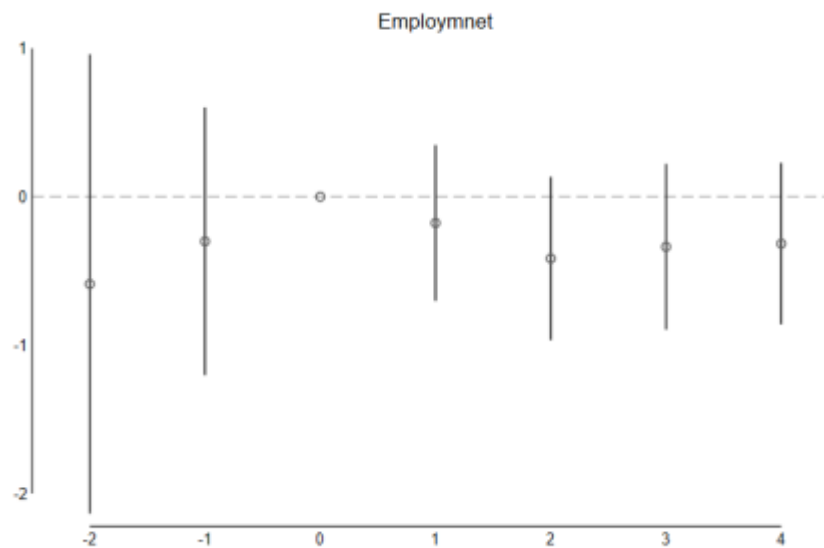
## 7. Robustness Analysis

Our data highlights a notable pattern of workforce reductions within low-wage farms following the implementation of a substantial and sustained minimum wage increase. While Figure 4 provides support for the plausibility of the common trend assumption, it is a fundamental principle in empirical analysis to further validate the robustness of key findings. A commonly employed method in the literature to achieve this is the placebo test, where the treatment is hypothetically assumed to commence before the actual policy event, allowing us to assess any resulting policy effects on outcome metrics. The detection of any policy effect in this context could potentially challenge the validity of our primary findings, suggesting the presence of extraneous variables at play.

Due to the temporal constraints of our dataset, which includes only two years prior to the policy shift, a conventional horizontal placebo test is not feasible. However, a vertical placebo test remains a viable alternative. To conduct this test, we reconstructed our sample to focus on high-wage farms—those least affected by the wage amendment. Specifically, we tailored our sample to include farms situated above the 75th percentile of labour costs during the pre-policy period. This placebo group comprises 1,884 farms and,

interestingly, still exhibits some variation in the treatment metric, which is represented by the fraction of affected workers.

Figure 6: Placebo test: Effect of minimum wage hike on high -wage farms



**Notes:** Figure 6 shows the evolution of employment for farms above the 75th percentile of the pre-policy labour cost distribution. Appendix B presents a regression table showing estimate results for employment and other outcome variables.

**Source:** Authors computations from own datasets based on National Treasury and UNU-WIDER (2021)

Figure 6 presents the employment outcomes derived from our model tailored for a subset of high-wage firms. Remarkably, our observations do not indicate any noticeable policy-induced changes in employment patterns (for detailed regression results, please refer to Appendix B). The placebo results enhance our confidence in the notion that the shifts observed in our primary dataset are fundamentally linked to the modification of the minimum wage policy.

Nevertheless, it is crucial to acknowledge the analytical frontier ahead. The broader relationship between firm longevity and potential exits warrants further investigation. It remains plausible that farms exiting our dataset trajectory were already facing declining revenue streams, suggesting that potential declines in profitability could have been an inherent response mechanism.

## 8. Conclusion

Utilizing a unique compilation of administrative tax records, our analysis has provided a comprehensive examination of the firm-level consequences stemming from a substantial minimum wage increase in South Africa's agricultural sector. Through our rigorous difference-in-differences estimation, our findings do not indicate an increase in aggregate labor expenses for the affected entities. However, there is a clear and progressively increasing trend in per-employee labor expenditures, a trend that corresponds with concurrent reductions in the size of the workforce. These dynamics suggest that the agricultural entities subject to the new wage landscape chose to downsize their workforce as a strategic response to mitigate the pronounced labor cost increases resulting from the adjusted wage floor.

Remarkably, these same entities, now operating with a reduced labor force and maintaining their capital expenditures at pre-policy levels, managed to sustain their revenue levels. Typically, in the "tradable" agricultural sector, revenue levels might plateau or even decline in response to wage inflation. However, our insights present a nuanced narrative: the primary adaptation mechanism appears to be workforce recalibration. Consequently, our data suggests a compelling proposition—South Africa's minimum wage policy may have unintentionally stimulated efficiency improvements within its agricultural sector. This enhanced efficiency could potentially be attributed to strategic workforce optimization—removing less productive employees while retaining a core of highly productive workers, thereby ensuring revenue consistency.

Appendix A : Regression Table

	Labour cost	Labour cost	Employment	Employment	Capital	Capital	Revenue	Revenue	Profit	Profit
fa*2011	0.308 (0.353)	-0.149 (0.558)	0.199 (0.382)	-0.083 (0.507)	0.585 (0.473)	0.334 (0.527)	0.225 (0.393)	-0.358 (0.638)	-0.125 (0.414)	-0.504 (0.621)
fa*2012	0.079 (0.180)	-0.208 (0.357)	0.538*** (0.195)	0.085 (0.293)	0.475** (0.242)	0.220 (0.299)	0.201 (0.201)	-0.220 (0.397)	-0.012 (0.212)	-0.314 (0.382)
fa*2013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
fa*2014	0.016 (0.105)	0.001 (0.158)	-0.349*** (0.114)	-0.202 (0.145)	-0.122 (0.141)	-0.190 (0.166)	-0.006 (0.117)	-0.040 (0.162)	-0.046 (0.123)	-0.038 (0.162)
fa*2015	-0.002 (0.106)	-0.006 (0.162)	-0.544*** (0.115)	-0.392** (0.157)	-0.069 (0.142)	-0.178 (0.177)	0.009 (0.118)	0.038 (0.167)	-0.086 (0.124)	-0.065 (0.167)
fa*2016	-0.017 (0.109)	0.030 (0.167)	-0.630*** (0.118)	-0.430*** (0.159)	0.008 (0.146)	-0.068 (0.186)	0.006 (0.121)	0.039 (0.174)	-0.104 (0.128)	-0.116 (0.176)
fa*2017	0.024 (0.112)	0.152 (0.172)	-0.756*** (0.121)	-0.436*** (0.163)	0.041 (0.150)	0.053 (0.188)	0.075 (0.125)	0.135 (0.174)	-0.057 (0.131)	-0.046 (0.173)
Weight	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	10513	10299	10513	10299	10513	10299	10513	10299	10509	10295
R squared	0.34	0.28	0.46	0.42	0.58	0.57	0.43	0.38	0.35	0.30

Appendix B : Placebo sample regression table

	Labour cost	Employment	Capital	Revenue	Profit
fa*2011	-0.601 (0.871)	-0.588 (0.789)	-0.311 (0.750)	-0.288 (1.050)	-0.418 (1.013)
fa*2012	-0.284 (0.541)	-0.300 (0.460)	-0.377 (0.468)	-0.351 (0.610)	-0.364 (0.571)
fa*2013	0.000	0.000	0.000	0.000	0.000
fa*2014	0.126 (0.279)	-0.177 (0.268)	-0.232 (0.290)	0.011 (0.304)	0.006 (0.295)
fa*2015	0.155 (0.282)	-0.416 (0.281)	-0.184 (0.303)	0.289 (0.311)	0.137 (0.300)
fa*2016	0.303 (0.289)	-0.338 (0.285)	-0.079 (0.316)	0.472 (0.319)	0.229 (0.304)
fa*2017	0.481 (0.296)	-0.316 (0.278)	0.088 (0.308)	0.588* (0.312)	0.248 (0.304)
Observations	3415	3415	3415	3415	3412
R squared	0.19	0.32	0.43	0.25	0.18

Source :Authors computations from own datasets (CIT and IRP5) based on National Treasury and UNU-WIDER (2021)

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