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STRUCTURAL ANALYSIS OF MINIMUM WAGE RATES, UNEMPLOYMENT AND FOOD PRICES OF FARM WORKERS IN SOUTH AFRICA: CO-INTEGRATION APPROACH

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Abstract. This paper examines the short- and long- term effects of increasing minimum wage rates for farm workers in South Africa on structural unemployment and rising food prices in the economy. The Pearson correlation model was used to establish association between variables. Analysis found a negative association (–0.651) between wage rate and employment of farm workers, while a positive (0.021) association was found to exist between wage rate (W) increases and food prices (F_p). No association (0.001) was found between employment and food prices (F_p). Co-integration was further employed to determine the short-term and long-term relationships, and the analysis found wages to have a positive and significant (0.453) effect on structural unemployment of farm workers. Unemployment was observed to be wage elastic in the long term and wage inelastic in the short term. The long-term relationship showed increasing unemployment in agriculture (L) and rising food prices (F_p) (1.168), while the short-term relationship showed a significant error correction coefficient (ECT) with an expected starting point of 41.9% adjustment rate towards long-term equilibrium within a year. Structural analysis confirmed an inelastic demand for basic food. The study suggest government subsidies to farmers through cost-cutting technologies and farm worker's skills development on the use of these technologies.

Key words: minimum wage, unemployment of farm workers, food prices, structural change

INTRODUCTION

In November 2012, farm workers in the Western Cape Province of South Africa went on strike demanding a 54% minimum wage increase from R69 to R150 per day. With the official unemployment rate hovering around 25% and the current level of low direct foreign investment, the country's capacity to generate new jobs is diminishing fast. Agriculture is one of the last remaining labour-intensive sector and a major contributor to national job creation (unskilled labour) although its contribution to the national GDP has been declining (LDA, 2012). According to the SARB (2012), minimum wage increases for the lowest paid farm workers may translate to an increase in sectorial unemployment and consequently higher food prices. Higher food prices reduce the purchasing power of consumer's mainly low income earners because food expenditures account for over 60% of lower income household's budgets (Lee et al., 2008).

According to the International Labour Organisation (ILO, 2015), various benchmarks for minimum wage setting exist but countries must consider the local socio-economic factors during the implementation. Machin et al. (2003) revealed that, agricultural growth in South Africa was 2% lower than average for most LDCs by 2002. Given the low productivity/wage ratio, South

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African agricultural sector is still one of the most labour intensive sectors globally (ECC, 2013). Lower wage unskilled farm workers make up a relatively larger proportion of the workforce in the agricultural sector and the wage payment constitute over 40% of farmer's production costs (Lee et al., 2000). Freeman (2009) has argued that, the level at which the minimum wage is set affect firms ability to create employment. Hence, the effect of minimum wage increases on jobs is typically negative (mostly for relatively unskilled workers) or neutral, and sometimes positive. A study by BFAP (2008) has revealed that, the introduction of minimum wage policy in agriculture did result in real increases in wage rates, especially for unskilled farm workers earning the lowest wages.

In the South African agricultural sector, minimum wages are set at different levels and are sector and region' specific. The ballooning minimum wage increases in the agricultural sector not accompanied by increase productivity have led farmers to change employment patterns from permanent unskilled farm workers to sizable amount of seasonal workers in South Africa. This has resulted in relatively high levels of structural unemployment in the sector. Findings by Economic Conditions Commission (ECC, 2013) indicated that the mean and median real wages in agriculture were lower compared to other sectors of the economy. In 1997 the average wages for a farm worker were 13% lower, 63% lower, 72% lower and 80% lower than the wages of domestic workers, mining workers, basic manufacturing workers and basic service sector workers respectively.

In South Africa, most studies on minimum wage have focused on the short-term effects on employment and food price increases. However, empirical work indicates that, the direct effect of higher minimum wages on job destruction and food prices normally shows up in the longer term as firms slowly replace labour with machinery and shift away from labour-intensive systems (Sorkin, 2015; Meer and West, 2013). Rival narratives on the other hand have suggested that rising minimum wage boost job creation by increasing the purchasing power of low-paid workers. They suggested that as the disposable income of workers increases, so is their purchasing power which in turn results in sales improvement and output increase by firms and hence, hiring of more workers. Theoretically, such 'wage-led growth' is possible if higher domestic sales generate sufficient profits and funds for investment to compensate domestic firms for the increase in labour costs. However, macroeconomic analyses of the South Africa economy using data from the 1990s and 2000s found that wage-led growth was not feasible and that increasing the share of income going to wages would probably undermine investment, growth and employment due to the higher consumption of imports in the country (Gibson and Van Seventer, 2000; Onaran and Galanis, 2013).

The National Treasury of South Africa has provided several projections for different levels of the NMW (including household poverty lines), with higher wages generating worse economic outcomes especially for the poor. This is consistent with the macroeconomic simulation by Pauw and Leibbrandt (2012) which concluded that higher minimum wages hurt the poor and hence is not an appropriate instrument for addressing household poverty as shown in Table 1. The reasons why minimum wages have a generally muted impact on employment in developing countries is because governments tolerate significant levels of non-compliance. Studies suggest that there are high levels of non-compliance in South Africa: 34% of retail workers in retail earn below the sectoral determination compared to, 39% in domestic work, 53% in forestry, 47% in the taxi industry, 67% in private security and 55% in agriculture (reported in MacLeod, 2015).

Some scholars (Gibson and Van Seventer, 2000; Onaran and Galanis, 2013) have argued that, models are not infallible and are assumptions and data dependent. With an ever increasing population to feed, this situation poses a threat to the country's food security. Therefore, it is critical for public policy makers to know how food prices may be affected by raising the minimum wage rate. With this in mind, the objective of the study was to analyse the extent to which increases in minimum wage of unskilled farm workers in South Africa have resulted in structural unemployment and increase food prices. The study hypothesised that, increasing minimum wage rate in agricultural has resulted in structural unemployment of farm workers. Furthermore, there is a short and long-run effect of minimum wage increases on food prices. The study adopted the Pearson product–moment correlation model using a time series secondary data (2002–2014) and Co-integration model to show both association and effect of increasing minimum wage on structural unemployment of farm workers and food prices in South Africa.

Table 1. Macroeconomic modelling results (summary) from the National Treasury
Tabela 1. Wyniki modelowania makroekonomicznego (podsumowanie) według Skarbu Państwa

% Deviation from base-line (ie. Modelled situation before the introduction of a NMW) % Odchylenia od linii bazowej (tzn. sytuacji modelowej sprzed ustalenia płacy minimalnej)	Monthly minimum wage (2015 prices) Miesięczne wynagrodzenie minimalne (stan cen z 2015 r.)			
	R1,258	R1,886	R3,189	R4,303
Real GDP – short run PKB realny – krótkookresowo	–0.3	–0.7	–2.1	–3.7
Real GDP – long run (Investment varies according to the rate of return, skilled labour no longer in short supply) PKB realny – długookresowo (inwestycje kształtują się w zależności od stopy zwrotu, nie obserwuje się już braku wykwalifikowanej siły roboczej)	–1	–2.5	–7.5	–13
Employment – short run Zatrudnienie – krótkookresowo	–0.8	–2.1	–6.2	–10.1
Additional scenario: NMW does not apply to informal agricultural and domestic workers Dodatkowy scenariusz: Płaca minimalna nie ma zastosowania wśród nieoficjalnych pracowników rolnych i gospodarczych				
Real GDP – short run PKB realny – krótkookresowo	–0.2	–0.6	–1.9	–3.4
Employment – short run Zatrudnienie – krótkookresowo	–0.7	–1.8	–5.1	–8.2
Additional scenario: NMW does not apply to informal agricultural and collective bargaining agreements Dodatkowy scenariusz: Płaca minimalna nie ma zastosowania w nieoficjalnych porozumieniach rolniczych i zbiorowych				
Real GDP – short run PKB realny – krótkookresowo	–0.2	–0.4	–1.5	–2.7
Employment – short run Zatrudnienie – krótkookresowo	–0.5	–1.3	–4.4	–7.8

Source: MacLeod (2015).
Źródło: MacLeod (2015).

MATERIALS AND METHODS

In this study, the data came from the National Treasury, abstract of agricultural statistics from Department of Agriculture and Forestry (DAFF), Economic Conditions Commission (ECC) of South Africa. The focus areas were minimum wage, unemployment and food prices from 2002 to 2014. The study utilises the Pearson Product Moment Correlation model and Co-integration model to measure the association and causality of increasing minimum wage rates on unemployment and food prices in South Africa. The data were analysed using trend tables and graphs.

The Pearson product-moment model is widely used in social sciences as a measure of the degree of linear dependence between two or more variables. The Correlation coefficient is a measure of the linear dependence (strength and direction) between two specified variables X and Y. The value ranges between –1 and 1, whereby 1 is total positive dependence, 0 is no dependence, and −1 is total negative dependence. Pearson's correlation coefficient when applied to a population is commonly

represented by the Greek letter ρ (rho) and may be referred to as the population correlation coefficient or the population Pearson's correlation coefficient. The formula for ρ is:

$$\rho_{X,Y} = \frac{Cov\,(X, Y)}{\sigma_X \sigma_Y}$$

Where:

$Cov\,(X, Y)$ – covariance of X and Y
σ_X – the standard deviation of X
σ_Y – the standard deviation of Y.

Therefore the correlation function amongst W, L and F_P can be summarized as follows:

$$\rho_{W,L,Fp} = \frac{Cov\,(W, L, F_P)}{\sigma_W \sigma_L \sigma_{Fp}}$$

Where:

$\rho_{W,L,Fp}$ – correlation amongst W, L and F_P
$Cov\,(W, L, F_P)$ – covariance of W, L and F_P
σ_W – the standard deviation of W
σ_L – the standard deviation of L
σ_{Fp} – the standard deviation of F_p
W – minimum wage rate
L – unemployment of unskilled farm workers
F_p – food prices.

Agricultural minimum wage is determined by both price and non-price factors. Econometric studies of labour supply response studies have revealed that estimation methodologies are based on the assumption that variances and means of stationary variables are defined constants which are independent of time. The supply response of labour in this study is estimated using the function:

$$Lt = f\,(W, F_P, \text{Trend})$$

Where:

W – minimum wage rate
L_t – unemployment of unskilled farm workers
F_p – food prices
Trend – stands for time trend.

Non-stationary or unit root factors are those variables whose variances and means do change over time. By using the Ordinary Least Squares (OLS) estimation methods to estimate relationships with unit root variables results in spurious regression which gives misleading inferences. Co-integration is the appropriate technique to estimate the equilibrium or long-run parameters in a relationship with unit root variables (Rao, 2007). Vector Error Correction Model (VECM) is a category of multiple time series models used for data analysis where the underlying variables have a long-run stochasticity known as co-integration'. The test of Co-integration involves estimating Vector Error Correction Models (VECM) in the form:

$$\Delta Yt = \Sigma\alpha j + \Delta Y_{(t\text{-}i)} + \Sigma\gamma j\ Xj_{(t\text{-}i)} + \delta i Dit + \lambda\varepsilon_{(t\text{-}1)} + V\varepsilon_{(t\text{-}1)} = Y_{(t\text{-}1)} - \Sigma\beta j Xj_{(t\text{-}1)}$$

Where:

ΔYt – changes in dependent variable
$\Sigma\alpha j$ – constant of the jth data period
$\Delta Y_{(t\text{-}1)}$ – changes in lagged dependent variable
$\Sigma\gamma j$ – summation of non-stationary parameters of endogenous variables
$Xj_{(t\text{-}1)}$ – lagged for non-stationary endogenous explanatory variables
Δi – vector parameter of exogenous variables
Dit – vector of stationary exogenous variables
$\lambda\varepsilon_{(t\text{-}1)}$ – lagged Coefficient of error correction term
$V\varepsilon_{(t\text{-}1)}$ – random error term
$Y_{(t\text{-}1)}$ – lagged dependent variable
$\Sigma\beta j Xj_{(t\text{-}1)}$ – sum of coefficient of lagged explanatory variable.

Co-integration and vector error-correction techniques were used to overcome spurious regressions problem and provide consistent and reliable estimates of both long-run and short-run factor elasticities that satisfy the characteristics of the classical regression analysis. This is because all chosen variables involved in an Error Correction Model (ECM) are integrated of order zero, I (0) or (1). Spurious regression are inconsistent and indistinct when it comes to the measurement of short-run and long-run elasticities (McKay et al., 1999). Hence, the empirical model to estimate the effect of minimum wage rate on unemployment and food prices given by:

$$L_t = f\,(L_{t-1}, Fp_{t-1}, W, \text{STRU}, \text{Trend})$$

In = logarithmic form, the model is represented as:

$$\Delta Ln\ L_t = \lambda\,(ln\ L_{t-1} + \alpha_0\ ln\ W_t - \gamma\text{Trend} - \delta_0) + \rho\Delta\ ln\ L_{t-1} + \alpha 1\Delta\ ln\ Fp_{t-1} + \delta_1 + \eta Fp_t + \mu\text{STRU}$$

Where:

$Ln\ L_t$ – natural logarithm of employment in agriculture

$Ln\ W_t$ – natural logarithm of real relative price of farm labour (Wage)
Trend – time trend
STRU – structural break dummy of unemployment
λ – error correction Term (ECT)
α_0, β_0 and γ – coefficients of the variables in the long run relationship
α_1, β, ρ, η, μ – coefficients of the variables in the short run.

ANALYSIS OF RESULTS AND DISCUSSION

The study aimed at determining the association as well as establishing the causality of increasing minimum wage rate on unemployment of unskilled farm workers and food prices using correlation matrix, tables and figures as well as structural changes. Findings from literature were summarised to support our analysis.

Results of the Pearson product-moment correlation analysis found some form of association between Wage rate (*W*), Employment of unskilled farm workers (*L*) and food prices (F_p) at the 5% significance level as shown in Table 2. The analysis reveals that, a negative association exists between minimum wage rate for unskilled farm workers and employment of these workers. The implication maybe that, as the minimum wage rates of unskilled farm workers increases, so does the increase in unemployment of these workers (–0.651). This finding is contrary to that of a study conducted by Lemos (2003) in Brazil where unemployment in the agricultural sector was low and statistically insignificant as minimum wage rates increase but shows a negative association with sizeable wage increase similar to this study. The low unemployment rate in Brazil compared to South Africa was attributed to the existence of many alternative institutions/sectors capable of absorbing unskilled labour force retrenched by the agricultural sector. Hence, both the supply and demand side of unskilled labour in Brazil was competitive and the supply side relatively more inelastic compared to South Africa where supply of unskilled labour is relatively flexible.

Table 2. Correlation matrix on the association between Wage rate (*W*), Employment of unskilled farm workers (*L*) and food prices (F_p)
Tabela 2. Macierz korelacji między poziomem wynagrodzenia (*W*), zatrudnieniem wśród niewykwalifikowanych pracowników rolnych (*L*) a cenami żywności (F_p)

	W	*L*	F_p
W			
L	–0.651		
F_p	0.021	0.001	

Values are run at $p < 0.05$.
Source: DAFF (2013).
Wartości są istotne przy $p < 0,05$.
Źródło: DAFF (2013).

Furthermore, a positive (0.021) association was established between Wage rate (*W*) increases and food prices (F_p). This is because in South Africa, the wage bills of unskilled farm workers constitute more than 50% of farmer's operational costs.

Any increase in minimum wage rate will be transferred in the form of higher output prices in the short-run period because farmers cannot substitute workers with machines/technology due to stringent labour legislations. Furthermore, no association (0.001) was found between Employment and food prices (F_p). The implication maybe that, the rise in minimum wage unskilled farm workers is not sufficient enough to offset food prices increases. This is because households with low income spend over 60% of their monthly income on food. This finding is consistent with that of Frye and Gordon (1981), which found that a 10% increase in the minimum wage of unskilled workers in the US increase the overall inflation by 0.02 percentage points.

The use of Co-integration in this study was to analyse the short and long term effects of increasing minimum wage rate on employment of farm workers and food prices in South Africa. The argument is that, South Africa's economic growth is not 'wage-driven' rather it is 'investment-driven'. As a result, the high levels of structural unemployment witness from 2012 onwards in the agricultural sector can be attributed to the rising minimum wage of unskilled farm worker. The first step in the application of co-integration analysis was to test for the order of integration. The order of integration determine whether the data series possess past effects, hence integrated. An integrated series is considered non-stationary and the order of integration of a series is determined by the number of times it must be differenced before it is rendered stationary. A linear relationship of series can be estimated if more than two series exists. In this study, to examine the order of integration a null hypothesis stating that there was no co-integration

Table 3. Unit root test
Tabela 3. Test pierwiastka jednostkowego

Variable Zmienna	Level – Poziom			
	Without trend – Bez trendu		With trend – Z trendem	
	t-statistic statystyka *t*	*P*-value wartość *P*	*t*-statistic statystyka *t*	*P*-value wartość *P*
ln W	–0.9895	3.1158	0.7489	0.1154
ln L	–4.4542	0.0009	–4.4457	0.0050
ln F_p	–3.7478	0.0065	–5.637115	0.0002
	First difference – Pierwsza różnica			
ln W	–6.3150	0.0000	–6.3281	0.0000
ln L	10.2327	0.0000	–10.1417	0.0000
ln F_p	–8.96467	0.0000	–8.855475	0.0000

Lag length selection was automatic blased on Eviews' Schwarz Information Criteria, *ln W*: Natural logarithm of employment, *ln L* Natural logarithm of wage rate and Natural logarithm of food prices (F_p).
Source: own elaboration.
Wyboru rzędu opóźnień zmiennych dokonano automatycznie za pomocą pakietu EViews w oparciu o kryterium informacyjne Schwarza, *ln W*: logarytm naturalny z zatrudnienia, *ln L*: logarytm naturalny z poziomu wynagrodzenia i logarytm naturalny z cen żywności (F_p).
Źródło: opracowanie własne.

tested against the alternative hypothesis (Alemu et al., 2003). Hence, this test attempts to determine the order of integration of the variables (W, L and F_p) followed by the test for co-integration.

Table 3 shows that employment in agriculture is integrated in order 1 or I (1) both in the non-trended and trended models. Also, the mixed results were calculated by differencing the series as it is in line with literature. However (Maddala, 1992) stated that data generating process is stationary and has little consequence on the consistency of parameter estimates. This is because differencing creates a moving error and hence, inefficient estimates, which can be corrected by estimating the differenced regression equation using Ordinary Least Square (OLS) techniques. But, if data in levels are wrongly considered stationary and are modelled without being differenced, its likelihood of violating the assumptions of classical regression procedure is very high. This will result to an overtime increase in the variance of errors. Therefore, it is a widely accepted view that it is best, with most economic time series, to work with differenced data rather than data in levels (Plosser and Schwert, 1978). The consequence of differencing is loss of information on the long-run relationships among variables, which can be handled by estimating Vector Error Correction Model (VECM). With this in mind, the study differenced all the I (1) and others with inconclusive test results. The results obtained on the ADF tests for the differenced series were all stationary in the process or I (0) which is the alternative as illustrated in Table 4.

In this study, the Vector Error Correction Model (VECM) was formulated to determine a long run relationship between minimum wage rates (W_t), unemployment (L_t) and food prices (F_p) in the South African agricultural sector. Hallam and Zanoli (1993) stated that, a high R^2 in the estimated long-run regression equation is required in order for the equation to reduce the effect of small sample size bias on the estimated co-integration regression parameters (α_0, β_0 and γ), which may otherwise be carried over to the estimates of the error correction model.

According to Engle and Granger (1987), causality has to exist in at least one direction of integration if more than two variables in a regression equation are co-integrated. Furthermore, in the error correction model, the Granger causality test implies causality from

Table 4. Co-integration test for employment and other variables
Tabela 4. Test kointegracji dla zatrudnienia i pozostałych zmiennych

Hypothesized No. of CE(s) Hipotetyczna liczba wektorów korygujących	Eigen value Wartość własna	Trace stat Test śladu	0.05 critical value Wartość krytyczna 0,05	Probability** Poziom istotności**
Co-integration test for unemployment in agriculture using trace statistics test Test kointegracji dla bezrobocia w rolnictwie z wykorzystaniem statystyki testu śladu macierzy				
None* – Brak*	0.669359	75.67529	63.87610	0.0037
At most 1 – Co najwyżej 1	0.277480	28.08630	42.91525	0.6169
At most 2 – Co najwyżej 2	0.186501	14.11085	25.87211	0.6485
At most 3 – Co najwyżej 3	0.114630	5.235216	12.51798	0.5630
Co-integration test for unemployment in agriculture using maximum eigen value test Test kointegracji dla bezrobocia w rolnictwie z wykorzystaniem testu maksymalnej wartości własnej				
None* – Brak*	0.669359	47.58899	32.11832	0.0003
At most 1 – Co najwyżej 1	0.277480	13.97545	25.82321	0.7246
At most 2 – Co najwyżej 2	0.186501	8.875634	19.38704	0.7372
At most 3 – Co najwyżej 3	0.114630	5.235216	12.51798	0.5630
Co-integration test for unemployment in agriculture using trace statistics test Test kointegracji dla bezrobocia w rolnictwie z wykorzystaniem statystyki testu śladu macierzy				
None* – Brak*	0.621919	79.51113	63.87610	0.0014
At most 1 – Co najwyżej 1	0.397246	37.68732	42.91525	0.1512
At most 2 – Co najwyżej 2	0.238448	15.91873	25.87211	0.4991
At most 3 – Co najwyżej 3	0.093175	4.205641	12.51798	0.7122
Co-integration test for unemployment in agriculture using maximum eigen value test Test kointegracji dla bezrobocia w rolnictwie z wykorzystaniem testu maksymalnej wartości własnej				
None* – Brak*	0.621919	41.82381	32.11832	0.0024
At most 1 – Co najwyżej 1	0.397246	21.76859	25.82321	0.1570
At most 2 – Co najwyżej 2	0.238448	11.71309	19.38704	0.4423
At most 3 – Co najwyżej 3	0.093175	4.205641	12.51798	0.7122

*Hypothesis shall be rejected at the 0.05 level, ***p*-values.
Source: own elaboration.
*Hipotezę należy odrzucić na poziomie istotności 0,05; **wartości *p*.
Źródło: opracowanie własne.

the independent variables in levels to the dependent variable which is unemployment in the agricultural sector (L_t). Testing for Granger causality requires testing whether the Error Correction Coefficient (ECT) is significantly different from zero. Even, if the coefficients of the lagged changes in the independent variables are not statistically significant, Granger causality still can exist as long as ECT is significantly different from zero (Choudhry, 1995). As a result, the models specified in Table 5 and 6 indicate the significance of the ECT which also indicates the presence of granger causality for the independent variables to the dependent variables.

The estimates of VECM for employment in agricultural sector and Food prices (*Fp*) has an R^2 of 54.5%

Table 5. Long-run and short-run vector error correction estimates of employment (L_t) and wage rate (W_t)
Tabela 5. Estymacje długo- i krótkookresowego modelu korekty błędem dla zatrudnienia (L_t) i poziomu wynagrodzenia (W_t)

Variables Zmienne	Long-run Długookresowo
$ln\ L_t$ (–1)	1.000
$ln\ W_t$ (–1)	0.453 (0.180)*
Trend (Time) – Trend (w czasie)	0.009 (0.004)*
Constant – Stała	13.808

Short run – Krótki przebieg
$\Delta\ Ln\ L_t$

Error correction Korekta błędem	Coefficient Współczynnik	Standard error Błąd standardowy	*P*-Value Wartość *P*
CointEq (ECT) Błąd równowagi długookresowej	–0.606	0.116	0.000
$\Delta\ ln\ L_t$ (–1)	0.036	0.127	0.778
$\Delta\ ln\ W_t$ (–1)	–0.139	0.081	0.093
Constant – Stała	0.086	0.101	0.393
DUM	0.314	0.061	0.000
R^2	0.484		
Adj. R^2 – Skor. R^2	0.414		
F-statistic – Statystyka *F*	6.939		
AIC	–1.471		
SIC	–1.225		
DW stat	2.185		

*Significance at 5% level, figures in parenthesis denotes standard error. S.E. – standard error, DUM – dummy for structural behaviour of unemployment due to policy change, AIC – Akaike information criterion, SIC – Schwarz information criterion, DW stat – Durbin-Watson stat, ECT – error correction coefficient, *Ln* W_t – natural logarithm of price of labour in agriculture (wage rate).
Source: own elaboration.
*Istotność na poziomie 5%, liczby w nawiasach oznaczają błąd standardowy. S.E. – błąd standardowy, DUM – zmienna fikcyjna dla strukturalnej reakcji bezrobocia na zmiany polityczne, AIC – kryterium informacyjne Akaike, SIC – kryterium informacyjne Schwarza, DW stat – test Durbina-Watsona, ECT – współczynnik korekty błędem, *Ln* W_t – logarytm naturalny z ceny pracy w rolnictwie (poziomu wynagrodzenia).
Źródło: opracowanie własne.

and significant at 1% level. The long-run co-integration response model revealed that, the price of labour (Wage rate) in agriculture has a positive and significant effect (0.453) on employment within the industry as shown in Table 5. The implication is that as the price of labour increases, the number of unemployed workers also increases. This relationship is based on the hypothesis that was put forward in the application of the model. Furthermore, the time trend effect was also found to be positive and was highly significant at 5%. This is an indication that as the minimum wages of farm workers increase so does the increase in unemployment of farm workers. The trend variable showed a positive response of unemployment in agricultural sector due to change in technology over time. The short-run relationship reveals an error correction term with an expected sign and level

Table 6. Long-run and short-run vector error correction estimates of employment (L_t) and real food prices (F_p)
Tabela 6. Estymacje długo- i krótkookresowego modelu korekty błędem dla zatrudnienia (L_t) i realnych cen żywności (F_p)

Variables Zmienne	Long-run Długookresowo
ln L_t (–1)	1.000
ln Fp_t (–1)	1.168(0.38296)*
Trend (Time) – Trend (w czasie)	(0.00501)*
Constant – Stała	–13.092

Short run – Krótki przebieg
Δ *Ln* L_t

Error correction Korekta błędem	Coefficient Współczynnik	Standard error Błąd standardowy	P-Value p-wartość
CointEq (ECT) Błąd równowagi długookresowej	–0.419	0.110	0.001
Δ *ln* L_t (–1)	–0.015	0.141	0.858
Δ *ln* Fp_t (–1)	0.247	0.156	0.121
Constant	0.077	0.114	0.505
DUM	0.185	0.053	0.001
R^2	0.545		
Adj. R^2 – Skor. R^2	0.261		
F-statistic – Statystyka *F*	3.964		
AIC	–1.239		
SIC	–0.993		
DW stat	2.112		

*Significance at 5% level, figures in parenthesis denotes standard error. S.E. – standard error, DUM – structural break dummy of food prices (F_p), SIC – standard industrial classification (agricultural sector), DW stat – Durbin-Watson stat, ECT – error correction coefficient, *Ln* L_t – natural logarithm of unemployment, *Ln* F_p – natural logarithm of food prices.
Source: own elaboration.
*Istotność na poziomie 5%, liczby w nawiasach oznaczają błąd standardowy. S.E. – błąd standardowy, DUM – zmienna fikcyjna zmiany strukturalnej dla cen żywności (F_p), SIC – klasyfikacja działalności gospodarczej w sektorze rolniczym, DW stat – test Durbina-Watsona, ECT – współczynnik korekty błędem, *Ln* L_t – logarytm naturalny z poziomu bezrobocia, *Ln* F_p – logarytm naturalny z cen żywności.
Źródło: opracowanie własne.

of significance of approximately 61% adjustments rate towards the long-run equilibrium of unemployment in agriculture. The analysis also found that, planned supply is significantly affected by the dummy variable for structural break (DUM) in 2012 when minimum wage policy was implemented.

Similarly, the model for minimum wage was estimated and the VECM estimates display an R^2 of 54.5% at a significant level of 5%. The long-run relationship indicated a negative response to unemployment in agriculture (*L*) while revealing a positive but significant response for food prices (F_p; 1.168). Agricultural supply was observed to be price elastic in the long-run but price inelastic in the short-run. The short-run relationship also showed a significant Error correction coefficient (ECT) with an expected starting point of 41.9% adjustments

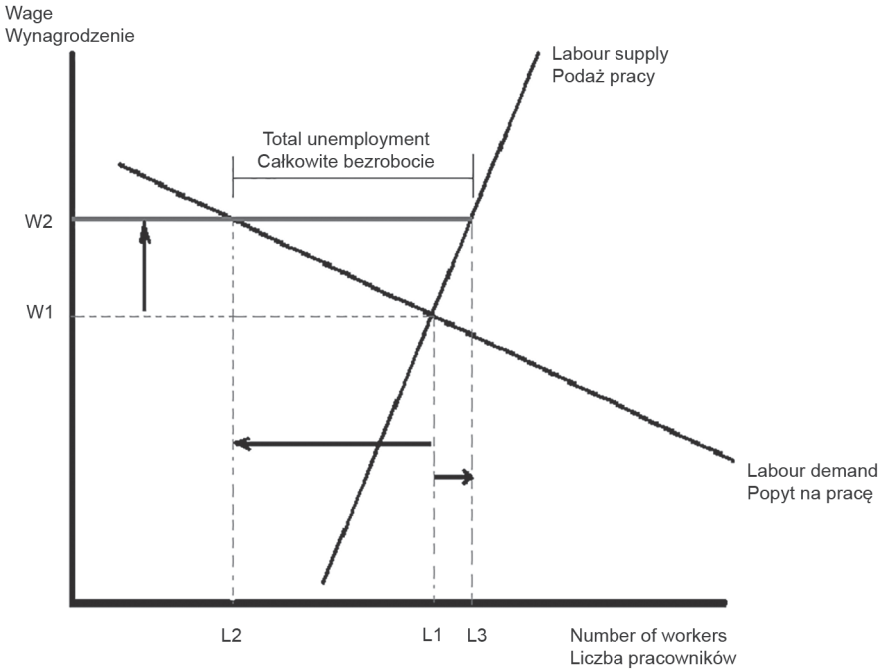

Fig. 1. Structural adjustment of employment in agricultural sector
Source: own elaboration.
Rys. 1. Strukturalne dopasowanie zatrudnienia w sektorze rolniczym
Źródło: opracowanie własne.

rate towards the long-run equilibrium within one year period. The structural dummy also observed is very important in explaining policy change within the agricultural labour market (Table 6).

Furthermore, the demand for and supply of labour and the impact of a minimum wage changes are normally explained using the neo-classical theories. The theory is based on the concept of partial equilibrium. In this study, supply and demand diagrams are used to show how the factor market attain equilibrium at an equilibrium wage level. Based on these theories, structural analysis of minimum wage rate and employment of unskilled farm workers in South Africa were performed and illustrated in Figure 2. From the figure, the equilibrium market wage would be W_1 and the equilibrium level of employment would be L_1 in the absence of a minimum wage. When a minimum wage of W_2 is introduced, the level of employment drops to L_2. The analysis reveals that, the quantity of labour in demand exceeds the quantity of labour in supply at a minimum wage rate of W_2. At this level, a total of $L_3 - L_2$ unemployed farm workers will be created as a result of the increase of minimum wage from W_1 to W_2 *ceteris paribus*. Economic theories (Philips curve; labour demand and supply) and empirical evidence on the minimum wage employment predicts that employment decreases in the presence of wage increases. Opponents of this view have argued that, in an economy where growth is 'wage-led' higher minimum wage will generate much needed consumption which will translate into increase investment, production and employment.

However, this is not the case with the South African economy since the country consumes a great deal of imported products compared to locally manufactured ones. Furthermore, although empirical evidence has established that an increase in minimum wage rates raises farm wages of the unskilled farm workers, there is no consensus on whether this is the main driver of unemployment in the agricultural sector or not (Card and Krueger, 1995). Table 7 shows the Consumer Price Index (CPI) of foods with low degree of processing as a proxy for overall annual food prices. The goods selected for the analysis constitutes more than 42 % of lower income households consumption expenditure

BFAP (2008), The table below indicates average agricultural product prices have been increasing annually since 2000. Assuming 2005 the base year, the analysis focused on explaining the relationship between minimum wage increase in the farm sector and changes in the overall food prices.

BFAP (2008) reported that, labour cost constitutes approximately 40–55% of the less processed agricultural product consumers buy on a monthly basis. Results from the table below have shown that, since the implementation of minimum wage legislation in the agricultural sector 2003, low processed products price has generally increased compared to the base year of 2005. The finding is consistent to that of Olujenyo (2008) who found that, the overall food price increases are mainly influenced by increase in input prices such as fuel, electricity and labour as shown in Table 7 below.

It cannot be conclusively said that, increases in food prices are solely a result of increases in workers minimum wage rates. However, Olujenyo (2008) stated that, the labour cost factor plays a significant role in the general food price increase. This finding is supported by Aaronson (2001) who found evidence that, the increasing food inflation in US and Canada during the 1970s–1980s was significantly derived by the pass-through effect of annual increase in minimum wage of farm workers in these countries. The graphs below indicates the effect of minimum wage increases on food prices in the long and short-run period.

In South Africa, the demand for basic agricultural food is inelastic due to the necessity nature associated with these products (Fig. 2). In the short-run farmer's production costs increase due to the introduction of minimum wage. However, farmers can only change variables factors of production (labour, fertilizers and other costs) that vary with the production level in the long-run. Due to increases in minimum wage rate, farmers are forced to adjust variable costs of production

Table 7. CPI indexes for basic agricultural goods and price change from (2000–2012) with 2005 as the base year
Tabela 7. Wskaźniki cen towarów i usług konsumpcyjnych dla podstawowych produktów rolnych oraz zmiany cen (2000–2012) dla roku 2005 jako okresu bazowego

Year Rok	All items Wszystkie produkty	Food Żywność	Meat Mięso	Grain products Produkty zbożowe	Milk, cheese and eggs Mleko, ser, jaja	Vegetables Warzywa	Overall food inflation Całkowita inflacja
	2005 = 100						
2000	78.1	72.5	70.9	76.4	66.5	75.4	–0.219
2001	82.5	76.4	75.6	79.4	73.9	74.3	–0.175
2002	90.1	88.5	88.9	93.1	85.7	89.8	–0.099
2003	95.4	95.6	94.2	100.3	95.4	97.4	–0.046
2004	96.7	97.8	96.4	98.8	97.7	97.4	–0.033
2005	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*0*
2006	104.6	107.2	115.3	104.3	105.6	107.3	0.046
2007	112.1	118.3	127.2	118.1	117.0	120.3	0.121
2008	125.0	138.3	138.7	154.7	139.6	133.9	0.25
2009	134.2	150.9	148.3	169.8	155.1	154.7	0.342
2010	139.9	152.3	149.0	163.0	158.0	157.8	0.399
2011	146.9	163.3	164.7	173.7	159.6	164.0	0.469
2012	155.2	175.3	177.1	187.7	172.4	170.9	0.552

Source: DAFF (2013).
Źródło: DAFF (2013).

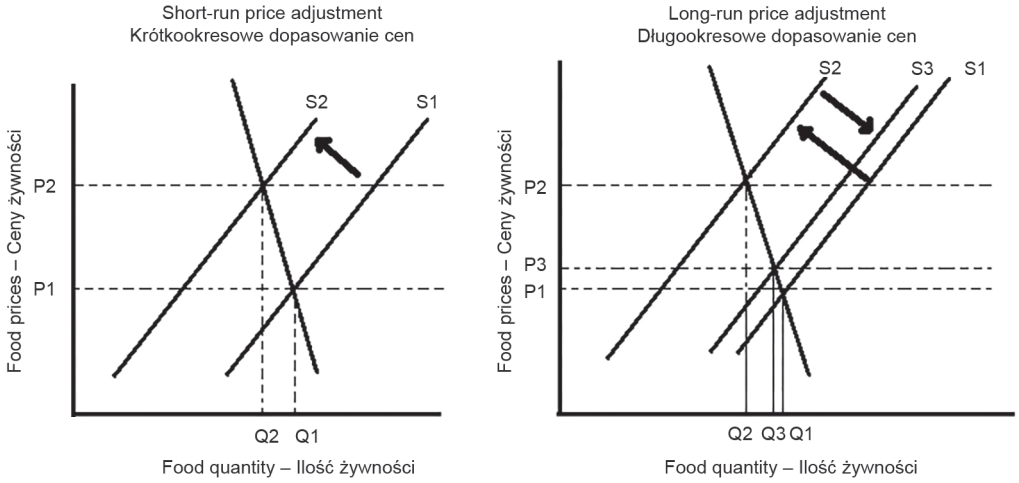

Fig. 2. Short-run and long-run structural adjustment of food prices
Source: own elaboration.
Rys. 2. Krótko- i długookresowe strukturalne dopasowanie cen żywności
Źródło: opracowanie własne.

while maintaining efficiency in production and profitability. The reduction in variable costs causes the supply curve of agricultural products to shift from S_1 to S_2. In the short-run, such a reduction may lead to a decrease in the quantity of agricultural products at the disposal of consumers resulting in demand exceeding the supply. The demand excess over supply will result in price increases from P_1 to P_2, *ceteris paribus*.

MaCurdy and McIntyre (2001) applied the structural change methodology and data from the SIPP and US Census to analyse the 1996–1997 US minimum wage increase. Their study concluded that a minimum wage increase raises overall prices. In the long-run farmers can switch to less labour intensive technologies pushing the supply curve to shift from S_2 to S_3. This will result in increasing the quantity of food supplied in the market from Q_2 to Q_3 as shown in Figure 3. The increase in the quantity of food produced will reduce food prices from P_2 to P_3. However, since capital investment is costly (acquisition and maintenance), real food prices will possibly not go back to P_1. Hence, the total long-run price adjustment effect is from P_1 to P_3, *ceteris paribus* as depicted in Figure 3. However, Machin et al. (2003) used regression analysis to estimate the impact of the introduction of minimum wage in the UK in April 1999 on the agro processing industry. The results found no evidence that the introduction of minimum wage had an impact on food price increase. Furthermore, the study concluded that price regulations limit the extent of price adjustments of processed food commodities. The increase in food prices affects lower income consumers relatively more than higher income consumers. Findings by MaCurdy and McIntyre (2001) expressed that because the disposable income for lower income earners spend on food is higher than that of higher income earners. The extra costs of food are usually 1% higher for lower income families compared to those of higher income groups in the US.

SUMMARY

Analysis reveals a negative association (–0.651) between minimum wage rate and employment of farm workers in South Africa. The study establishes a positive (0.021) association between wage rate (W) increases and food prices (F_p). There was no association (0.001) between employment and food prices (F_p). The analyses have shown that, despite large increases in minimum wage of unskilled farm workers from 2012 to date in South Africa, the disposable income of these workers is not sufficient enough to offset the increases in food prices.

Findings of the co-integration analysis revealed that the time trend effect is positive and highly significant at 5% level of confidence confirming the increase in

unemployment of farm workers due to rising minimum wages. Planned supply in the agricultural sector was significantly affected by the dummy variable for structural break (DUM) in 2012 when minimum wage policy was implemented. Agricultural supplies are observed to be price flexible in the long-run but price inflexible in the short-run. The long-run relationship showed increasing unemployment in agriculture (L) and food prices (F_p) (1.168) while the short-run relationship also showed a very significant Error Correction Coefficient (ECT) with an expected starting point of approximately 41.9% adjustments rate towards the long-run equilibrium within one year period.

Structural analysis confirmed, the demand for basic agricultural food is almost inelastic due to the necessity nature associated with these products. In the short-run, farmer's production costs increased following the introduction of minimum wage. The supply curve for food shifted to the left due to the retrenchment of some farm workers resulting in the quantity of food supply in the market to decrease. In the long-run, farmers are forced to switch to less labour intensive technologies forcing the supply curve of food to shift to the right. The result is an increased quantity of food supplied in the market which resulted in reduced food prices although real food prices will possibly not go back to the original price before the introduction of the minimum wage.

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ANALIZA STRUKTURALNA POZIOMÓW WYNAGRODZENIA MINIMALNEGO, BEZROBOCIA ORAZ CEN ŻYWNOŚCI WŚRÓD PRACOWNIKÓW ROLNYCH W AFRYCE POŁUDNIOWEJ – PODEJŚCIE KOINTEGRACYJNE

Streszczenie. W niniejszym artykule zbadano krótko- oraz długookresowy wpływ wzrostu wynagrodzenia minimalnego pracowników rolnych w Afryce Południowej na bezrobocie strukturalne oraz wzrastające ceny żywności. W celu ustalenia związku między zmiennymi wykorzystano współczynnik korelacji Pearsona. Z analizy wynika, że istnieje ujemna korelacja (–0,651) między poziomem wynagrodzenia a zatrudnieniem wśród pracowników rolnych. Korelacja dodatnia (0,021) zaistniała za to pomiędzy wzrostem poziomu wynagrodzenia (W) a cenami żywności (F_p). Nie stwierdzono związku (0,001) pomiędzy zatrudnieniem a cenami żywności (F_p). Następnie posłużono się analizą kointegracji, by określić krótko- i długookresowe relacje przyczynowe. Okazało się, że płace miały pozytywny i istotny (0,453) wpływ na bezrobocie strukturalne wśród pracowników rolnych. Bezrobocie było elastyczne w stosunku do płac w długim okresie i nieelastyczne w krótkim okresie. Długookresowa kointegracja ukazała wzrost bezrobocia w rolnictwie (L) oraz wzrost cen żywności (F_p) (1,168), natomiast krótkookresowa ujawniła istotny parametr korekty błędem (ECT) z przewidywanym punktem początkowym na poziomie 41,9% dostosowań zmiennych do równowagi długookresowej rocznie. Analiza strukturalna potwierdziła nieelastyczny popyt na podstawową żywność. W artykule zaleca się subsydiowanie pracowników rolnych przez rząd przez zastosowanie technologii zmniejszających koszty, a także rozwój umiejętności pracowników w zakresie technologii zmniejszających koszty.

Słowa kluczowe: wynagrodzenie minimalne, bezrobocie pracowników rolnych, ceny żywności, zmiana strukturalna

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