The impact of national minimum wage policy on inflation and unemployment in South Africa: A segmented regression analysis

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ABSTRACT

This study aims to investigate how inflation and unemployment responded to the implementation of the national minimum wage (NMW) policy in South Africa. The existing evaluation of this topic is hypothetically based on empirical evidence from other countries because South Africa's NMW policy is still in its early stages since its inception in 2019, and thus the NMW data is still insufficient for evidence-based analysis using classical time series regression approaches. This methodological gap is addressed in this study by employing a segmented regression approach. More importantly, the study contributes to the debate on the efficacy of the policy's morale mandate in alleviating poverty and inequality in the country. According to the study's findings, the national minimum wage policy significantly exacerbated inflation and unemployment rates in the country. These findings suggest that the NMW policy implementation caused more harm than good to low-income earners and the low-skilled unemployed population, who continue to disproportionately suffer from inflation and limited employment opportunities. Hence, for the NMW policy to fulfill its moral mandate, it should be effectively aligned with other tax and benefit policies for firms to ensure that increases in the NMW rate translate into increases in disposable income while minimising the upsurge in labour costs.

Contribution/Originality: Meanwhile, empirical evidence on this topic is scarce in South Africa because the NMW policy is still in its nascent stages, with limited data available to conduct the study using classical time series econometric techniques. The current study contributes to this gap by employing a segmented regression approach.

1. INTRODUCTION

South Africa implemented its national minimum wage (NMW) policy on January 1, 2019, based on Section 6 of the National Minimum Wage Act 9 enacted on November 28, 2018 (Republic of South Africa, 2018). The Act provides for the appointed NMW Commission to conduct an annual review of the NMW rate and to make recommendations to the Minister of Employment and Labour, with the adjusted NMW rate imposed on March 1st

of each year. According to the Department of Employment and Labour (2021), the implementation of the NMW policy is a milestone initiative aimed at alleviating rampant poverty and inequality among the country's working population. Similarly, the International Labour Organization (ILO) perceives NMW policy as a tool for alleviating poverty and reducing inequality. Bhorat, Lilenstein, and Stanwix (2020) found that this policy benefited nearly half (46%, or 5.2 million) of the working population who earned below the NMW rate before its imposition on January 1, 2019. These were predominantly low-skilled workers. The NMW policy can therefore be considered a moral policy, which Barber II et al. (2021) define as a good economic initiative aimed at lifting the poor and working population to enhance economic growth and development.

According to the ILO (n.d) and the OECD (2022), the NMW policy should not be used in isolation; rather, it should be designed to complement other social, economic, and employment policies relevant to addressing income and labour market inequality, such as pro-employment policies, social transfers, and creating an enabling environment for sustainable enterprises. ILO further asserts that the policy's effectiveness is determined by employee compliance and its inclusivity, that is, the extent to which it covers all employees regardless of race, nationality, gender, or age. Employee non-compliance is usually the main issue, typical in developing countries where unemployment rates of both the skilled and unskilled labour force are rampant; employers tend to be exploitative, preying on job seekers' desperation. Employee non-compliance is also common in countries with a high immigrant population from relatively less developed countries. South Africa fits well in these non-compliance issues, with reports emerging that the unskilled domestic labour force and immigrants from neighboring countries (both skilled and unskilled) are underpaid relative to the NMW rate due to desperation.

The NMW rate was initially set at R20 per hour and was increased by approximately 3.8%, 4.5%, and 6.9% to R20.76, R21.69, and R23.19 in 2020, 2021, and 2022, respectively Figure 1. The statutory wage floor excludes allowances, bonuses, and tips. It is understood that the commission utilized the inflation rate as measured by the consumer price index (CPI) as the primary baseline indicator for NMW rate adjustment (Department of Employment and Labour, 2021). Precisely since 2021, the commission has proposed adopting NMW rates that are at least 0.5% or 1% higher than the previous year's annual inflation rate.

The 2021 NMW Commission's recommendation of inflation plus 0.5% or 1% is supported by Figure 1, which shows that in 2021, NMW rates rose by approximately 4.5% or 1.29% more than the annual inflation rate in 2020. However, in 2022, the NWM rate was adjusted at par with the preceding year's inflation rate of 6.9%. In March 2023, the NMW rate increased by approximately 9.6% from R23.19 in 2022 to R25.42 per hour, bringing it 2.7% ahead of the 6.9% annual inflation rate in 2022. This is the largest increase since 2020.
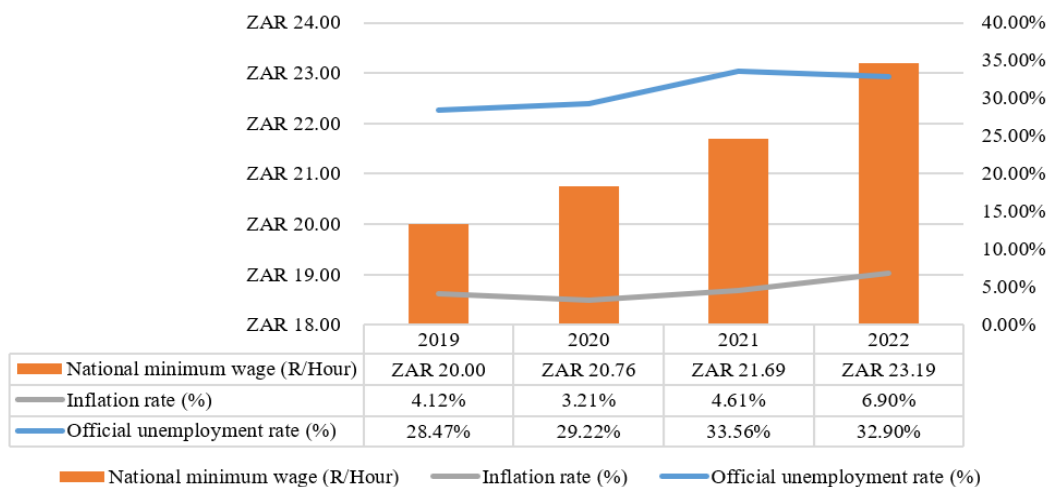

	2019	2020	2021	2022
National minimum wage (R/Hour)	ZAR 20.00	ZAR 20.76	ZAR 21.69	ZAR 23.19
Inflation rate (%)	4.12%	3.21%	4.61%	6.90%
Official unemployment rate (%)	28.47%	29.22%	33.56%	32.90%

Figure 1. NMW, inflation and unemployment rates in South Africa.

While raising the NMW rate above the annual inflation rate is a good recommendation for preserving the purchasing power of workers' nominal wages in times of rising inflation (OECD, 2022), it tends to result in a wage-price spiral due to an increase in workers' disposable income and unemployment due to an increase in labour costs. There has been no empirical validation of these hypotheses in the South African context because the NMW policy is still in its preliminary stages since its inception in 2019, making it difficult to conduct empirical analysis using classical econometric models. The current study fills this gap by using segmented regression analysis.

The remainder of the study is organized as follows: Section 2 discusses the theoretical foundation of the study as well as previous empirical studies on the impact of NMW policy on inflation and unemployment. Section 3 presents the empirical strategy. Section 4 presents and discusses the empirical findings of the study, while Section 5 concludes the study.

2. THE IMPACT OF NMW POLICY ON INFLATION AND UNEMPLOYMENT

Based on the monetarists' point of view, the wage-price spiral is a consequence, not a cause, of inflation. Inflation is caused by an increase in the disposable income of a significant portion of the employed population. In the current case, the wage-price spiral theory suggests that the NMW policy's implementation was a mixed blessing. On the one hand, it increased wages and thus the disposable income of 46% of the working population whose earnings were less than R20 per hour before 2019, increasing demand and causing prices to rise in the commodities market. On the other hand, it increased labour costs, putting additional upward pressure on prices as firms raised their product prices to offset the additional labour costs. The cycle continued in subsequent years owing to the recommendation to adjust NMW to a rate at least 0.5% or 1% higher than the preceding year's annual inflation rate.

Neoclassical theory argues that an increase in the NMW discourages employment; a wage rise increases (or decreases) labour supply (labour demand). In the worst-case scenario, some businesses, particularly small and medium-sized enterprises (SMEs), may resort to retrenchment as a turnaround strategy, with unskilled workers being the most vulnerable (Kemal & Kocaman, 2019). In general, the potential unemployment effect is more likely in economies with a large proportion of the unemployed population who are unskilled (Lemos, 2004), and South Africa is no exception, with over 90% of the unemployed population having at most matric in terms of educational attainment (Ngundu & Ngalawa, 2023).

Figure 1 appears to confirm the aforementioned narratives, and one might be tempted to conclude that the imposition of the NMW has exacerbated South Africa's inflation and unemployment. However, reaching such a conclusion without empirical evidence is unsatisfactory, especially given that the topic is still debatable. Meanwhile, there is a scarcity of empirical evidence in South Africa because the NMW policy is still in its preliminary stages, and thus there is limited data available to conduct a macro-level classical time series regression analysis to examine the impact of NMW on inflation and unemployment. The current study uses a segmented regression approach to address this gap.

The wage-price spiral theory and the neoclassical view of the wage rise-employment nexus serve as the theoretical foundations for this study. As noted above, these theories contend that an increase in NMW raises inflation and unemployment rates, at least in the short run. On the contrary, according to the Philips curve hypothesis, if NMW policy can lead to inflation, it should have a favourable transitory effect on unemployment, and vice versa. Moreover, in a scoping review conducted by Lemos (2004) as well as the literature provided in Babalola (2019) and Kemal and Kocaman (2019), some studies argue that the impact of NMW on inflation and unemployment is dependent on the magnitude of wage changes and the level of competition in the labour market. If wage increases are marginal in magnitude, the change in consumer spending may be insignificant enough to influence prices, and firms may resort to absorbing additional labour costs by reducing profit margins and/or increasing employee productivity. In that case, NMW may not have a significant impact on inflation. In terms of

the unemployment effect, an NMW rate imposed below or above the labour market's equilibrium level may result in a decrease or increase in unemployment.

In addition to the fact that this is still a contentious topic, the majority of the above-mentioned propositions were derived from case studies of developed countries, mainly the United Kingdom (UK) and the United States (US). The global north and global south have different inflation and unemployment rates due to differences in monetary policy instruments, labour market characteristics, and labour market regulations. Monitoring the effects of minimum wage increases on inflation and unemployment is thus a critical component of an evidence-based system. Otherwise, assuming that the outcomes of developed countries apply to developing countries may mislead policy development. Evidence-based analysis of the NMW policy impact on inflation and unemployment in developing countries is still scarce, particularly in Africa, thanks to Babalola (2019) contribution in Nigeria. Using the autoregressive distributed lag (ARDL) model for the period 1980-2019, Babalola (2019) found that the increase in national minimum wages significantly increased inflation and unemployment rates in Nigeria, with a severe impact in the short run. Kemal and Kocaman (2019) obtained the same findings using the same model in Turkey. For now, it is not feasible to employ classical time series regression models such as ARDL to examine the impact of the NMW policy on inflation and unemployment in South Africa because the national minimum wage data is still very short. This study, therefore, employs the segmented regression model to examine how inflation and unemployment rates have responded to the NMW policy implementation in South Africa. The empirical strategy is presented in the section that follows.

3. EMPIRICAL STRATEGY

Segmented regression analysis is a useful and robust statistical technique for estimating intervention effects in interrupted time series studies when random assignment is not feasible (see, for example, (Muggeo, 2008; Schober & Vetter, 2021; Taljaard, McKenzie, Ramsay, & Grimshaw, 2014; Wagner, Soumerai, Zhang, & Ross-Degnan, 2002)). It is prominent for experimental intervention in epidemiology and occupational medicine disciplines, but in the current study, it is used in macroeconomics to examine the impact of NMW policy interventions on inflation and unemployment in South Africa. The segmented regression model is described in Equation 1.

$$y_t = \alpha + \beta_1 T_t + \beta_2 P_t + \beta_3 R_t + \varepsilon_t \qquad (1)$$

This study conducts two estimates based on Equation 1: one for the inflation rate as measured by the period-on-period percentage change in the CPI of all items, and the other for the official unemployment rate. The outcome variable y_t serves as a proxy for the inflation and unemployment series for the period t. Data for both series were obtained from the QUANTEC database and are available at a high frequency of monthly for inflation rates and quarterly for unemployment rates. Accordingly, the inflation series is examined monthly from January 2015 to December 2022, whereas the employment series is examined quarterly from the first quarter of 2015 to the third quarter of 2022, resulting in 96 and 31 observations, respectively. The time T is a continuous variable indicating the number of periods from the beginning to the end of the study period, and P is an indicator for period t occurring before ($P = 0$) or after ($P = 1$) the implementation of the NMW policy on January 1st, 2019 ($T = 49$ for inflation series and $T = 17$ for unemployment series). Schober and Vetter (2021) recommend that the pre-and post-intervention observation periods be at least 12 periods long to reduce the risk of regressing seasonal trends or the mean of the outcome variable. The continuous variable R counts the number of periods after the implementation of the NMW policy, which is coded zero (0) before the implementation and ($T - 48$) for the inflation series and ($T - 16$) for the unemployment series after the implementation.

The subscripts α, β_1, β_2, and β_3 estimate the baseline level of y_t at $T = 0$, the baseline trend of y_t (change of the outcome variable over time) before the implementation of the NMW policy, the level change of y_t immediately after the implementation of the NMW policy, and the trend change of y_t after the implementation of the NMW policy, respectively. The error term ε_t depicts random variability that is not captured by Equation 1. The sum of β_1

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and β_3 is the post-policy slope. Thus, the major strength of using segmented regression analysis to estimate level and trend changes associated with the policy implementation is that it can control for baseline level and trend.

To estimate the absolute and relative impact of NMW policy implementation on inflation and unemployment, we express Equation 1 estimates at any justifiable post-policy period, such as the 66th period for inflation (1.5 years after the policy was implemented) and at the 24th period for unemployment (2 years after the policy was implemented), as shown in Equations (2-6) below. This is the period following the initial adjustment of the NMW rate from R20 to R20.76 per hour (see, Figure 1). The year 2021 cannot serve as a good assessment period due to the COVID-19 pandemic, which has added severe economic strain in all countries globally.

Impact on Inflation:

$$\hat{y}(66)_{with\ policy} = \hat{\alpha} + \hat{\beta}_1(66) + \hat{\beta}_2(1) + \hat{\beta}_3(18) \qquad (2)$$

$$\hat{y}(66)_{without\ policy} = \hat{\alpha} + \hat{\beta}_1(66) \qquad (3)$$

Impact on Unemployment:

$$\hat{y}(24)_{with\ policy} = \hat{\alpha} + \hat{\beta}_1(24) + \hat{\beta}_2(1) + \hat{\beta}_3(8) \qquad (4)$$

$$\hat{y}(24)_{without\ policy} = \hat{\alpha} + \hat{\beta}_1(24) \qquad (5)$$

The absolute impact is obtained by subtracting Equation 2/4 from Equation 3/5, respectively, while the relative change of $\hat{y}_t$ as a result of NMW policy is calculated using Equation 6.

$$\frac{\hat{y}_{with\ policy} - \hat{y}_{without\ policy}}{\hat{y}_{without\ policy}} \times 100 \qquad (6)$$

The empirical findings are presented and discussed in the following section.

4. EMPIRICAL FINDINGS

The findings of this study are presented in four steps. First, we estimate the main results of the segmented regression approach as specified in Equation 1. Second, we run diagnostic tests to validate the estimated results. Third, we present the estimated results graphically. Finally, we analyse the absolute and relative impact of NMW policy on inflation and unemployment based on Equations 2-6.

Table 1. Estimated results of the segmented regression model.

Dependent variable:	Inflation	Unemployment
Intercept ($\hat{\alpha}$)	0.574***	25.537***
	(0.128)	(0.405)
Baseline trend ($\hat{\beta}_1$)	-0.006	0.132***
	(0.004)	(0.035)
Level change immediately after the inception of NMW policy ($\hat{\beta}_2$)	-0.106	-1.632
	(0.153)	(0.989)
Trend change after the inception of NMW policy ($\hat{\beta}_3$)	0.017***	0.589***
	(0.006)	(0.089)
Slope 1 (Before the inception of NMW policy):		
Lower bound	-0.014	-0.047
Upper bound	0.002	0.312
Slope 2 (After the inception of NMW policy):		
Lower bound	-0.351	-3.771
Upper bound	0.136	0.961

Notes: *** indicates statistically significant at 1%. Robust standard errors are in parentheses. All slopes were computed at a 95% confidence level.

Table 1 indicates that the unemployment and inflation rates were 25.54% and 0.57%, respectively, just before the start of the study period. These estimates are relatively close to the actual average unemployment (25.08%) and inflation (0.4%) rates in 2014[1]. The results show a statistically insignificant month-to-month change in the inflation

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[1] Authors' estimates based on the QUANTEC database. Average unemployment and inflation rates in 4 quarters and 12 months of 2014, respectively.

rate prior to the implementation of the NMW policy, while the unemployment rate increased by 0.13% per quarter. Both the inflation and unemployment series did not change significantly immediately after the NMW policy was implemented. However, after the policy was implemented, their trends increased by 0.02% per month and 0.59% per quarter, respectively. This is not surprising given that commodities and labour markets do not immediately adjust to policy changes.

Since time is a regressor in segmented regression analysis, the error terms of consecutive observations tend to be correlated. Inflation and unemployment patterns prescribed at two-time points close together may be more similar than outcomes prescribed at two-time points further apart, resulting in serial autocorrelation of the error terms. These series may also exhibit seasonal patterns. So, to obtain valid inferences from Equation 1, the underlying assumptions of homoscedasticity and no autocorrelation of the ordinary least squares (OLS) regression must be met (see, for example, Taljaard et al. (2014) and Wagner et al. (2002)). We generated heteroskedasticity- and autocorrelation-robust standard errors in parentheses in Table 1 to eliminate potential heteroscedasticity and autocorrelation. Furthermore, we checked for autocorrelation statistically using the Durbin-Watson (DW) test and graphically using Autocorrelation Function (ACF) plots, as shown in Figure 2.
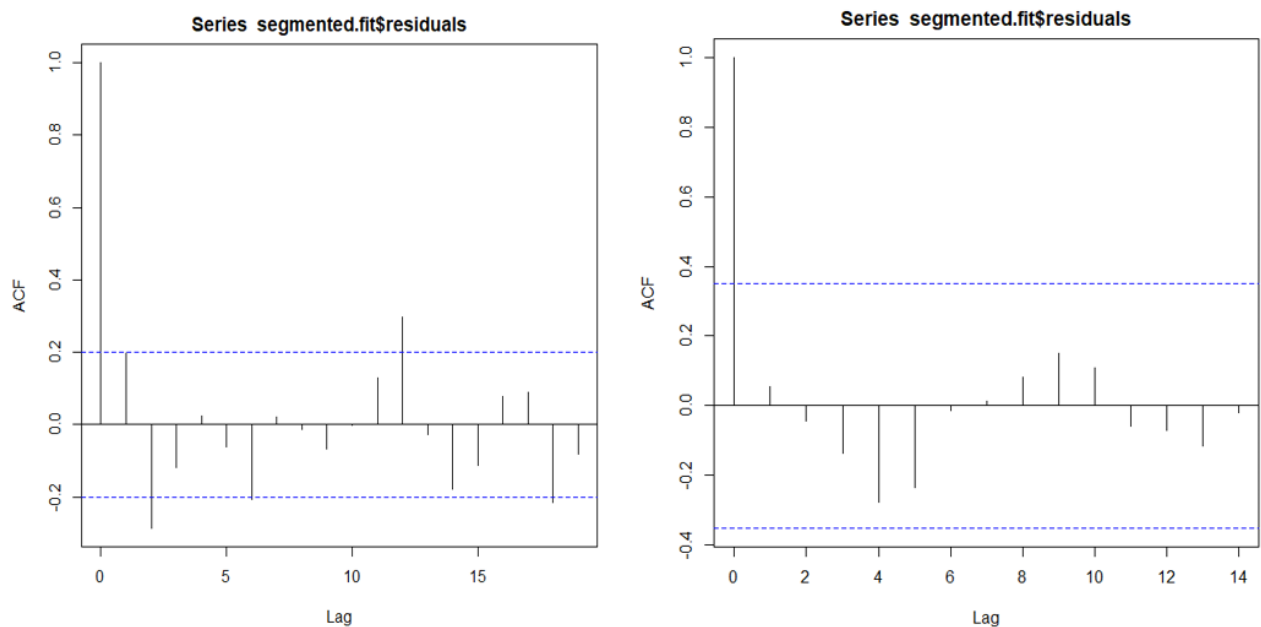

Figure 2. ACF plots of the inflation (left graph) and unemployment(right graph) functions, respectively.

We found a DW test statistic of 1.52 for the inflation function and 1.89 for the unemployment function and concluded that the residuals are not auto correlated because these statistics fall within the recommended range of 1.5 and 2.5. The Autocorrelation Function (ACF) plots in Figure 2 also confirm the absence of autocorrelation in both the inflation (left) and unemployment (right) series.

Having validated our estimated results, we can now display them graphically, as shown in Figure 3 below. The inflation and unemployment series are marked in black, their trends in red, and the time point of the interest intervention is marked with a blue dotted line. As stated in the preceding section, the time point of the interest intervention is the period when the NMW rate was imposed (1st January 2019), which is the 49th period since January 2015 for the inflation series and the 17th period since the first quarter of 2015 for the unemployment series.
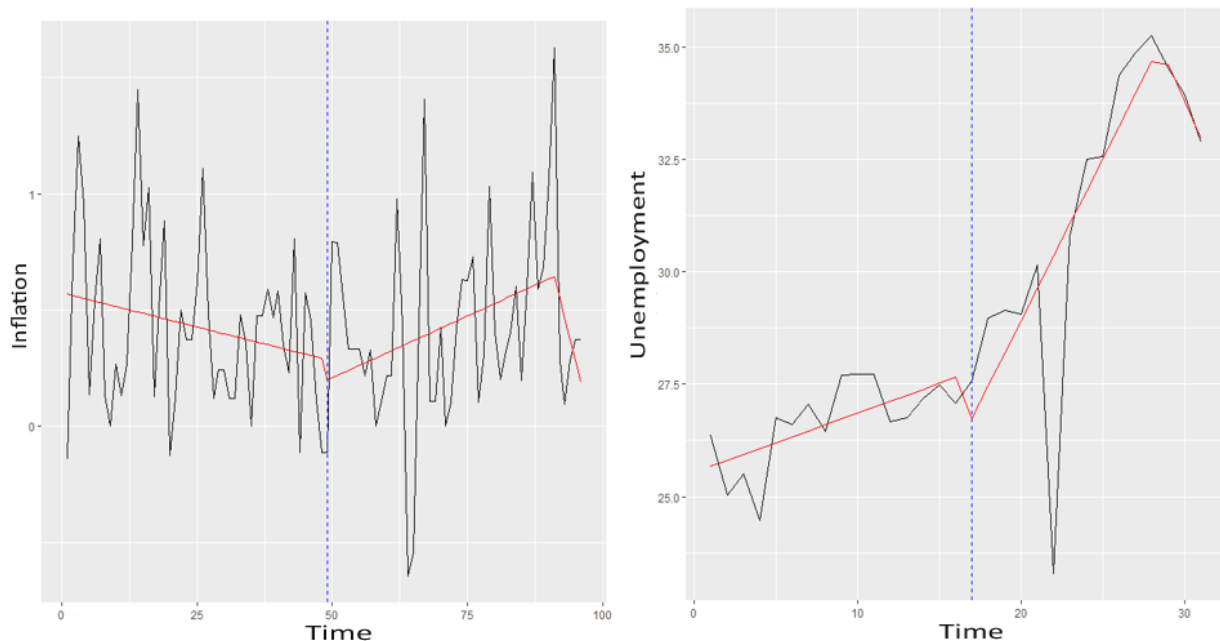
Figure 3. The impact of the NMW policy on inflation and unemployment.

Figure 3 shows that when the NMW policy was put into place, there was a big change in the slope of both series. This suggests that the policy intervention did have a real effect on the outcome variables (Schober & Vetter, 2021). We, thus, can proceed to estimate the absolute and relative impact of NMW policy on inflation and unemployment as demonstrated in Equations 2-6 and using the estimated results in Table 1.

Had the policy not been implemented, say, in the 66th period (1.5 years after the policy was implemented), the inflation rate would have been 0.19%. The NMW policy caused the inflation rate to double to 0.38%, other things being equal. The estimated policy-influenced inflation rate (0.38%) is 0.05% lower than the actual inflation rate (0.43%) in June 2020 (66th period), with other inflation determinants accounting for this difference.

We also estimated that if the policy had not been implemented, say, in the 24th period (2 years after the policy was implemented), the unemployment rate would have been 28.7%. The NMW policy increased the unemployment rate by 3.08% (10.73%) to 31.79%, other things being equal. The actual unemployment rate in the fourth quarter of 2020 (24th period) was 32.5%, a 0.71% difference from the estimated policy-influenced unemployment rate explained by other unemployment determinants.

According to the findings above, actual rates are higher than estimated policy-influenced rates by a very narrow margin, while they are higher than estimated rates without policy by a relatively large margin. These findings are consistent with prior expectations as well as the empirical contribution of Babalola (2019) in Nigeria and Kemal and Kocaman (2019) in Turkey, who found that the NMW policy has a significant role in increasing inflation and unemployment, with a severe impact in the short run. Furthermore, the findings show that the implementation of the NMW policy had a more severe impact on inflation than on unemployment. This implies that the implementation of the NMW policy caused more harm than good to low-income earners, who continue to suffer disproportionately from inflation because they spend the largest portion of their disposable income on essential commodities, which typically experience higher price increases than non-essential items. The NMW policy also exacerbated job shortages for the unskilled unemployed, who, according to Ngundu and Ngalawa (2023), account for a large proportion of South Africa's unemployment rate.

5. CONCLUSION

The implementation of the NMW policy has always been a controversial topic among researchers and policymakers in government. Based on the monetarist view of the wage-price spiral hypothesis and the neoclassical

view of the wage increase-unemployment nexus, a large pool of researchers argue that the implementation of the NMW policy can have a transient detrimental impact on inflation and unemployment. Government officials, on the other hand, believe that the NMW policy is necessary to improve the living standards of low-income earners and alleviate poverty. South Africa is not exceptional in this debate, following its initiative to implement the NMW policy on January 1st, 2019. However, there is still a scarcity of empirical evidence to substantiate whether or not the policy has yielded favourable outcomes as expected by government officials. The scarcity of studies is primarily due to data issues: there is still insufficient NMW data to conduct an empirical examination of the impact of NMW on inflation and unemployment using classical time series models. The current study uses segmented regression analysis for the period 2015-2022 to fill this gap. The study's findings support the researchers' notion. Furthermore, the findings show that the NMW policy implementation had a more severe impact on inflation than on unemployment. Based on these findings, the study concludes that the implementation of the NMW policy in South Africa caused more harm than good to low-income earners, who continue to bear a disproportionate share of the burden of inflation, and to the unskilled unemployed population, whose employment opportunities were further constrained. As a result, effective and balanced alignment of the NMW policy with other tax and benefit policies for firms is necessary to ensure that increases in the NMW rate translate into increases in disposable income while minimising the upsurge in labour costs.

REFERENCES

Babalola, A. (2019). Impact of national minimum wage increase on unemployment and inflation rates in Nigeria: An empirical analysis. *Amity Journal of Economics, 4*(1), 17-34.

Barber II, W. J., Barnes, S. G., Bivens, J., Faries, K., Lee, T. M., & Theoharis, L. (2021). *Moral policy = Good economics: Lifting up poor and working-class people-and our whole economy economic policy institute.* Retrieved from https://www.epi.org/publication/moral-policy-good-economics/

Bhorat, H., Lilenstein, A., & Stanwix, B. (2020). *The impact of the national minimum wage in South Africa: Early quantitative evidence.* A Report for the National Minimum Wage Commission DPRU University of Cape Town.

Department of Employment and Labour. (2021). *Report of the national minimum wage commission on the review and adjustment of the national minimum wage for year 2022.* Government gazette No. 45649.

ILO. (n.d). *Chapter 1: What is a minimum wage.* Retrieved from https://www.ilo.org/global/topics/wages/minimum-wages/definition/WCMS_439072/lang--en/index.htm

Kemal, B. M., & Kocaman, M. (2019). The impact of minimum wage on unemployment, prices, and growth: A multivariate analysis for Turkey. *Economic Annals, 64*(221), 65-83. https://doi.org/10.2298/eka1921065k

Lemos, S. (2004). *The effect of the minimum wage on prices.* IZA Discussion Paper No. 1072.

Muggeo, V. M. (2008). Segmented: An R package to fit regression models with broken-line relationships. *R News, 8*(1), 20-25.

Ngundu, M., & Ngalawa, H. (2023). A sectoral analysis of output elasticity of employment in South Africa. *South African Journal of Economic and Management Sciences, 26*(1), a4825. https://doi.org/10.4102/sajems.v26i1.4825

OECD. (2022). *Minimum wages in times of rising inflation*: OCED Publishing. Retrieved from https://www.oecd.org/employment/Minimum-wages-in-times-of-rising-inflation.pdf.

Republic of South Africa. (2018). *Act No. 9 of 2018: National minimum wage act.* Retrieved from https://www.gov.za/sites/default/files/gcis_document/201811/42060gon1303act9of2018.pdf

Schober, P., & Vetter, T. R. (2021). Segmented regression in an interrupted time series study design. *Anesthesia & Analgesia*, *132*(3), 695-697. https://doi.org/10.1213/ane.0000000000005269

Taljaard, M., McKenzie, J. E., Ramsay, C. R., & Grimshaw, J. M. (2014). The use of segmented regression in analyzing interrupted time series studies: An example in pre-hospital ambulance care. *Implementation Science*, *9*(77), 1-4. https://doi.org/10.1186/1748-5908-9-77

Wagner, A. K., Soumerai, S. B., Zhang, F., & Ross-Degnan, D. (2002). Segmented regression analysis of interrupted time series studies in medication use research. *Journal of Clinical Pharmacy and Therapeutics*, *27*(4), 299-309. https://doi.org/10.1046/j.1365-2710.2002.00430.x