The Non-Agricultural Labour Productivity Effects of Working Time: South Africa's Case

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DOI: 10.24818/mer/2024.01-04

ABSTRACT

The purpose of the current study is to assess the impact of working time on non-agricultural labour productivity in the South African economy. To achieve this objective, the study utilised the Autoregressive Distributed Lag Model (ARDL) and correlation analysis to analyse the effects of different working time arrangements on labour productivity. The results of the study indicated that weekly working hours have a significant influence on worker productivity. Working between 30 and 39 hours per week was found to greatly enhance productivity both in the short and long term. Additionally, working between 15 and 29 hours per week showed a slight positive effect on productivity. Conversely, working more than 39 hours per week (between 40 and 45 hours) only increased productivity in the short term, while working less than 29 hours and exceeding 45 hours per week had a negative impact on labour productivity. These findings suggest that an optimal working schedule to maximise labour productivity is between 30 and 40 hours per week, with overtime not exceeding 5 hours per week. Establishing a proper schedule of weekly working hours is crucial for maximising labour productivity and reducing work-related stress, which can impede productivity.

KEYWORDS: *employment, labour productivity, working hours, working schedules, labour market.*

JEL CLASSIFICATION: *C22, D2, F66, J24.*

1. INTRODUCTION

The significance of human capital productivity as a fundamental factor influencing resilient and high economic growth, employment, wages, competitiveness, and improved living standards has long been acknowledged by experts (The Organisation for Economic Co-operation and Development-OECD, 2018). Numerous studies conducted in different countries and regions have indicated that without efficient labour productivity, economic growth and development remain unattainable (Campbell, 2009; Fosse et al., 2014). Unfortunately, despite the global economic benefits of labour productivity, some countries still face labour productivity issues. Various surveys conducted worldwide have identified several factors that influence workers' perceived productivity, including lack of monetary incentivisation, managerial and supervisory aspects, materials planning factors, and excessive overtime work (Alinaitwe et al., 2007; Enshassi et al., 2007; Jarkas and Bitar, 2012; Kadir et al., 2005; Kaming et al., 1998; Makulsawatudom, 2004; Rivas et al., 2011; Thomas & Sudhakumar, 2014).

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One key factor in worker productivity is the number of working hours. Proponents of labour working hours legislation argue that reasonable working hours can boost workers' morale and overall productivity. However, others contend that fixed working hours imposed through legislation can negatively impact businesses' competitive edge (Man & Ling, 2014). The impact of working time on labour productivity remains subject to debate, especially considering the varying labour legislation and union systems, levels of development, access to markets and resources, and the organisation of production factors in different economies. Nonetheless, it is widely accepted that improvements in working time arrangements can benefit both enterprises and workers. The International Labour Organisation (2004) emphasises the importance of determining the length and organisation of working time in generating productivity improvements. This includes considering both company-based considerations and employee-centred schedules that promote work-life balance and well-being (Golden, 2012).

Labour productivity is a vital component of the total factor productivity model and serves as a crucial economic indicator at the national, departmental, and individual levels. It is closely linked to an economy's competitiveness, living standards, and economic growth (Bureš & Stropková, 2014). The OECD (2016) defines labour productivity as the measurement of gross domestic product (GDP) per hour worked, reflecting the efficiency of resource utilisation in production processes. It represents GDP per unit of labour at a specific time and provides information on the quality and efficiency of human capital in production processes (International Labour Organisation-ILO, 2022).

South Africa's labour force faces social and economic challenges stemming from unequal treatment and opportunities, particularly favouring men over women. These include barriers preventing women's decision-making roles, high income disparities, and lower labour participation rates for women compared to men (Statistics South Africa, 2021). The OECD (2022b) also notes that women are less likely to be in full-time employment and often have limited opportunities for career advancement, being confined to lower-paying positions. However, South Africa has experienced an overall increase in labour productivity over time, as shown in Figure 1. Despite this general upward trend, there was a significant drop in productivity in 2019 and 2020 due to the COVID-19 pandemic and subsequent lockdown measures. Analysing the percentage growth in labour productivity, as shown in Figure 2, reveals a different story. Since the early 2000s, labour productivity has experienced declining percentage growth, with several periods of negative growth. The increase in labour input has not resulted in the corresponding real output, leading to a decrease in labour productivity. For example, from 2017 to 2018, labour productivity decreased from 0.4% to -0.9%. The period from 2014 to 2017 was marked by volatile productivity growth, including negative growth in 2015 and 2016. In 2019 and 2020, South Africa faced strong negative pressure on labour productivity, further shifting towards negative growth (Productivity SA, 2022).

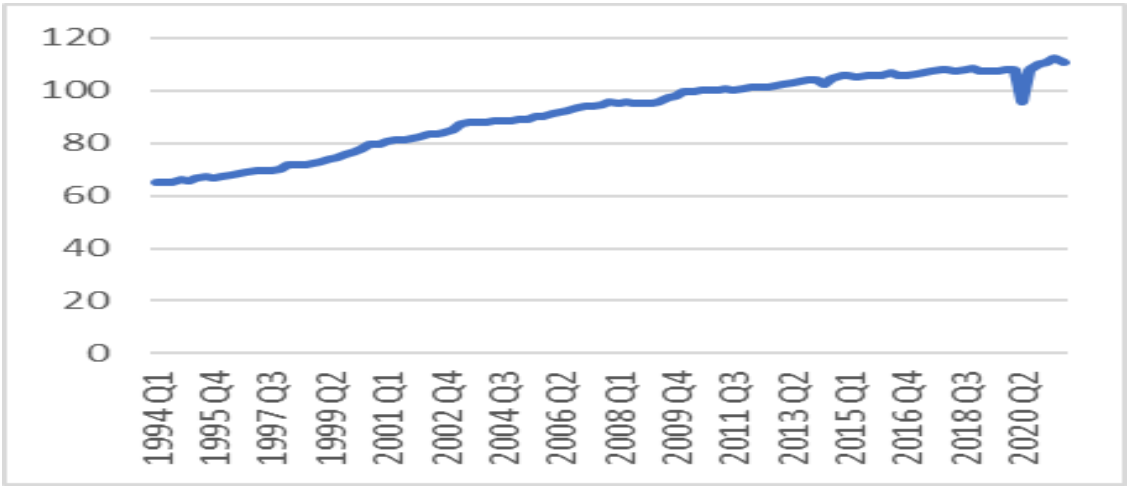

Figure 1. Non-Agricultural labour productivity
Source: Own compilation

Figure 2. Non-Agricultural labour productivity growth
Source: Own compilation

Based on the statistics presented above, it can be concluded that it is difficult to, a priori, determine the real cause of labour productivity in South Africa. Additionally, despite the significant interest in the productivity of working times, there is little research tailored to address the various labour productivity effects of South Africa's decomposed working schedules and in light of the country's legislated ordinary and overtime hours. Therefore, this study intends to analyse the worktime effects on labour productivity according to the number of workers employed in different working hours schedules. It focuses on worker-level productivity by considering variations for workers in shorter and longer weekly working hours. Prior to establishing the empirical analysis, the study presents the reviewed literature in Section 2 followed by the research methodology in Section 3.

2. LITERATURE REVIEW

2.1 South Africa's workforce characteristics and working schedules

Standard hours are often considered to be exogenous to the firm and are determined by labour agreements or by law, while employment and aggregate hours are the profit-maximising firms' control variables (Brunello, 1989). Thus, profit-maximising firms as the demand side central players, are key determining forces of working hours and workers may only choose

from the packages of wage-hours. To exercise some regulation over the wage-hour packages, the national minimum wage is enforced as a critical instrument in providing a benchmark of the minimum wages to be offered per hour of ordinary working hours (Mather, 2022). In the South African context, the standardised working hours per week as legislated by the South African Basic Conditions of Employment Act (BCEA) (No. 75 of 1997) is 45 hours weekly, which excludes unpaid lunch breaks, meaning nine hours daily for a five-day week, and eight hours daily for a more than five-day week. However, the hours worked are subject to a contractual agreement arranged between the employee and the employer. Thus, certain workers may work anything less than 45 hours of normal time, and so forth.

The 45 hours per week serves as the statutory ceiling or the maximum number of hours to be considered as "normal time" or "ordinary working hours" (The South African Labour Guide, 2022). Thus, anything beyond the stipulated 45 weekly hours would be considered overtime hours. An employee, under a voluntary agreement with the employer, may not be required or permitted to work ten hours overtime per week or three hours overtime per day, and must be either remunerated or granted prospective time off based on the agreement (Office of the President, 1997:14). Furthermore, in the issue of minimum wage, South Africa's national minimum wage spans all economic sectors, having only recently witnessed its introduction in 2019 under the National Minimum Wage Act (Expatica, 2022). Accordingly, the latter stands at R23,19 per hour as of the first of March 2022 from 21,69 per hour (LWO, 2022).

Full-time or part-time contracts tend to differ based on the type of job and the accompanying remuneration wholly or partly based on the number of hours worked. Full-time employment generally consists of more working hours per week than part-time work (Adams and Adams, (2021), Cloete, 2022). The Wage Indicator (2022) posits that a part-time employee typically works 35 or 30 hours or less, weekly. Correspondingly, the OECD (2022a) defines part-time employment as workers who typically work less than 30 hours per week. Those in full-time employment are usually on more steady incomes than part-time employees, who are normally not eligible for the same benefits as the former (Beneke, 2022). Beneke (2022) underscores that full-time employment tends to consist of an average of 30 to 40 hours per week, whereas part-time jobs are usually for a minimum of 20 hours per week. Other part-time jobs, such as the short part-time, and marginal part-time are respectively less than 20 hours and less than 15 hours per week. In light of Statistics South Africa's (StatsSA) working hours schedules and South Africa's statutory normal working hours of 45 hours per week, the foregoing distinctions of part-time working hours thereby lead to the understanding that full-time employment can naturally range from anything above 30 hours to 45 hours weekly. However, anything from 29 hours and below may be deemed as part-time hours, with overtime hours being more than 45 hours weekly.

2.2 Review of empirical findings on the effects of working hours on labour productivity

In a study conducted by Man and Ling (2014), the relationship between productivity and working hours duration in Hong Kong industries was analysed. The study found that although the results were not statistically significant, working hours were identified as critical factors that impact productivity. Similarly, Devicienti et al. (2015) discovered that part-time work had a negative effect on productivity in Italian corporations. An increase in the share of part-time work was found to decrease total factor productivity by 2%, mainly due to information

inefficiencies associated with part-time occupations. Vallo and Mashau (2020) conducted a study at Sabertek in South Africa and found a positive and significant relationship between long and ordinary working hours and employee productivity. The wages were also shown to have a positive effect on productivity during these hours. The authors emphasised the importance of employee engagement and re-evaluating work schedules. These findings align with Lewis' hypothesis that output is proportional to hours worked.

However, Pencavel (2014) argued that this relationship only holds until a certain threshold. His study on munition workers in the United States revealed a diminishing return to scale in labour productivity beyond a certain number of hours worked. Okugawa (2021) also supported the positive effects of scheduled working hours on productivity, but found that overtime hours had a negative impact. Golden (2012) established that longer working hours did not necessarily lead to increased manufacturing productivity. Instead, shorter hours were associated with increased output per hour in most industries. Flexible working time arrangements, such as working time and compressed workweeks, were found to have positive effects on labour productivity and job satisfaction.

Goudswaard et al. (2013) highlighted the role of employee-based working time flexibility in accommodating family and personal needs. Collewet and Sauermann (2017) found that productivity decreased as the number of hours worked increased, particularly among call centre agents. Delmez and Vandenberghe (2018) also observed diminishing marginal returns to working hours in Belgian firms, with productivity increasing as hours were reduced. However, firms were motivated to choose longer working hours to cover quasi-fixed labour costs. Caruso et al. (2004), Golden et al. (2011), Sparks et al. (2001), and van der Hulst (2003) suggested that long working hours could have adverse effects on workers' health, leading to decreased productivity. Increased work stress and fatigue were associated with longer hours and were likely to compromise workers' productivity and well-being. Several studies highlighted the various physical and mental health risks associated with long or irregular working hours. A survey by Bond and Galinsky (2006) found that more than half of employees in the United States preferred shorter hours to improve their well-being and work productivity.

3. METHODOLOGICAL FRAMEWORK

3.1 Data description

The study utilised quarterly time series captured from 2008 quarter one to 2021 quarter two, with an aggregate of 54 quarterly observations. The time series were extracted from Statistics South Africa (StatsSA) and the South African Reserve Bank (SARB). Particularly, time-series data on labour productivity in non-agricultural sectors was retrieved from the SARB, and the data of those employed in the various working hours schedules was sourced from StatsSA. The working schedules captured South African workers who were employed according to their “usual hours of work”. A crucial consideration of this study is the differentiation of part-time (temporary) versus full-time (permanent) working hours to better understand the insinuations of full-time and part-time labour on labour productivity, the study classified the average working hours for part-time weekly working hours and those for full-time employment in light of the foregoing reviewed literature by the OECD (2022a),

WageIndicator (2022) and Beneke (2022). Full-time employment is considered here to be ranging from 30 hours to 45 hours per week, with overtime hours being more than 45 hours weekly, and part-time hours are considered to be from 29 hours and less per week. Such classifications provided further understanding of the nature of labour in line with working hours and the implications on labour productivity.

3.2 Data description

Before estimating cointegration tests, it is paramount that the data is first checked for the data-generating process to ascertain the stationarity of the series to circumvent any likelihood of making spurious inferences about relationships that may not exist (Gujarati and Porter, 2008). To do so, the Augmented Dickey-Fuller (ADF) test was employed to test for data stationarity and whether the variables were *I*(0) or *I*(1), or mixed.

3.3 Specification of the ARDL Model

The Autoregressive Distributed Lag Model (ARDL) was employed to estimate the long-run and short-run relationships of the dependent and independent variables. The ARDL was chosen for its superiority compared to other cointegration techniques, such as the Johansen multivariate cointegration test. Mah (2000), Narayan and Narayan (2005) assert that the ARLD model presents consistent estimates even in small samples. This method can also be executed even when the covariates are mixed with *I*(0) and *I*(1) series (Dube and Zhou, 2013:203). The ARDL bounds test also deals with endogeneity issues when optimal lags are used, and concurrently permits the rectification of serial correlation in residuals. Therefore, the ARDL model was subsequently estimated in Equation (1) as expressed in the following form:

$$\Delta LY_t = \alpha_0 + \sum_{i=1}^{k} \beta_i \Delta LY_{t-i} + \sum_{i=0}^{k} \delta_i \Delta LLABPROD_{i-i} + \sum_{i=0}^{k} \sigma_i \Delta LLESS15HRSPW_{t-i} + \sum_{i=0}^{k} \emptyset_i \Delta L15\_29HRSPW_{t-i} + \sum_{i=0}^{k} \hat{u}_i \Delta L30\_39HRSPW_{t-i} + \sum_{i=0}^{k} \Omega_i \Delta L40\_45HRSPW_{t-i} + \sum_{i=0}^{k} \mu_i \Delta LMORE45HRSPW_{i=1} + \eta_1 LLABPROD_{t-1} + \eta_2 LLESS15HRSPW_{t-1} + \eta_3 L15\_29HRSPW_{t-1} + \eta_4 L30\_39HRSPW_{t-1} + \eta_5 L40\_45HRSPW_{t-1} + \eta_6 LMORE45HRSPW_{t-1} + \varepsilon_t \quad (1)$$

Where:

Δ represented the variables' first difference operator, the natural log of non-agricultural labour productivity was represented by ΔLY_t as the dependent variable.

Subsequently, *LLABPROD* signified the natural log of labour productivity, *LLESS15HRSPW* represented the natural log of employees workers who worked less than 15 hours per week, *L15_29HRSPW* denoted the natural log of employees who worked from 15 hours to 29 hours per week, *L30_39HRSPW* denoted employees who worked from 30 hours to 39 hours per week, *L40_45HRSPW* represented employees who worked from 40 hours to 45 hours per week, and lastly, *LMORE45HRSPW* denoted employees who worked more than 45 hours per week. Moreover, ε_t signified the white noise error term, while the sequence $\beta_i, \delta_i, \sigma_i, \emptyset_i, \hat{u}_i, \Omega_i, \mu_i, \gamma_i$ represented the short-run relationship coefficients between the

explanatory variables and the dependent variable, also, $\eta_1 \ldots to..\eta_6$ indicated the long-run relationship between the dependent variable and the explanatory series.

4. RESULTS AND DISCUSSION

Reported in Table 1 are the descriptive statistics of the considered time series for the respective sample period (2008 quarter one to 2021 quarter two). During this period, the working hours schedule which absorbed the largest amount of South Africa's labour was the category 40 hours to 45 hours per week (9156 workers), followed by the category of those who worked more than 45 hours per week (5152 workers) considered to have worked overtime or irregular hours. These schedules also had the highest concentration of workers on average, respectively. Those who worked less than 15 hours per week experienced the lowest concentration of workers in terms of aggregate figures and, on average, followed by the quadrant of 15 hours to 29 hours per week.

In light of Brunello (1989), given South Africa's increased labour supply and high unemployment rate, workers may not have the freedom to choose between different wage-hour packages, causing them to take on any potential job which may predominantly consist of a low-wage to maximum hours ratio. As a result, it leads to a demoralised working force. Drawing on the current national minimum wage of R23,19 per hour, those working a maximum of 45 hours per week of the ordinary working hours would be earning about R1044 per week and R4174 per month on an average of at least four full weeks. Longer working hours, as traditionally known for Japanese firms, can also be a serious impediment to an individual's work-life balance and may cause dire health concerns (Okugawa, 2021). Evidence from the descriptive statistics also showed that, second only to the ordinary hours, South Africa has a relatively high number of the overworked class.

Table 1. Descriptive statistics

	Less than 15 hrs p/w	15 to 29 hrs p/w	30 to 39 hrs p/w	40 to 45 hrs p/w	More than 45 hrs p/w
Mean	325	967	1073	8259	4490
Median	325	949	1082	8316	4467
Maximum	634	1215	1167	9156	5152
Minimum	228	771	974	7006	3821
Std. Dev.	73.57	132.41	46.58	571.26	302.59
Skewness	1.82	0.22	-0.32	-0.19	-0.20
Kurtosis	8.175	1.62	2.41	1.91	2.34
Jarque-Bera	90	4.75	1.73	3.017	1.34
Probability	0.00	0.093	0.42	0.22	0.51
Sum	17567	52234	57920	446003	242458
Sum Sq. Dev.	286847.4	929268.5	115009.1	17295644	4852632
Obs.	54	54	54	54	54

Source: own computation

Indicated in Table 2 are the Pairwise Correlation estimates in terms of the correlation between non-agricultural labour productivity as the dependent variable and those employed in different working hours schedules as the independent variables. The results of the non-existing correlation between labour productivity and working hours coincide with Man and Ling's

(2014) findings, specifically for 15 to 29 hours per week, 40 to 45 hours per week, and more than 45 hours per week based on non-statistically significant p-values. However, current findings revealed that the dependent variable is negatively correlated with those working less than 15 hours per week, supported by the p-value, which was statistically significant at 1%. Those working from 30 hours to 39 hours were also revealed to have had a positive correlation with non-agricultural labour productivity, albeit having only been statistically significant at 10%.

Table 2. Pairwise correlations analysis

	Less than 15 hrs P/W	**15 to 29 hrs P/W**	**30 to 39 hrs P/W**	**40 TO 45 HRS P/W**	**More than 45 hrs P/W**
Non-agricultural labour productivity	[-0.3895] (0.0036)	[-0.0258] (0.853)	[0.2329] (0.09)	[0.0369] (0.7912)	[0.1102] (0.4278)

Note: Correlation [], probability ()
Source: own computation

Moreover, Table 3 provided a summary of the considered variable representations in testing for cointegration between non-agricultural labour productivity and employed labour in various working hours schedules. The variables were estimated according to the transformed logarithms for all series based on their natural logarithmic forms. Henceforth, all variables were described according to their respective representations as illustrated.

Table 3. Representation of logged variables

Logged variable	**Representation**
Log of non-agricultural labour productivity	LLABPROD
Log of workers working less than 15 hours per week	LLESS15HRS
Log of workers working 15 hours to 29 hours per week	L15_29HRSPW
Log of workers working 30 hours to 39 hours per week	L30_39HRSPW
Log of workers working 40 hours to 45 hours per week	L40_45HRSPW
Log of workers working more than 45 hours per week	LMORE45HRSPW

Source: own computation

Furthermore, stationarity tests were conducted to avoid obtaining spurious regression results using the ADF test. Findings in Table 4 showed that all the considered variables were stationary, such that the series LLABPROD, LLESS15HRS and L30_39HRSPW were observed to have been stationary at level, while the series L15_29HRSPW, L40_45HRSPW and LMORE45HRSPW were deemed stationary at first difference. These results show a mixed order of integration amongst the considered variables. One of the benefits of the ARDL model is its capacity to handle a mixed order of integration of *I*(0) and *I*(1) orders.

Table 4. Augmented Dickey-Fuller Unit Root test results

Variables	**Level**				**First Difference**		**Order Of integration**
	Intercept without trend		**With trend**		**Without trend**		
	t-stat	**P-value**	**t-stat**	**P-value**	**t-stat**	**P-value**	
LLABPROD	-3.0934	0.0337*****	-4.0153	0.0146	-4.3977	0.0009	I(0)
LLESS15HRS	-2.2695	0.1854	-4.2617	0.0072******	-6.5292	0.0000	I(0)
L15_29HRSPW	-1.3936	0.5786	-3.0081	0.1398	-7.1262	0.0000******	I(1)
L30_39HRSPW	-3.6269	0.0083******	-4.4692	0.0040	-5.5337	0.0000	I(0)
L40_45HRSPW	-2.4265	0.1395	-2.5343	0.3112	-9.1502	0.0000******	I(1)
LMORE45HRSPW	-2.5275	0.1149	-2.5177	0.3188	-6.6281	0.0000******	I(1)

Note: ******** *denotes P-value at 1% level of significance and* ******* *at 5% significance.*
Source: Own computation

Having established the stationarity of the dataset, provided in Table 5 was the ARDL model which was estimated using the Akaike Information Criteria, which suggested the use of the ARDL model (1, 4, 0, 3, 1, 3) as the optimal lags. Overall, this model had a P-value of 0.00000, deemed to be statistically significant at 1% significance level. Also, the capacity of the model to explain variation in non-agricultural labour productivity was supported by a high R-squared value of 0.911770, ensuring the capacity for the model to explain about 91.2% of the variations in non-agricultural labour productivity. Moreover, the model's p-value was found to be statistically significant at a 1% significance level, while the Durbin-Watson stat of 1.910048 rounded off as 2, implying the absence of serial correlation (autocorrelation).

Table 5. Model selection

Akaike Information Criteria						
	Selected model	**Trend Specification**	**R^2**	**Adj R^2**	**Prob (F-statistic)**	**Durbin-Watson stat**
$LLABPROD_t$(Eq. 1)	(1, 4, 0, 3, 1, 3)	Rest.Constant	0.9118	0.8649	0.0000	1.91005

Source: own computation

4.1 F-Statistic and Bounds Test to Cointegration Results: Long-run Relationship

Subsequently, an F-statistic value above the lower and upper bounds critical values corresponds with the rejection of the null hypothesis of no long-run relationship between non-agricultural labour productivity and working time schedules. Findings revealed that the F-statistic value of 11.90305 was greater than the lower bound (3.06) and upper bound (4.15) critical values and was significant at 1% significance level. Therefore, the null hypothesis of no long-run relationship was rejected in favour of the alternative relationship of the presence of cointegrating long-run relationships between South Africa's non-agricultural labour productivity and the working time schedules. In other words, changes or fluctuations in working time schedules lead to long-term changes in non-agricultural labour productivity. This is explained by the coefficients of the explanatory variable in Table 7.

Table 6. F-statistic and Bounds test to cointegration results

Estimated models	**F-Stat value**	**I0 Bound**	**I1 Bound**
(Eq.1) $F_{LLABPROD}$ [LLABPROD/ (LLESS15HRS, L15_29HRSPW, L30_39HRSPW, L40_45HRSPW, LMORE45HRSPW)]	11.90305**	3.06	4.15

Note: *** denotes P-value significant at 1% level of significance. Source:* Own computation

Upon establishing long-run cointegration, Table 7 reported long-run cointegration results and the underlying coefficients. Results exhibited evidence of long-run relationships in the coefficients of the schedules on non-agricultural employees working from 30 to 39 hours per week, 40 to 45 hours per week, and those working more than 45 hours per week. Such that, the null hypothesis of no long-run relationship between non-agricultural labour productivity and those employed in the three working hours schedules was rejected at 1% for 30 to 39 hours per week and more than 45 hours per week, and slightly significant at 10% for 40 to 45 hours per week. Whereas long-run results for less than 15 hours and 15 hours to 29 hours per week were not statistically significant. These findings were supported by the above corresponding F-statistic value. The findings suggest that employees are most energetic and mentally focused when they work between 30 and 39 hours per week. As the amount of work time increases, employees may push themselves to earn more money, but their productivity decreases due to fatigue. In other words, working between 40 and 45 hours can benefit the

industry, but not as much as when employees are scheduled to work between 30 and 39 hours per week. However, working less than 30 hours per week is not sufficient for the industry to cover the cost of production. Even if workers exert their full effort, their productivity remains insignificant due to the limited number of hours worked. According to the coefficients in Equation (2) derived from Table 7, there is a positive long-term relationship between non-agricultural labour productivity and employees working 30 to 39 hours per week. This indicates that a 1% increase in the number of workers working from 30 to 39 hours per week results in a 5.8754% increase in South Africa's non-agricultural labour productivity. These findings align with Bond and Galinsky's (2006) survey in the United States, which reported that more than half of employees preferred to work fewer hours, ranging from 43 hours to 35 hours per week. These findings also support Okugawa's (2021) observation that reducing working hours may not always be the most effective solution for increasing labour productivity.

Table 7. Long-run coefficients results of the autoregressive distributed lag model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LLESSTHAN15HRS	-0.406158	0.362323	-1.120984	0.2706
L15_29HRSPW	0.665806	0.556008	1.197475	0.2399
L30_39HRSPW	5.875411	1.706118	3.443730	0.0016**
L40_45HRSPW	-1.762928	1.000897	-1.761348	0.0877*
LMORETHAN45HRSPW	-3.430357	0.908549	-3.775644	0.0007**
C	4.098059	7.450356	0.550049	0.5861

Note: ******** *and* ******* *denote significant at 1% and at 10%, respectively.*
Source: Own computation

$$LLABPROD = 4.0981 - 0.4062*LLESSTHAN15HRS + 0.6658*L15\_29HRSPW + 5.8754*L30\_39HRSPW - 1.7629*L40to\ 45HRSPW - 3.4304*LMORETHAN45HRSPW \quad (2)$$

Contrary to Vallo and Mashau's (2020) study, which found a positive relationship between long working hours and labour productivity, this study found a significant negative relationship between non-agricultural labour productivity and employees working 40 to 45 hours per week. Vallo and Mashau's results only held when compared to this study's shorter work schedule of 30 to 39 hours per week. However, similar to Golden (2012), an increase in working hours from 40 to 45 per week resulted in a decrease in South Africa's non-agricultural labour productivity by 1.7629%. The study also revealed a negative relationship between non-agricultural labour productivity and employees working more than 45 hours per week, including overtime or irregular schedules. This suggests that any increase in overtime or irregular working hours would decrease South Africa's non-agricultural labour productivity, aligning with Okugawa's (2021) findings on the negative impact of overtime work on labour productivity. The 40 to 45-hour schedule and the practice of working more than 45 hours align with traditional working hours in profit-maximising firms. This further supports the existing literature by Caruso et al. (2004), Golden et al. (2011), Sparks et al. (2001), and van der Hulst (2003), which indicate that longer working hours can hinder labour productivity due to mental and physical health risks such as fatigue, poor self-care, injury, work stress, and depression. Golden (2012) also notes that overtime hours can lead to decreased morale and productivity, as well as increased absenteeism.

4.2 Error Correction Model: Short-run Test Results

The above evidence of cointegrating vectors required the estimation of short-run tests to establish the adjustments in short-run disequilibrium towards long-run equilibrium using the

ARDL's Error Correction Model (ECM). The ECM showed the existence of some short-run adjustment processes which inhibit the proliferation of long-run errors. According to Asteriou and Hall (2007) and Brooks (2014), the ECM is a convenient approach useful for gauging the correction from disequilibrium of a previous period towards the existing equilibrium suggested in the long run. Mukhtar and Rasheed (2010:54) add that a necessary precondition for such adjustment processes is that the ECM's error correction term (ECT) should be significant and negative. The ECM's ECT is the "equilibrating" error term that corrects the deviations in the estimated model of the current study, given the established cointegrated Equation (2) (Gujarati, 2011).

Table 8 reported the findings of the ECM and the short-run coefficients. The ECT had a coefficient of -0.901738, which was both negative and highly statistically significant at 0.01 significance level. Insinuating that it takes approximately one quarter (1/0.901738) for the short-run disequilibrium to be adjusted towards establishing equilibrium in the long run. Interestingly, all short-run coefficients were shown to have had p-values that were, respectively, statistically significant at either 1%, 5% or 10% significance levels.

The coefficients revealed that the number of people employed working less than 15 hours per week had a negative relationship with non-agricultural labour productivity in the short run, having been highly statistically significant. With such a working schedule being mostly associated with part-time work as mentioned by Beneke (2022) and the Wage Indicator (2022), results corresponded with findings by Devicienti et al. (2015) who found that part-time work negatively affected total factor productivity. Devicienti et al. (2015) explain that this is a likely cause of information inefficiencies observed in part-time work which are associated with increased transaction and communication costs. Furthermore, those working from 15 hours to 29 hours per week were shown to positively influence non-agricultural labour productivity, despite only being statistically significant at 10%. Subsequently, employees working from 30 hours to 39 hours per week were also shown to positively influence non-agricultural labour productivity in the short run, and the results were extremely statistically significant. Corresponding with the empirical evidence by Vallo and Mashau (2020) of a positive impact of increasing working hours on labour productivity. However, the quadrant of employees working 30 hours to 39 hours per week was shown to be unstable over time, as the past lags in the workers of the former quadrant were shown to negatively affect non-agricultural labour productivity in the first and the second lags (periods).

Table 8. Findings of the Error Correction Model for productivity in non-agricultural sectors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LLESSTHAN15HRS)	-0.841893	0.223196	-3.771987	0.0007***
D(LLESSTHAN15HRS(-1))	-0.570028	0.224428	-2.539911	0.0161**
D(LLESSTHAN15HRS(-2))	-1.001128	0.207723	-4.819540	0.0000***
D(LLESSTHAN15HRS(-3))	-0.932754	0.210758	-4.425713	0.0001***
D(L15_29HRSPW)	0.797968	0.445669	1.790493	0.0828*
D(L30_39HRSPW)	2.244209	0.630851	3.557429	0.0012***
D(L30_39HRSPW(-1))	-3.865379	0.700114	-5.521069	0.0000***
D(L30_39HRSPW(-2))	-1.189097	0.648512	-1.833579	0.0760*
D(L40_45HRSPW)	4.166733	0.986856	4.222229	0.0002***
D(LMORETHAN45HRSPW)	2.218473	0.579944	3.825325	0.0006***
D(LMORETHAN45HRSPW(-1))	1.818020	0.815555	2.229182	0.0329**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LMORETHAN45HRSPW(-2))	1.263934	0.650264	1.943722	0.0608*
CointEq(-1)	-0.901738	0.097155	-9.281393	0.0000***

Note: *, ** and *** denote significant at 10%, 5% and 1%, respectively.

Source-: Own computation

Furthermore, the working schedule of 40 hours to 45 hours per week was revealed to positively influence non-agricultural labour productivity in the short-run, where a 1% increase in the former would lead to a short-run increase in non-agricultural labour productivity of approximately 4.17%. The findings were extremely statistically significant at the 1% significance level. Lastly, the quadrant of workers working more than 45 hours per week was indicated to have had a positive short-run relationship with non-agricultural productivity. Past lags of workers in this quadrant were also indicated to positively influence the dependent variable. Unfortunately, the suggested positive benefits of longer working hours in the short run do not hold in the long run, echoing Golden (2012) notice that the mental and physical risks of longer working hours may compromise either short-term or long-term rate of labour productivity, in this case, long-term labour productivity would be compromised.

4.3 Robustness analysis (Diagnostic results)

The preceding specifications were subject to residual diagnostic tests, as reported in Table 9, considering the tests for normality, heteroscedasticity, and serial correlation (autocorrelation) to establish the performance of the model (Takaendesa, 2006) and to ensure that the stochastic properties are met to avoid concerns which may violate model regressions (Sibanda, 2012). Diagnostic findings revealed that the model passed Jarque-Bera's test for normality, where its p-value was found to be higher than the 10% significance level, attesting that the series were normally distributed. The model also passed the test for autocorrelation based on the p-value of the Breusch-Godfrey Serial Correlation LM test, which was also found to be greater than the 10% significance level. Further cementing that the error terms were not correlated with each other during the period. Accordingly, the model was also found to be free from heteroscedasticity based on the p-value of the Breusch-Pagan-Godfrey test, which was above the 10% significance level.

Table 9. Residual diagnostics

Test	H0	Probability	Decision
LM Test	No serial correlation	0.8769	The H0 is rejected due to the P-value being above 5%. Thus, no serial correlation exists in the model.
Breusch-Pagan-Godfrey	No heteroscedasticity	0.8910	The H0 is rejected due to the P-value being above 5%. Thus, no heteroscedasticity exists in the model.
Jarque-Bera	Residuals are normally distributed	1.031032	With a P-value above 5%, accept H0. Thus, findings show that the series are normally distributed.

Source: own computation

To ensure the parameter stability of the recursive estimates, similar to Lee and Strazicich (2004), the cumulative sum of recursive residuals (CUSUM) test was employed as shown in Figure 3. Findings revealed that the model passed the parameter stability test, as the plots of the CUSUM test remained within the critical bounds, suggesting that the employed model

was free from model instabilities, as the plots and model parameters were stable over time. These results reaffirmed the robustness of the model specifications and thus supported the soundness of the short-run and long-run estimates between non-agricultural labour productivity and those employed in the various working schedules.

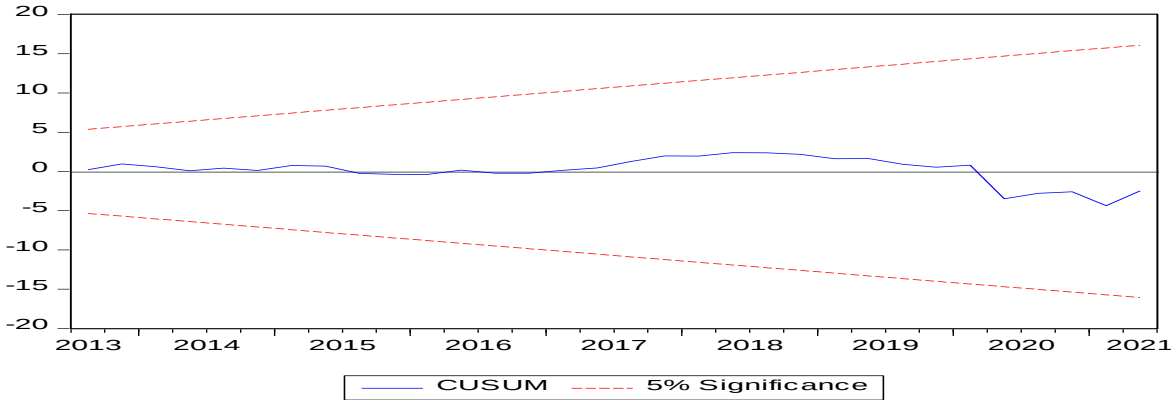

Figure 3. Recursive estimation of the CUSUM test

Source: Own computation

5. CONCLUSION

In conclusion, the working schedule of 30 hours to 39 hours per week was the most suitable and beneficial range of hours for South Africa's non-agricultural employment in terms of increasing its labour productivity and also matches the worker preferences indicated in Bond and Galinsky's (2006) survey in the United States. Any fewer hours than the former would be non-significant in leading to an increase in labour productivity; also, increasing the amount of labour working any more than 39 hours would lead to a decrease in non-agricultural labour productivity, at least in the long run. Coincidentally, these findings resonated with results and implications made by Delmez and Vandenberghe (2018) and Pencavel (2014) that longer working hours up to a certain point are beneficial to increasing labour productivity, however, beyond a certain point, excessively long hours may have a negative impact on labour productivity. Such was the case for the working schedule of any more than 40 hours per week. This was also in line with Kuroda's (2017) assertion that longer working hours may negatively impact labour productivity due to the associated negative characteristics of mental issues and working fatigue in those working longer hours. With that said, the findings upheld the diminishing returns to scale of working hours productivity in labour. This meant that South Africa's extreme spectrum of longer working schedules and overtime work proved to affect labour productivity negatively in the long run. Consequently, results also showed that reducing the number of hours may not benefit labour productivity, working hours may only be reduced to a certain threshold.

Worktime schedules that are longer than 40 hours per week and overtime or irregular working hours are not suitable for labour productivity in South Africa. It would be beneficial for firms to allocate ideal and fixed (other than irregular) working schedules that allow employees to effectively manage their responsibilities in allocating their tasks according to the given schedule, and not the longer and overtime hours. Having fixed yet ideal schedules would boost employees' morale and focus on completing tasks based on the limited schedule through effective time and resource management. Longer and overtime schedules constitute unanticipated costs, which may hinder the effective management of company budgets. Firms are also recommended to make adequate consultation-based considerations of workers'

preferences and working needs in efforts to grant suitable rest periods and breaks, determine shift patterns, reduce weekend and night work as unsocial hours, and arrangements for worker-friendly working schedules such as flexitime (Golden, 2012; International Labour Office, 2004;).

Longer working hours can be detrimental to labour productivity in the long run and may potentially affect output. Reducing working hours from 40 hours per week may be to labour productivity both in the short-run and the long-run, whereas extreme reductions in working hours from 29 hours and less per week could mean that firms may not be fully maximising productivity levels and potentially affect output. The International Labour Organisation (2004) posits that appropriate working time arrangements can promote workers' psychological willingness and capacity to utilise their energy efficiently, based on motivational effects. Despite workers being available in the course of work during certain working times, some working times may prove to be unproductive, as workers may spend their time in activities void and unrelated to the duties and tasks of the job, yet they continue to be available (Greenwood, 2001). It is also necessary that firms promote inclusion and equity within the workplace and the job selection process to allow the absorption of marginalised groups, such as women, to be included in full-time occupations and not predominantly and solely restrict them to part-time roles as described in the literature. Confining particular groups to certain roles and schedules such as part-time work is an impediment to the workers' morale, confidence, and sense of belonging within establishments and thus affects employee productivity and overall business growth.

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