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DEVELOPMENT ECONOMICS | RESEARCH ARTICLE

The effects of shock in strikes on non-agriculture employment, output, and inflation in South Africa: A structural analysis of Bayesian VAR models

Marvellous Ngundu^{1,2*}, Shonisani Mphinyana-Chauke³, Reon Matemane⁴ and Harold Ngalawa²

Abstract: This study empirically addresses claims about the effects of strikes on output growth, inflation, and non-agricultural employment in South Africa using a structural analysis of Bayesian VAR models with a Normal inverted Wishart prior for the period 1982–2018. We find empirical support for a strikes shock's transitory negative impact on the country's output growth. In any case, this was not contested. Our findings, however, contradict the claims that strikes ensue inflation and unemployment in South Africa. Precisely, the findings show that a strikes shock has a positive transient impact on non-agriculture employment but has no effect on inflation. The inflation finding suggests that strikes do not cause a wage-price spiral because the workers' bargaining power is weak to influence a significant wage increase settlement that can trigger prices. The employment finding implies a negative net change in the number of strikers after a settlement rather than an absolute increase in non-agriculture employment. These findings reveal that strikers resume work with unfulfilled wage increase demands. Hence, the burden borne by companies as a result of strikes is mainly due to lost production rather than a substantial increase in the wage bill.

Subjects: Macroeconomics; Labour Economics; Econometrics; Development Economics

Keywords: bayesian models; inflation; non-agriculture employment; Normal inverted Wishart prior; output; South Africa; structural VAR; strikes

Jel classification: C11; E24; E31; J52

1. Introduction

Strikes have become a common language used by South African workers to communicate their workplace grievances to their employers. What is unclear is whether employers are reluctant to address their employees' grievances amicably at the negotiating table or whether there is a communication barrier that only trade unions can bridge. Whatever the dilemma, production lost during strikes unquestionably impedes output growth. Striking workers, on the other hand, lose their wages based on the no work-no pay policy. Anecdotal evidence has recently linked strikes to

rising inflation (based on the wage-price spiral hypothesis) and unemployment rates in the country. However, no empirical evidence has been found to validate these assertions. The current study is conducted in response to this gap.

The background of strikes in South Africa can be divided into two phases: one during which the struggle of majority workers was at its peak, owing primarily to the apartheid system, and the other during the democratic dispensation, remarkably since the enactment of Labour Relations Act 66 of 1995. Figure 1 depicts the annual number of strikes during the first and second phases.

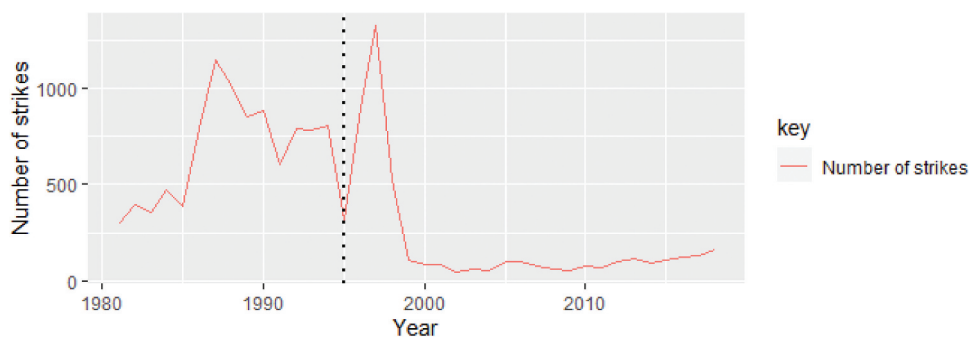
Figure 1 indicates that strikes sharply increased from 292 in 1981 to 1148 in 1987. According to Gentle et al. (2018), this upsurge was mainly caused by the economic downturn as workers tried hard to defend their jobs. It is during this period that the Congress of South African Trade Unions (COSATU) and the National Council of Trade Unions (NACTU) were launched in 1985 and 1986, respectively. Up to now, COSATU is the most powerful and largest union movement in the history of South Africa, while NACTU is the second-largest trade union federation in the country. These federations organized massive campaigns and strikes to advocate for “a Living Wage, a Worker’s [Labour Relations Act], and the Workers Charter” whilst at the same time participating in the liberation struggle (Gentle et al., 2018: 22). The apartheid government initially responded using repression, but this did not detour the union movement until the government resorted for negotiations in the late 1980s. This explains why strikes decreased from 1987 until the end of the apartheid era. It is widely acknowledged that the COSATU-led union movement made a significant contribution to the victory over workplace oppression and the demise of the apartheid system.

An important achievement of the union movement is the enactment of the Labour Relations Act 66 of 1995,¹ which guarantees every South African worker’s right to join trade unions, engage in collective bargaining, and strike without harassment. Strikes spiked in the subsequence 2 years from 315 in 1995 to 1324 in 1997. This is the highest number of strikes recorded in South Africa since 1981 if not ever in the history of the country, but they dropped to 107 in 1999 and have since risen to a high of 165 in 2018. According to Kenny (2020), since 1994 strikes in South Africa were largely caused by wage increment demands and to some extent demands for better working conditions, with the public, mining, manufacturing, and transport industries recording the most strikes.² Nonetheless, wages have not significantly increased nor have working conditions improved (Webster & Francis, 2019). Given these arguments, the main question we ought to address is whether or not strikes in South Africa can spark a wage-price spiral, as some analysts claim.

To this end, there is a great deal about strikes in South Africa, and a great deal of confusion about their consequences precisely on inflation and employment. However, there is a need to recognize that widespread strikes can have serious socioeconomic repercussions in society (Phipps, 1975). This study contributes to the debate on the economic consequences of strikes in South

Figure 1. Number of strikes in South Africa from 1981 to 2018.

Source: International Labour Organization (ILO) Database.



Africa. Typically, the study aims to determine the effects of shock in strikes on non-agriculture employment, output, and inflation in South Africa using Bayesian structural vector autoregressive (BSVAR) model with Normal inverted Wishart prior from 1982 to 2018. The agricultural sector is excluded because strikes and the union penetration in this sector have always been minimal (see, for example, Gentle et al., 2018, Kenny, 2020, Mzangwa, 2017, Tenza, 2020, Wörgötter & Nomdebevana, 2020).

The study is organized into five sections. The theoretical propositions about the impact of strikes on non-agriculture employment, output, and inflation follow. The third section outlines the empirical strategy. In the fourth section, the findings are presented, interpreted, and discussed. Finally, the fifth section concludes the study.

2. The impact of strikes on non-agriculture employment, output, and inflation

This study's theoretical framework is based on tangential references as there are no empirical studies noted on the subject matter. Workers (human capital) are critical output growth factors in the production function in both exogenous (Mankiw et al., 1992) and endogenous (Lucas, 1988) growth models. As a result, workers strike to compel employers to recognize their value and succumb to their demands. Strikes, thus, put a strain on the human capital factor in the production function, reducing output growth and having severe consequences if the settlement is prolonged. For instance, strikes from 2009 to 2013 are said to have reduced economic growth by 0.6%, from 3.8% in the fourth quarter of 2013 to 3.2% in the first quarter of 2014 (Mzangwa, 2017), with mining being the most affected sector (Tenza, 2020).

According to Tenza (2020), strikes can have an adverse impact on employment if businesses resort to retrenching as a turnaround strategy to adjust from losses incurred due to lost production and increased wage bills. Furthermore, strikes may result in dismissal if they are not protected. While the negative impact of strikes on employment may be minor and dependent on company-specific factors, the resultant effects of stifled output growth are certainly significant when Okun's law features are considered. Okun's law argues that labour absorption (employment) is constrained when output growth is stagnant or at worst declining (Okun, 1970).

Since the enactment of Labour Relations Act 66 of 1995, strikes in South Africa occurred whenever workers believe that inflation is eroding their wages and that their employer is doing nothing to address the situation. As a result, there is theoretically a bidirectional causality between strikes and inflation in South Africa, with strikes causing a wage-price spiral if workers' wage increase demands are met upon settlement. In Australia, Phipps (1975) confirmed this bidirectional causality and concluded that strikes are both a cause and an effect of inflation. A significant wage increase stimulates spending, which triggers demand in the market, causing prices to rise in the short run, other things being equal. A significant wage increase, on the other hand, is a cost burden for employers, which they tend to pass on to consumers by raising commodity prices. In a sense, workers' bargaining power through unions is the vital factor that influences wage-price spirals. Mzangwa (2017), for example, claims that excessive wage increment demands in 2013 pushed South Africa's inflation rates above the 6% maximum threshold.

Having discussed the propositions linking strikes to output growth, employment, and inflation, this study uses the empirical strategy highlighted in the following section to determine whether these theoretical propositions hold in the context of South Africa.

3. Empirical strategy

Structural VAR models are instrumental in the structural analysis of dynamic patterns of macroeconomic variables in response to structural shocks (see, for example, Waggoner & Zha, 2003). As a result, researchers have long focused on developing robust approaches to address the econometric issues associated with structural VAR models and improve their estimation accuracy. This study employs the Bayesian approach, which is widely recognized for producing exact finite-

sample inferences (see, for example, Bruns & Piffer, 2020, De Menezes Barboza & Vasconcelos, 2019, Inoue & Kilian, 2020, Mestiri, 2019).

Following the afore-mentioned studies, the basic structural VAR(p) model is described as follows:

$$A_0 y_t = v + \sum_{j=1}^p A_j y_{t-j} + \varepsilon_t, \text{ with } \varepsilon_t \sim N(0, I_k) \quad (1)$$

where, A_0 represents a lower triangular matrix with ones on the main diagonal, A_j for $j = 1, \dots, p$ are $k \times k$ parameter matrices for the contemporaneous and lagged effects of y_t , y_t is the $k \times 1$ matrix of the endogenous variables at time t , v proxies for a vector of constants, and ε_t is $k \times 1$ matrix of structural shocks.

In VAR models, Equation (1) is estimated in two steps: first in reduced form, and then using some identification strategy to recover the structural form. The reduced form of Equation (1) is derived by post-multiplying through by A_0^{-1} :

$$y_t = c + \sum_{j=1}^p B_j y_{t-j} + u_t, \text{ with } u_t \sim N(0, \Sigma) \quad (2)$$

where c , B_j , and u_t equate to $A_0^{-1}v$, $A_0^{-1}A_j$, and $A_0^{-1}\varepsilon_t$, respectively. This study considered a reduced-form VAR(2) model described below:

$$y_t = c + \sum_{j=1}^2 B_j y_{t-j} + u_t \quad (3)$$

Structural analysis is conducted to determine the response of a variable over time to the shock of the other. In the current case, the effects of shock in strikes on non-agriculture employment, output, and inflation in South Africa from 1982 to 2018. Be that as it may, the matrix of structural shocks in Equation (3) (u_t) has no economic interpretation because its elements are correlated across equations and cannot be isolated. Thus, a key distinction between structural VAR and reduced-form VAR is that the error covariance matrix in the former is diagonal (I_k), implying uncorrelated shocks. Equation (3), therefore, necessitates identifying restrictions (some identification strategy) to provide findings that can be economically interpreted (to recover the structural form). "Identification is typically achieved by imposing restrictions on $[A_0^{-1}]$ " (Inoue & Kilian, 2020: 6). Moreover, Equation (3) suffers from the curse of dimensionality precisely in the current case where the study period is short. Both issues are effectively addressed using the Bayesian approach which implements priors in VAR models as the main factor. The Bayesian approach shrinks the parameters to the prior unless the sampled data set is informative. There are several priors, but Minnesota prior of Litterman (1986) is considered as a baseline to evaluate the accuracy of other priors in Bayesian VAR models.

3.1. Prior specifications

Bañbura et al. (2010) used dummy observations to implement the Minnesota prior principles in the structural analysis of VAR models. De Menezes Barboza and Vasconcelos (2019: 228) imposed a Normal inverted Wishart prior to the parameters, "which allows for correlation residuals of different variables" in Equation (3), "making the model more adequate for structural analysis," and argued that the prior is convenient as it ensures tractable posterior distribution and equivalent to the former. Although several studies have expressed concerns that Normal inverted Wishart prior may be unintentionally informative about the implied prior for the structural impulse responses (see, for example, Baumeister & Hamilton, 2015, Bruns & Piffer, 2020), Inoue and Kilian (2020) show that the tools utilized to raise this concern are invalid in the Bayesian approach. Thus, the current study estimates the posterior distribution for the BSVAR model described by De Menezes Barboza and Vasconcelos (2019). The priors are configured to have the following moments for the parameters:

$$E[(B_j)_{h,i}] = \begin{cases} \delta_h, & h = i, j = 1 \\ 0, & \text{otherwise} \end{cases}, \quad V[(B_j)_{h,i}] = \begin{cases} \frac{\lambda^2}{j^2}, & h = i \\ \frac{\lambda^2 \sigma_h^2}{j^2 \sigma_j^2}, & \text{otherwise} \end{cases} \quad (4)$$

The prior shrinkage parameter λ controls the relative significance of the prior and the data, with small values favouring the prior. If $\lambda = 0$, the sampling information in Equation (3) is ignored, and the posterior distribution equates to the prior, the opposite is true if $\lambda \rightarrow \infty$. It is recommended to select λ in line with the size of the model to avoid over-fitting (see, for example, Bańbura et al., 2010, De Mol et al., 2008). This can be done by first estimating restricted VAR (in terms of variables) by ordinary least squares (OLS) to compute the in-sample root mean squared error (RMSE), and then choosing the value of λ that results in the same RMSE for the restricted model in the unrestricted model. However, in this study, we used the small range (0.0001–0.65) for λ since our unrestricted model constitutes four variables only. The hyper-parameter δ assumes a prior of white noise and random walk for stationary and non-stationary series, respectively. As in De Menezes Barboza and Vasconcelos (2019), we selected δ using the Phillips–Perron test for stationarity, with a value of 1 set for the first autoregressive term of each non-stationary equation and 0 for each stationary equation.

The Normal inverted Wishart prior is described as shown below:

$$\text{vec}(B) | \Sigma \sim N(\text{vec}(B_0), \Sigma \otimes \Omega_0) \quad (5)$$

$$\Sigma \sim hW(S_0, \alpha_0) \quad (6)$$

where the hyper-parameters B_0 , Ω_0 , and S_0 are selected in a manner that the moments in B meet the moments in Equation (4) and the expected value of Σ = the fixed residual covariance matrix of Minnesota prior.

3.2. Data

The study's data set contains annual percentage changes in Gross Value Added (GVA) at factor cost (output), Consumer Price Index (CPI) of all items (inflation), number of strikes (strikes), and non-agriculture employment. CPI data were obtained from the FRED Economic Data database, strikes data were collected from the ILO database, and the data of other series were sourced from South African Reserve Bank (SARB) database. The study period (1982–2018) is restricted by the availability of data for all variables utilized in this study. The findings of the study follow.

4. Findings and discussions

The results are presented in three stages. The descriptive statistics are presented first, followed by the main findings from the structural analysis of the strikes shock to non-agriculture employment, GVA, and inflation. Looking at how the variables behave in response to monetary policy is a good way to evaluate a VAR model in a macroeconomic framework like the current one. As a result, the third phase presents inflationary shock to strikes, non-agriculture employment, and GVA.

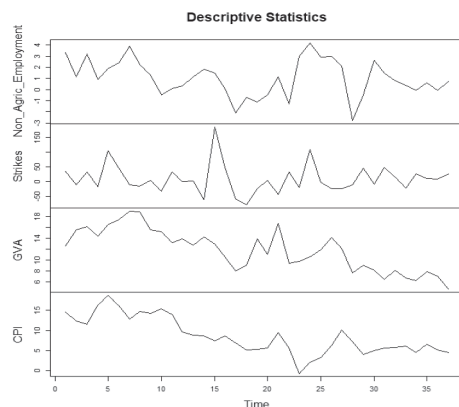
4.1. Descriptive statistics

Figure 2 illustrates the descriptive statistics. All series are expressed as annual percentage changes over the period (1982–2018).

Figure 2 demonstrates that the annual rate of change in output, non-agriculture employment, inflation, and strikes has slowed gradually over the study period (1982–2018). While this is a good thing for inflation and strikes, it is worrying for output and non-agriculture employment. Output growth rate has declined by 14.30% since its peak in 1988 to when the lowest rate was recorded in 2018. Non-agriculture employment rate declined by 2.60% from 3.30% in 1982 to 0.70% in 2018. However, the trend is characterized by some upswings (2004–2006), with the highest peak

Figure 2. Descriptive statistics.

Source: Authors.



Variable	Min	Median	Mean	Max
Non-Agric employment	-2.800	1.100	1.035	4.200
Strikes	-79.696	2.945	9.079	186.038
GVA	4.693	12.166	11.841	18.964
Inflation	-0.700	7.200	8.589	18.700

recorded in 2005, and downswings (2007–2009), with the worst employment rate recorded in 2009. Although the trajectory has since improved, it was still below average in 2018. The inflation rate declined by 14.20% from its peak in 1986 to 4.50% in 2018, with the lowest rate recorded in 2007. The rate of change in strikes dropped by 9.93%, from 34.93% in 1982 to 25.00% in 2018, with an exception of the 1997 spike. Notably, 1999 had the lowest strike rate.

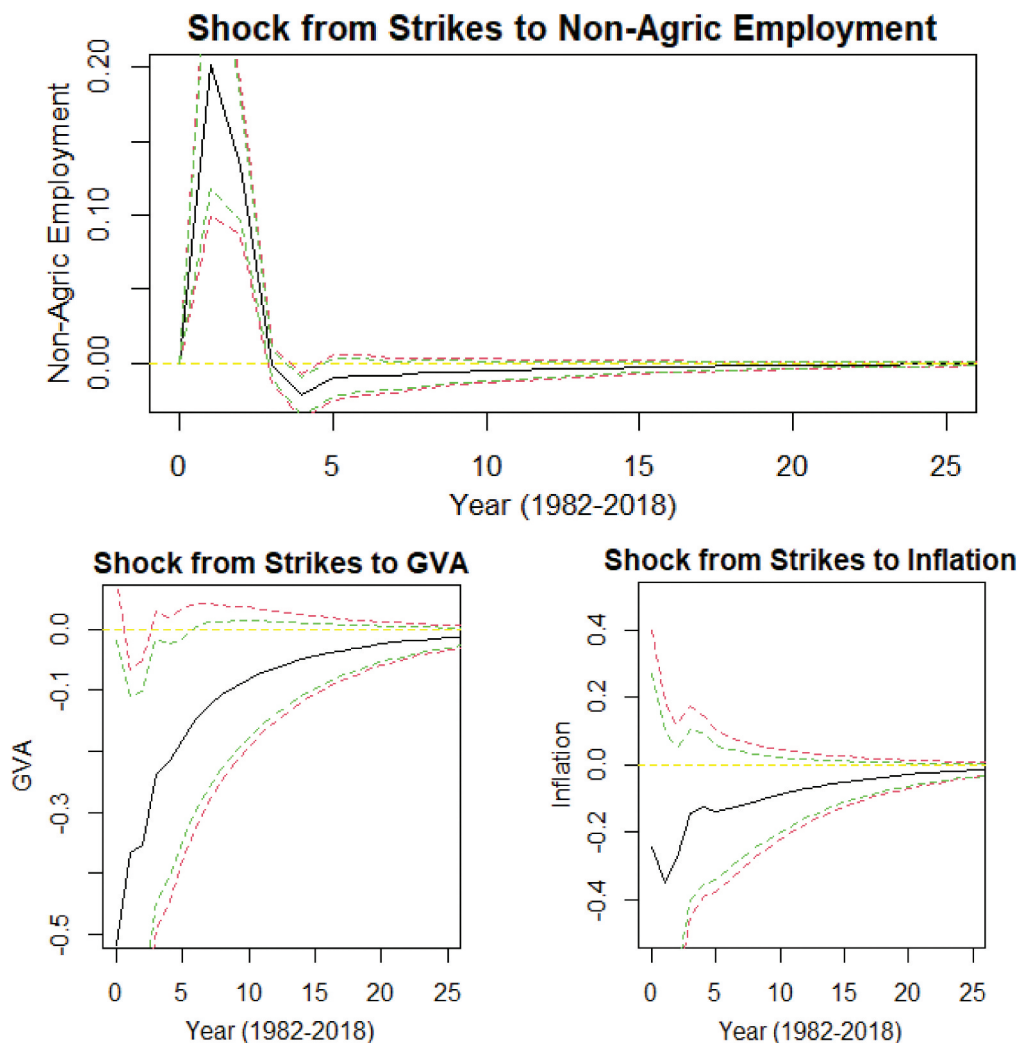
4.2. Structural analysis of strikes shock to non-agriculture employment, GVA, and inflation

Figure 3 illustrates how non-agriculture employment, GVA (output) growth, and inflation rates respond to strikes shock over the period (1982–2018). The results show that the effects of a shock in strikes are more detrimental to output (GVA) than to non-agriculture employment and have no significant impact on inflation. Precisely, one standard deviation shock from strikes raises non-agriculture employment to a peak of 0.2% in the first year then sharply declines and turns negative in the second year, with a post-shock peak of 0.04% in the fourth year. The impact gradually dissipates in the subsequent year. According to this finding, strikes shock tends to boost non-agriculture employment in the short run, with negative effects offset by positive effects. At the same time, GVA responds negatively to the shock of the strikes only for the first 5 years of the shock, with a severe impact in the first year. Strikes shock has a negative impact on inflation, albeit insignificant in the short and long run.

The GVA result is consistent with the literature and the prevailing claims that strikes stifle output growth in South Africa primarily due to lost production. In any case, this point was not contested in this study. However, the widespread narrative that strikes ensue inflation is disputed, while the impact of strikes on non-agriculture employment is mixed in one specification. Strikes shock is commonly thought to be detrimental to employment (Tenza, 2020); yet, we find that it initially boosts employment with a greater impact than the preceding negative post-shock, and then gradually fades away. According to Rao (2000: 32), since people on strike are disregarded as employees due to no work-no pay policy, employment growth over the period in which strikes occurred depend on “the net change in the number of strikers”, that is, the difference between the number of people newly on strike and the number of returning workers after a settlement. If there are more (fewer) new strikers than returning workers, the net is positive (negative), implying that employment growth is reduced (boosted). Thus, our finding reflects a negative net rather than an absolute increase in non-agriculture employment. The finding regarding strikes shock to inflation is discussed below after factoring in inflation shock to GVA, strikes, and non-agriculture employment. This is essential to confirm the causal relationship between strikes and inflation identified in Section 2.

Figure 3. Structural analysis of strikes shock to non-agriculture employment, GVA, and inflation.

Notes: Impulse responses were generated using the *Ibvar* package in R. The dashed lines represent the 90% and 95% confidence bands of the Bayesian credible sets obtained through Gibbs sampling with 1000 draws of Σ .
Source: Authors.



4.3. Inflation shock to GVA, strikes, and non-agriculture employment

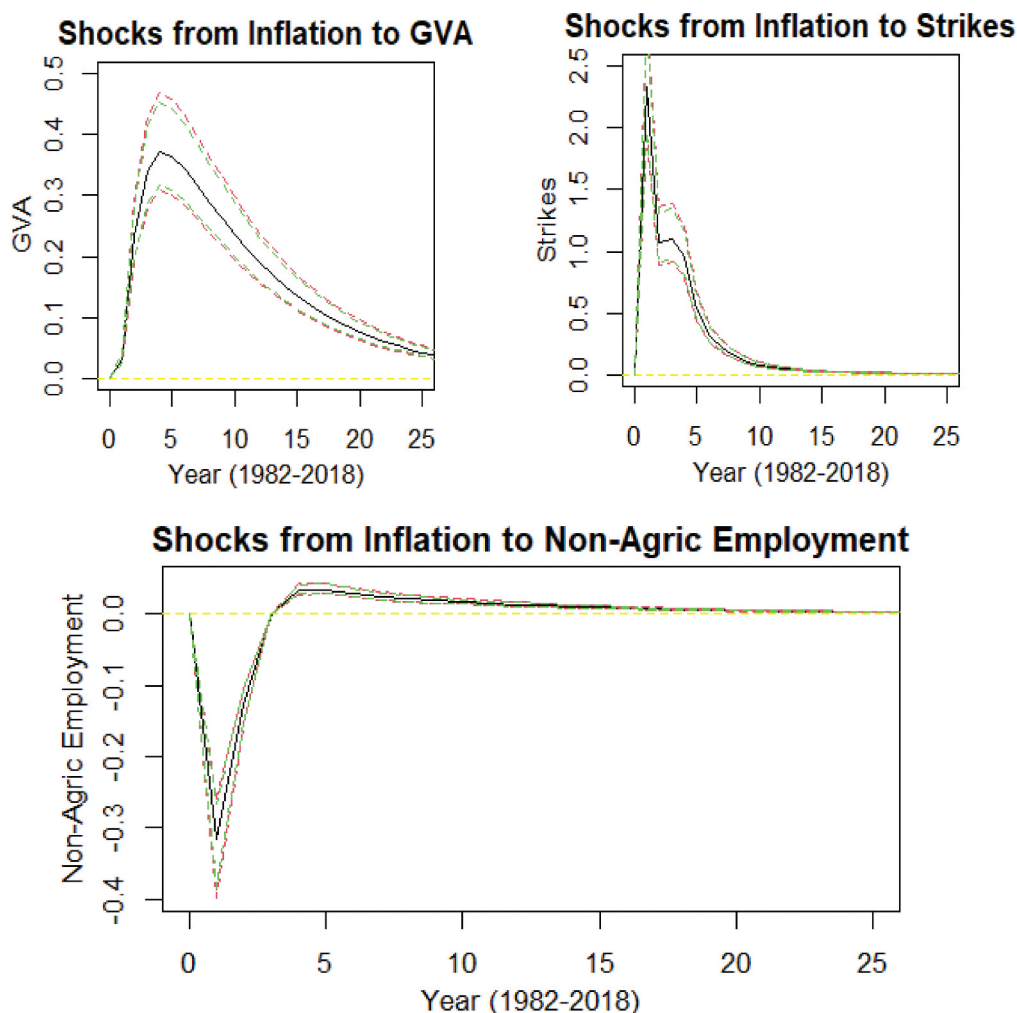
Figure 4 depicts how inflation shock affects GVA, strikes, and non-agriculture employment. One standard deviation increase in inflation raises GVA and strikes while decreasing non-agriculture employment. The impact on GVA is huge for the first 5 years, with a shock peak of 0.38% in the fifth year, and then gradually declines asymptotically towards zero, becoming less effective after 20 years. Strikes rise rapidly to a shock peak of 2.4% in the first year, then fall to zero, becoming less significant after 5 years. Non-agriculture employment falls sharply in the first year to a shock peak of 0.32%, then rises and turns positive in the second year, peaking at 0.03 in the fourth year. The impact gradually diminishes to zero and dissipates after 10 years. Thus, the inflation shock tends to strain non-agriculture employment, with positive effects offset by negative effects.

Figures 3 and 4 indicate that in South Africa, inflation significantly triggers strikes (Figure 4) and not vice versa (Figure 3). In contrast, Phipps (1975) found a bidirectional relationship between inflation and strikes in Australia and concluded that strikes are both a cause and an effect of inflation. The disparity can be attributed to differences in the bargaining power of workers (through their unions) in the two countries. Strikes do not necessarily ensue inflation, it is the bargaining power of workers that matters. Since workers frequently strike to keep their wages at par with the inflation rate, these findings reveal that workers' bargaining power is weak to influence a significant wage increase settlement that can trigger prices of commodities in the market.

Figure 4. Inflation shock to GVA, strikes, and non-agriculture employment.

Notes: Impulse responses were generated using the *Ibvar* package in R. The dashed lines represent the 90% and 95% confidence bands of the Bayesian credible sets obtained through Gibbs sampling with 1000 draws of Σ .

Source: Authors



The finding of the response of inflation to strikes shock (Figure 3) supports Webster and Francis (2019) argument that, despite strikes, wages and working conditions in South Africa have not significantly improved since 1994, indicating that the country's labour movement has lost influence and power as noted by Kenny (2020). Workers are thus forced to adjust their spending appetite (demand) to match the purchasing power of their nominal wages in the short run, *ceteris paribus*, hence, the negative albeit insignificant impact. In the long run, they may resort to borrow to supplement their wages. As borrowing increases, the government intervenes by raising interest rates to control demand-push inflation. The government may also impose price controls (particularly for basic commodities) to protect consumers from market forces.

The long-run impact of inflation on output growth has often been described using the Tobin effect (Tobin, 1965), which assumes that increasing the money supply to stimulate capital accumulation has a lasting positive impact on output growth because households respond to inflation by holding fewer money balances and more in other assets. In the short run, the Phillips Curve (Phillips, 1958) proposes that workers suffer from money illusion in that any increase in nominal wages which triggers inflation causes them to increase their labour supply (employment). Increased employment, in turn, boosts output growth. Similarly, monetarists deduce that households suffer from price illusion, at least in the short run, because any increase in nominal income or money supply induces their spending, resulting in an increase in aggregate demand. Increased demand, in turn, triggers production to meet that demand.

Inflation is thought of being detrimental to employment on one side (Vermeulen, 2017) and on the other Phillips Curve hypothesis argues that it boosts employment temporarily. In this study, these two opposing views are supported in one specification, with the inflation shock decreasing non-agriculture employment in the first year and enhancing it in the subsequent year before gradually dissipating. However, the severity of the initial negative shock renders the preceding positive shock ineffective. The long-run impact of the strikes on non-agricultural employment mimics the long-run Phillips Curve.

5. Conclusion

This study employs a structural analysis of Bayesian VAR models with Normal inverted Wishart prior for the period (1982–2018) to empirically validate speculations about the adverse effects of strikes on economic growth, inflation, and non-agriculture employment in South Africa. Except for tangential references, no empirical evidence was noted on this matter. We find empirical support for the detrimental impact of strikes shock on the country's output growth, and this was not debated in this study. However, our findings equally dispute that strikes ensue inflation and unemployment. Specifically, the findings show a significantly positive transient impact of strikes shock on non-agriculture employment, whereas the impact on inflation is negative albeit insignificant. The inflation findings suggest that in South Africa, strikes do not result in a wage-price spiral because workers' bargaining power through their unions is weak to influence a significant wage increase settlement that can trigger prices of commodities in the market. As a result, workers are compelled to shrink their demand in relation to the purchasing power of their nominal wages in the short run, while in the long run, they may resort to borrowing to supplement their wages. The employment finding reflects a negative net change in the number of strikers rather than an absolute increase in non-agriculture employment, implying that there were more returning workers than new strikers after a settlement. The main conclusion is that strikers resume work with unfulfilled wage increase demands. Accordingly, the burden borne by businesses as a result of strikes is primarily due to lost production rather than a significant increase in the wage bill. Strikes are thus a threat to the economy at large and must be avoided, but even so, companies must ensure that workers are fairly compensated.

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Notes

1. The Act's primary goals are to ensure workplace democracy, promote social justice, and advance economic development (Tenza, 2020).

2. This confirms Wörgötter and Nomdebevana's (2020) assertion that union penetration in South Africa is high in the public and mining sectors, moderate in the manufacturing and transport sectors, and low in the construction, trade, and finance sectors.

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