# Business confidence developments and the minerals industry

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## Abstract

This paper analyses the reaction of the minerals industry to business confidence *developments* in South Africa. This is achieved by augmenting a Taylor (1993) rule type central bank monetary policy reaction function with the indicator of business confidence. The results provide evidence of a statistically significant effect of an increase in business confidence on output of the minerals industry, which peaks after 5 months, the effect of which is statistically significant up to 7 months. The results are generally consistent with the information based rational and adaptive expectation hypotheses, while they are in contrast to the herd mentality based animal spirits hypothesis. The results have further shown a statistically significant effect of an increase in output of mining and quarrying on business confidence, which initially increase and then decrease, bottoming out after 9 months, the effect of which is statistically significant between 1 and 2 months as well as between 7 and 10 months. The results support the information based expectation hypotheses, which has implications for investment, employment and expansion plans, hence policy makers and mining authorities should continue to monitor the developments in business confidence to support overall economic activity and the minerals industry.

**JEL Classification**:C10, E32, E50, L72
**Keywords**: Business confidence, Minerals industry, Economic cycles

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## Introduction

Business confidence, which reflects the degree of business optimism about economic conditions, is central to understanding current and future economic performance. According to European Central Bank (ECB) (2013), business confidence reflects the willingness of businesses to invest, hire and expand operations, which have significant impact on aggregate demand. Business confidence is approximated using the Business confidence Index (BCI), which is a confidence indicator based on opinion surveys on developments in production, orders and stocks of finished goods in the manufacturing sector, according to Organisation for Economic Cooperation and Development (OECD) (2025). The factors influencing business confidence, according to Blanchard et al. (2013), include economic conditions, such as output growth, inflation, unemployment, consumer confidence, or demand for goods and services, operating conditions, such as supply chain disruptions, as well as global events, such as exchange rates fluctuations and armed conflicts. Confidence indicators, thus, do not only monitor economic conditions, that comprise business performance as well as household consumption and savings, but can also be used to assess the evolution of business cycles and anticipate cyclical turning points in economic activity.

Rational Expectations Theory (RET), first introduced by Muth (1961) and developed by Lucas (1972) and Sargent and Wallace (1976), is used to describe economic agents' views on current and future economic developments that influence the economy, where such expectations determine the economic agents' decision making. The Rational Expectations Theory (RET) hypothesises that economic agents, such as consumers and businesses, make decisions based on all available information, past experiences and rational thinking in forward looking manner without making systematic errors. Economic agents are assumed to be forward looking and able to adapt to changing circumstances given that they adjust

their expectations in response to new information, hence they learn from past trends and experiences to make their best guess of the future. Additional discussion on Rational Expectations Theory (RET) can be found on Barro (1976), Fischer (1980), McCallum (2012) and Sargent (2014), while Bordo (1986) provides a survey of related literature. Rational Expectations Theory (RET) builds upon Adaptive Expectations Theory (AET), introduced by Fisher (1911) and discussed in Cagan (1956) and Friedman (1957), where the economic agents base their predictions of current and future economic developments solely on past trends and experiences, without understanding the underlying economic dynamics.

Conventional macroeconomic models distinguish between alternative "anchors" to stabilise the cyclical behavior of economic activity. Macroeconomics literature further highlights the importance of the different shocks, that include the demand and supply side shocks, market rigidities as well as investor and consumer sentiments, while it also emphasises the effects of these shocks during the different phases and components of the economy. According to Blanchard et al. (1986), Shapiro (1987), Blanchard and Quah (1988), Shapiro and Watson (1988), Quah (1988), Kydland and Prescott (1990), Gali (1992) and Romer (1993) the short term, or transitory, economic fluctuations are determined by demand shocks while the long term, or permanent, economic fluctuations are determined by supply shocks. For instance, whereas monetary and fiscal policies are typical demand side management anchors, fiscal policy can also be a supply side management anchor, while the changes in indicators, such as consumer and business confidence, technological advancement, privatisation and deregulation, also demonstrate this demand and supply side disturbances to the economy. Consequently, Diebold and Rudebusch (1970) and Romer (1993) argue that the different economic sectors respond differently to endogenous and exogenous economic shocks as well as to long run and short run disturbances.

The short term, or transitory, economic fluctuations emanate from changes in monetary, financial and fiscal policies as well as consumer and business confidence, according to Blanchard et al. (1986), Shapiro (1987), Blanchard and Quah (1988), Shapiro and Watson (1988), Quah (1988) and Gali (1992). The long term, or permanent, economic fluctuations emanate from the nominal rigidities that include changes in technological advancement, privatisation, deregulation as well as multilateral agreements. The short term economic fluctuations are, therefore, determined by demand side shocks, while long term economic fluctuations are determined by the supply side shocks. Demand side and supply side economic management paradigm suggest the need to decompose the macroecomomic indicators into their transitory and permanent components. A detailed literature on the isolation of macroeconomic variables into the short and long run components can be found in Kydland and Prescott (1990), Romer (1993) and Stock and Watson (1999). Hodrick and Prescott (1997), Baxter and King (1999) and Christiano and Fitzgerald (2003), as will be discussed, provide the methodological approaches.

This paper analyses the reaction of the minerals industry to business confidence *developments* in South Africa. This is achieved by augmenting a Taylor (1993) rule type central bank monetary policy reaction function with the indicator of business confidence. Understanding the reaction of the minerals industry to business confidence *developments* over the economic cycle is important to mining authorities and policymakers alike. For instance, the comovement, or divergence, of the fluctuations of different economic sectors and industries, as with the minerals industry, could be because they behave differently to the common endogenous and exogenous shocks. As opposed to the macroeconomics literature, according to the European Central Bank (ECB) (2012) and Morgan Stanley Capital International (MSCI) (2014), the investment literature distinguishes between types of industries, categorised into defensive, cyclical and sensitive industries, based on how they respond to economic fluctuations over the economic cycle. The business confidence indicator will provide an indication of future developments in the minerals industry concerning investment, employment and expansion plans, which in turn, impact on aggregate demand and economic growth, including the performance of the minerals industry.

The paper is organised as follows. The next section discusses the data. This is followed by the specification of the model and the estimation technique. The subsequent section reports the empirical results and last is the conclusion, together with recommendations and areas of further research.

# Data

Monthly data spanning the period January 2000 to December 2023 is used to analyse the reaction of the minerals industry to business confidence *developments*. The variables comprise output of mining and quarrying, inflation rate, monetary policy interest rate and business confidence. Mining and quarrying output is Gross Value Added (GVA) of the mining and quarrying, or the minerals industry. Inflation rate, or annual change in Consumer Price Index (CPI), is the annual headline consumer price inflation.

Monetary policy interest rate, or central bank interest rate, is the short term interest rate, also called repurchase rate, and is the rate at which private sector banks borrow from the central bank. Business confidence is the OECD harmonised Business Confidence Index (BCI) and is based on opinion surveys on developments in production, orders and stocks of goods in the manufacturing sector. The data on mining output and inflation rate was sourced from Statistics South Africa, the data on the interest rate was sourced from the South African Reserve Bank, while the data on business confidence was sourced from OECD Data Explorer. The descriptions and sources of the variables are presented in Table 1. Mining and quarrying output is denoted $GVAMng$, inflation rate, is denoted $CPIRate$, central bank monetary policy interest rate, is denoted $CBRate$, while $BCISA$ denotes business confidence.

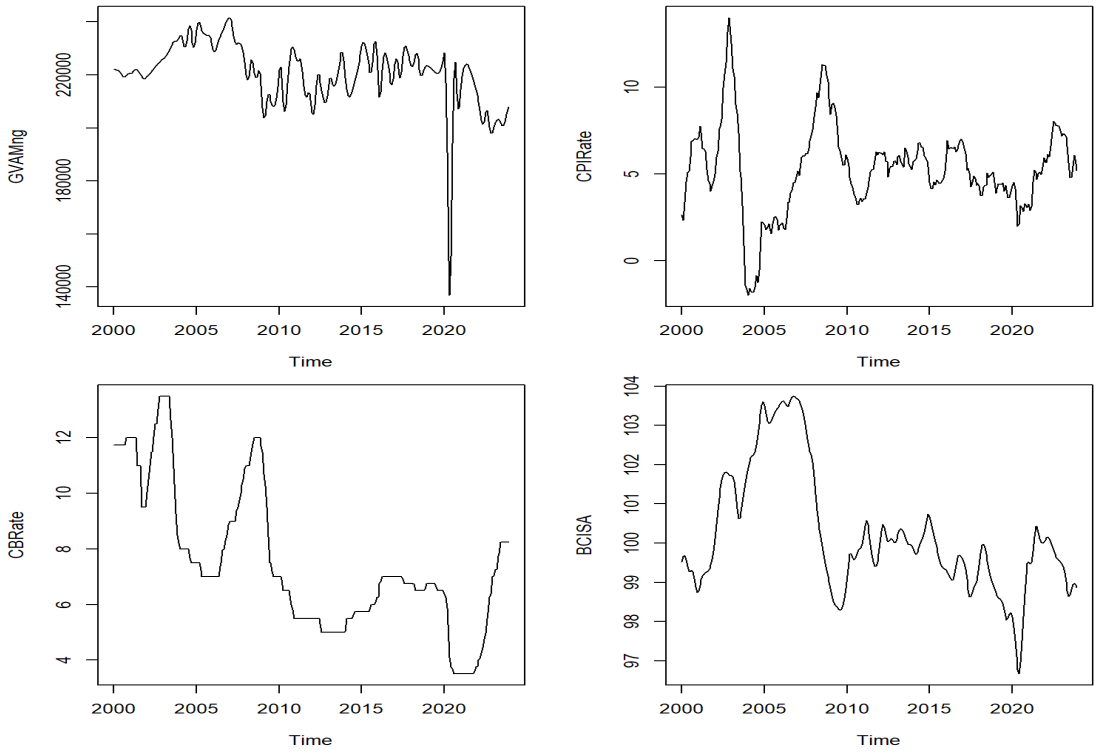
| Variable | Denotation | Description |
|---|---|---|
| Mining output | GVAMng | Gross Value Added (GVA) of the mining and quarrying, or minerals, industry |
| Inflation rate | CPIRate | Inflation rate, or annual Consumer Price Index (CPI), is the annual headline consumer price inflation |
| Interest rate | CBRate | Central bank policy rate and is the rate at which private sector banks borrow from the central bank |
| Business confidence | BCISA | OECD harmonised Business Confidence Index (BCI) based on opinion surveys in the manufacturing sector |

Notes: Data sourced from Statistics South Africa, South African Reserve Bank and the World Bank. Mining and quarrying output is denoted $GVAMng$, consumer price inflation rate, is denoted $CPI$, central bank monetary policy interest rate, is denoted $CBRate$ and $BCISA$ denotes business confidence.

Table 1: Description of variables

The evolution of the variables are depicted in Figure 1. Output of the mining and quarrying industry increased between 2003 and 2007, where it reached a peak, and decreased significantly to 2009. The decrease in output of the mining and quarrying was due to the onset of the Global financial crisis in late 2008. Output of the mining and quarrying industry then increased, albeit volatile, from 2010 to 2015 where it subsequently decreased from 2016 to 2023, and more so in 2022 and 2023. The significant decrease in output of the mining and quarrying in 2020 was due to the onset of the Covid 19 pandemic. Inflation rate, or the change in annual Consumer Price Index (CPI), increased from 2000 and reached a peak in 2003 where it decreased significantly and bottomed in 2004. Inflation rate increased again between 2005 and 2008 before it decreased between 2009 and 2011. The indicator then remained range bound but volatile between 2012 and 2021 where it then spiked in in 2022 before decreasing in 2023. The movements of the central bank monetary policy interest rate closely mirrored the movements in inflation rate during the sample period between 2000 and 2023. However, the interest rate, which is the rate at which private sector banks borrow from the central bank, was generally in a down ward trend between 2000 and 2023 with notable spikes and peaks in 2003, 2008 and 2003, while the opposite is true in 2005, 2013 as well as in 2021. The central bank interest rate increased substantially from early 2022 to counteract the rising consumer price inflation in the same period.

Business confidence maintained an upward trend, on average, between 2000 and 2006, or at the begining of the sample period, albeit volatile. Although business confidence decreased in 2000 and 2001, it accelerated notably from 2002, peaking in 2006 before it decreased sharply between 2007 and 2009. The decrease witnessed between 2007 and 2009 was followed by another increase and a peak in 2010. Business confidence subsequently decreased consistently, on average, from 2011 to 2018 before it decreased sharply and bottomed out in 2020. Another significant increase in business confidence was realised from 2021 with a peak in 2022, before it decreased again in 2023. The fluctuations in business confidence were erratic and inconsistent indicating volatility, or uncertainty, in the willingness of businesses to invest, hire and expand operations based on their perceptions about the current and future economic developments. Business confidence bottoms out in 2001, 2009 and 2020, which coincides with the bust of the dot-com bubble, onset of the Global financial crisis as well as breakout of the Covid 19 pandemic. The factors influencing the fluctuations in business confidence include economic conditions, consumer confidence, operating conditions and global events. Barro (1976) , Fischer (1980), Farmer (1999) and Sargent (2014) discuss in detail, the business confidence within the




Notes: Data sourced from Statistics South Africa, South African Reserve Bank and the World Bank. Mining and quarrying output is denoted $GVAMng$, consumer price inflation rate, is denoted $CPI$, central bank monetary policy interest rate, is denoted $CBRate$ and $BCISA$ denotes business confidence. The x axis depicts the time period.

Figure 1: Plots of the variables

realm of rational expectations, adaptive expectations and self fulfilling animal spirits hypotheses.

The variables were transformed to the deviation from their Hodrick and Prescott (1997) trends. 24 months were forecasted at the end of each variable series to correct the Hodrick and Prescott (1997) trend end point problem following Ravn and Uhlig (2002) and Mise et al. (2005). Dating the phases of the economic time series as well as decomposing the economic time series into its short run and long run components are discussed in Burns and Mitchell (1946), Friedman et al. (1963), Romer (1986), Gordon (2007), Kydland and Prescott (1990), Romer (1993) and Stock and Watson (1999), while Hodrick and Prescott (1997), Christiano and Fitzgerald (2003) as well as Baxter and King (1999) provide the methodological aspects of decomposing the economic time series into its components. Decomposing the economic time series into its unobserved short term, also called cyclical, as well as long term, also called permanent or trend, components, will facilitate the analysis of the reaction of mining and quarrying, or the minerals industry, to foreign exchange *developments* over the economic cycle.

# Methodology

A Vector Autoregression (VAR) model is estimated to capture the relationship between the minerals industry and the developments in business confidence. Examination of the Impulse Response Functions (IRFs) from a Vector Autoregression (VAR) model are analysed understand the reaction of the minerals industry and business confidence. The specified Vector Autoregression (VAR) model follows Stock and Watson (2001) and Kadiyala and Karlsson (1997). Vector Autoregression (VAR) models were introduced in applied macroeconomic research by Sims (1980), while the early contributions to their Bayesian equivalents include Litterman (1984). According to Stock and Watson (2001) and Rudebusch (1998), a Vector Autoregression (VAR) is a system of linear equations, one for each variable in the system. In reduced form, each equation in a Vector Autoregression (VAR) model specifies one of the variables as a linear function of its own lagged values as well as the lagged values of other variables being considered in the system and a serially uncorrelated error term. In general, for a VAR($p$) model,

the first $p$ lags of each variable in the system are used as regression predictors for each variable.

Vector Autoregression (VAR) models have become standard tools in macroeconomics structural analysis and forecasting, as argue Giannone et al. (2010), Koop and Korobilis (2010) and Koop (2013). According to Del Negro and Schorfheide (2011), these models can capture the important stylised facts about the economic time series despite their simple formulation. These include the decaying pattern in the values of the autocorrelations as the lag order increases and the dynamic linear interdependencies between the model variables. A Vector Autoregression (VAR) model is specified as follows

$$Y_t = \delta + \theta_1 Y_{t-1} + ... + \theta_p Y_{t-p} + \epsilon_t \tag{1}$$

where $Y_t = (Y_{1,t}, ..., Y_{n,t})$ is the $n * 1$ is vector of random variables observed at time $t$. $\delta = (\delta_1, ..., \delta_n)$ is the $n * 1$ vector of constants or intercept terms, $\theta_1, ..., \theta_p$ are $n * n$ matrices of coefficients, $p$ is the number of lags of each of the $n$ variables and $\epsilon_t = (\epsilon_{1,t}, ..., \epsilon_{n,t})$ is the $n * 1$ dimensional vector of white noise error terms denoted

$$\epsilon_t \sim N(0, \Sigma) \tag{2}$$

where $\Sigma$ is the $n * n$ variance covariance matrix. Evans and Kuttner (1998), Rudebusch (1998) and Stock and Watson (2001) argue that the error terms are the unanticipated policy shocks, or the surprise movements, after taking into account the past values of the Vector Autoregression (VAR) model.

A general matrix notation of a Vector Autoregression (VAR) model with $p$ number of lags, or VAR($p$), and no deterministic regressors, can be written as

$$\begin{bmatrix} Y_{1,t} \\ Y_{2,t} \\ \vdots \\ Y_{n,t} \end{bmatrix} = \begin{bmatrix} \delta_1 \\ \delta_2 \\ \vdots \\ \delta_n \end{bmatrix} + \begin{bmatrix} \theta_{1,1} & \theta_{1,2} & \cdots & \theta_{1,n} \\ \theta_{2,1} & \theta_{2,2} & \cdots & \theta_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ \theta_{n,1} & \theta_{n,2} & \cdots & \theta_{n,n} \end{bmatrix} \begin{bmatrix} Y_{1,t-1} \\ Y_{2,t-1} \\ \vdots \\ Y_{n,t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \\ \vdots \\ \epsilon_{n,t} \end{bmatrix} \tag{3}$$

where in this instance, $p$, or the number of lags, is equal to 1 for each of the $n$ variables. A detailed discussion on Vector Autoregression (VAR) models can be found in Hamilton (1994), while recent contributions include Lütkepohl (2005), Koop and Korobilis (2010) and Giannone et al. (2015).

A Vector Autoregression (VAR) model is estimated using Bayesian methods. A Minnesota prior is specified and a Gibbs style sampler is used in estimation following Kadiyala and Karlsson (1997). At the heart of Bayesian analysis is the Bayes theorem and it is specified as

$$P(\theta_i, \Sigma \mid Y_t, M_i) P(Y_t \mid \Sigma, M_i) = P(Y_t \mid \theta_i, \Sigma, M_i) P(\theta_i, \Sigma \mid M_i) \tag{4}$$

where $M_i$ is an arbitrary model among a general class of models, $\theta_i$ is the parameter vector described above, $p(\theta_i \mid Y_t, M_i)$ is the posterior model probability, $p(Y_t \mid \theta_i, M_i)$ is the marginal likelihood of the model, $p(\theta_i \mid M_i)$ is the prior model probability and $p(Y_t \mid M_i)$ is the constant integrated likelihood over all models. The details on a Bayesian Vector Autoregression (BVAR) model estimation with Minnesota prior, first introduced by Litterman (1979), Litterman (1980) and Litterman (1984) and developed by Sims (1989), is used in this paper, while a brief introduction to Bayesian econometrics and Bayesian Vector Autoregression models, can be found in O'Hara (2015). A more general treatment of Vector Autoregression (VAR) models, including Bayesian estimation with the different types of model priors, can be found in Koop and Korobilis (2010), Canova (2011) as well as Giannone et al. (2015).

According to Rudebusch (1998), the appeal of using Vector Autoregression (VAR) models for analysing policy reaction functions is that they have the ability to identify the effects of shocks without a need to specify a complete structural model of the economy. Giannone et al. (2010) contend that Vector Autoregression (VAR) models have become popular among empirical macroeconomists because they facilitate insight into the dynamic relationships between the economic variables in a relatively unconstrained manner. Koop and Korobilis (2010) and Koop (2013) further argue that the Bayesian methods have become an increasingly popular way of dealing with the problem of over parameterisation of economic models given the limited length of standard macroeconomic datasets. Vector Autoregression (VAR) models can be used successfully in macroeconomic forecasting with a large number of variables when coupled with Bayesian estimation, as argue Sims and Uhlig (1991), due to the flexibility provided by the application of the Bayesian parameter shrinkage. Sims and Uhlig (1991) further argue that Bayesian versions of these models can incorporate unit root nonstationary variables with negligible disadvantageous influence on the inference of the parameters of the model.

# Results

Bayesian Vector Autoregression (BVAR) model was estimated to capture the relationships between the minerals industry and business confidence, as discussed. The estimated Bayesian Vector Autoregression (BVAR) specifies a Minnesota prior and uses a Gibbs style sampler following Stock and Watson (2001) and O'Hara (2015). A 0.05 prior was set on all coefficients except the own first lags which were set to 0.95 to account for persistence in the variables. The number of lags to include of each variable was set to 4 following the Schwarz (1978) Bayesian information criterion. The integer value for the horizon of the Impulse Response Functions (IRFs) was set to 24, corresponding to 2 years, given that monthly data is used in estimation. 10000 is the number of Gibbs sampler replications to keep from the sampling run, while 1000 is the sampling burn in length for the Gibbs sampler. Gibbs sampling, or Gibbs sampler, is a Markov Chain Monte Carlo (MCMC) technique used to sample from probability distributions, where the Gibbs sampler draws iteratively from the posterior conditional probability distributions, as an alternative to drawing samples from a joint posterior probability distribution.

As discussed, conventional macroeconomic models distinguish between alternative "anchors" to stabilise the cyclical behavior of economic activity. Macroeconomics literature further highlights the importance of demand side and supply side shocks, market rigidities as well as business, investor and consumer sentiments. Business confidence, or the economic agents' views about current and future economic developments that influence decisions on investment, employment and expansion plans, which in turn, impacts on aggregate demand and economic growth, including the performance of the minerals industry. Such decisionsto invest, hire and expand operations are formed based on rational expectations, adaptive expectations and self fulfilling animal spirits hypotheses. A Taylor (1993) rule type central bank monetary policy reaction function with the output of mining and quarrying industry is, thus, augmented with a measure of business confidence as follows

$$i_t = \rho + \theta_\pi(\pi_t - \pi_t^*) + \theta_Y(Y_t - \bar{Y_t}) + \theta_B(B_t - \bar{B_t}) + \epsilon_t \tag{5}$$

where $i_t$ is the nominal interest rate, $\rho$ is the natural rate of interest, $\pi_t$ is the inflation rate, $\pi_t^*$ is the central bank target for inflation, $Y_t$ is output, $\bar{Y_t}$ is the natural rate of output, $B_t$ denotes business confidence, while $\bar{B_t}$ is the natural rate of business confidence. $\theta_\pi$, $\theta_Y$ and $\theta_B$ are the responsiveness of the nominal interest rate to the deviations of inflation from the central bank inflation target, the deviations of output from its natural rate and the deviations of business confidence from its natural rate, respectively. $\epsilon_t$ is the error, or disturbance, term and the subscript $t$ denotes the time period.

The central bank monetary policy reaction function captures the process through which monetary policy decisions affect consumer price inflation in particular and the aggregate economy in general. The specified central bank monetary policy reaction function ensures market clearing, or equillibrium, condition, in that when output equals its steady state level, inflation is the same as its target rate and business confidence equal their steady state level, hence the nominal interest rate is also equivalent to its natural rate. The variables in the specified central bank monetary policy reaction function comprise output of mining and quarrying, denoted $GVAMng_t$, inflation, denoted $CPI_t$, interest rate, denoted $CBRate_t$ and business confidence, denoted $BCISA_t$. $Y_t$ in Equation 1 can, therefore, be rewritten as

$$Y_t = (GVAMng_t, CPI_t, CBRate_t, BCISA_t) \tag{6}$$

where $Y_t$ is the vector of random variables observed at time $t$. Stock and Watson (2001) argue that a reduced form Vector Autoregression (VAR), on the one hand, expresses each variable as a linear function of its own past values, the past values of all other variables being considered and a serially uncorrelated error term. On the other hand, a recursive Vector Autoregression (VAR) constructs the error terms in each regression equation to be uncorrelated with the error in the preceding equations by including contemporaneous values as regressors. Consequently, the results of a recursive Vector Autoregression (VAR) depend on the order of the variables, where changing the order of the model variables changes the equations, coefficients and residuals of the Vector Autoregression (VAR).

According to Stock and Watson (2001), the standard practice in Vector Autoregression (VAR) model analysis is to report the results from Impulse Response Functions (IRFs) and Forecast Error Variance Decompositions (FEVDs). The reason is that these statistics are more informative than the estimated Vector Autoregression (VAR) regression coefficients. Rudebusch (1998) further argues that most Vector Autoregression (VAR) model equations do not have a clear structural interpretation. Vector Autoregression (VAR) models are also atheoretical, that is, they are not built on some economic theory, hence a theoretical structure is not imposed on the equations. Every variable is assumed

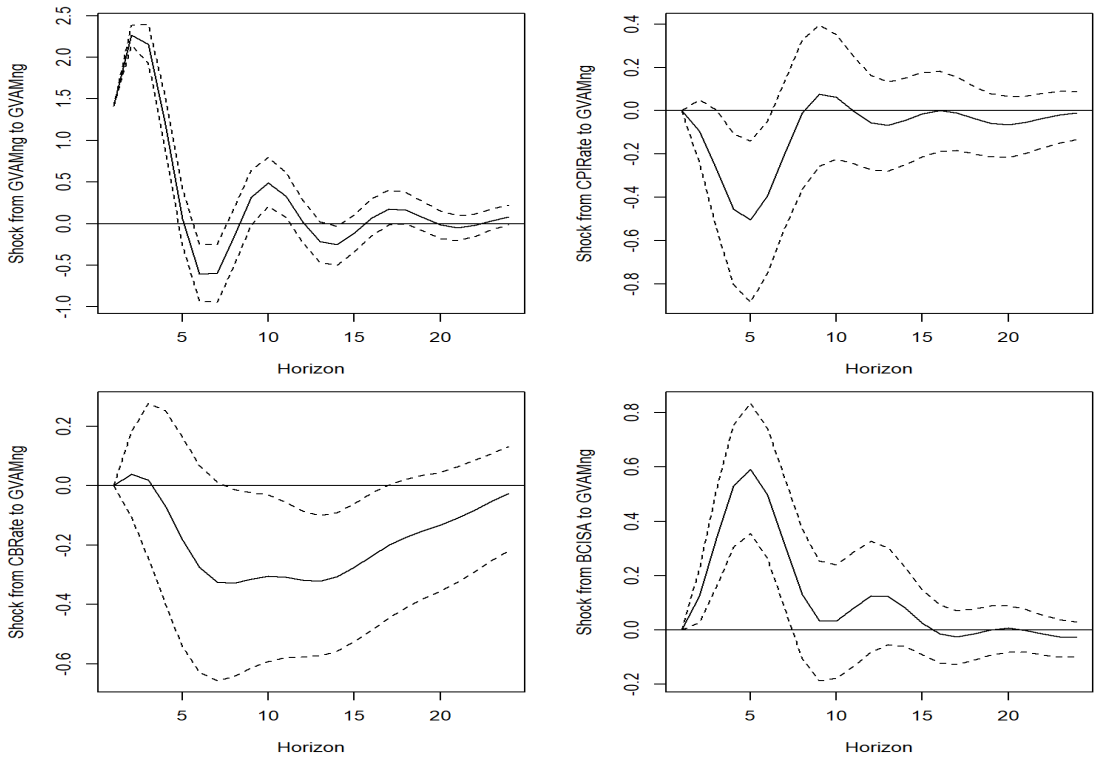
to influence all other variables in the system, which makes a direct interpretation of the estimated coefficients difficult, according to Hyndman and Athanasopoulos (2018). Therefore, in this paper, the Impulse Response Functions (IRFs) are the only model statistics that are reported given that the aim is to analyse the reaction of the minerals industry output to business confidence developments.

The variables were transformed to stationarity in that they were decomposed into deviations from their long term trends. The detrending is useful conceptually because it eliminates the common steering force that time may have on each variable series and hence induces stationarity. As such, the variables are mean reverting, thus, the Bayesian Vector Autoregression (BVAR) model is assumed to be covariance stationary. As discussed above, Rudebusch (1998) and Stock and Watson (2001) argue that the residuals of the Vector Autoregression (VAR) model are unanticipated shocks, or surprise movements in the variables. According to Stock and Watson (2001), the Impulse Response Functions (IRFs) trace out the response of current and future values of each of the variables to a unit increase in the current value of one of the Vector Autoregression (VAR) errors. This error is assumed to return to zero in subsequent periods and that all other errors are equal to zero. Consequently, the Impulse Response Functions (IRFs) show the impact, or effect, of a unit, or 1 percentage point, change in the variable under consideration on the rest of the other Vector Autoregression (VAR) model variables.

Impulse Response Functions (IRFs) of the Vector Autoregression (VAR) model for the reaction of the minerals industry output to innovations, or shocks, in the other variables are depicted in Figure 2, together with their 95 percent confidence intervals, or bands. According to the results, following an unexpected 1 percentage point increase in output of the minerals industry, minerals industry output initially increases and peaks at 2.26 percentage points after 3 months. The increase is followed by a rapid decrease where the minerals industry output bottoms out at -0.60 percentage points after 7 months. The initial increase in minerals industry output remains statistically significant for about 12 months following which its potency, or momentum, begins to progressively wane, or dissipate. Output of the minerals industry, thereafter, rapidly moves towards its steady state level in about 20 months. Following an unexpected 1 percentage point increase in consumer price inflation, the minerals industry output initially decreases and bottoms out at -0.50 percentage points after 5 months. Output of the minerals industry then increases, peaking at 0.08 percentage points after 9 months. Output of the Minerals industry then fluctuates around, and progressively tends towards, its natural rate. The surprise increase in consumer price inflation is statistically significant between 4 and 6 periods.

Following an unexpected 1 percentage point increase in monetary policy interest rate, output of the minerals industry increases slightly and peaks after 2 months. The initial increase in output of the minerals industry is followed by a decrease, where the minerals industry output bottoms out at -0.33 percentage points after 8 months. The effect of the surprise increase in monetary policy interest rate is, however, only statistically significant between 8 and 16 periods, following which it begins to progressively discipate and hence the minerals industry output gradually tends towards its steady state level. Following an unexpected 1 percentage point increase in business confidence, output of the minerals industry initially increases and peaks at 0.59 percentage points after 5 months. The initial increase is followed by the decrease and where output of the minerals industry bottoms out at -0.03 percentage points after 17 months. The decrease in output of the minerals industry is subsequently followed by a stable fluctuation and gradual increase of output of the minerals industry towards its equilibrium, or steady state, level after 24 months. The effect of an unexpected, or surprise, increase in business confidence on mining and quarrying output is statistically significant up to 7 months.

Impulse Response Functions (IRFs) of the Vector Autoregression (VAR) model with innovations, or shocks, in the minerals industry output are depicted in Figure 3, together with their 95 percent confidence intervals, or bands. The results of the reaction of the minerals industry output to its own innovations, or to an unexpected 1 percentage point increase in minerals industry output, are reported above, where the minerals industry output initially increases and peaks at 2.26 percentage points after 3 months following an unexpected 1 percentage point increase in output of the minerals industry. The increase is followed by a rapid decrease where the minerals industry output bottoms out at -0.60 percentage points after 7 months. The initial increase in minerals industry output remains statistically significant for about 12 months following which its potency, or momentum, begins to progressively wane, or dissipate. Output of the minerals industry, thereafter, rapidly moves towards its steady state level in about 20 months. Following an unexpected 1 percentage point increase in output of the minerals industry, consumer price inflation decreases and bottoms out at -0.17 percentage points after 7 months. Consumer price inflation subsequently increases progressively, tends towards and fluctuates around, its equilibrium level in about 20 months. The effect of the surprise increase in output of the



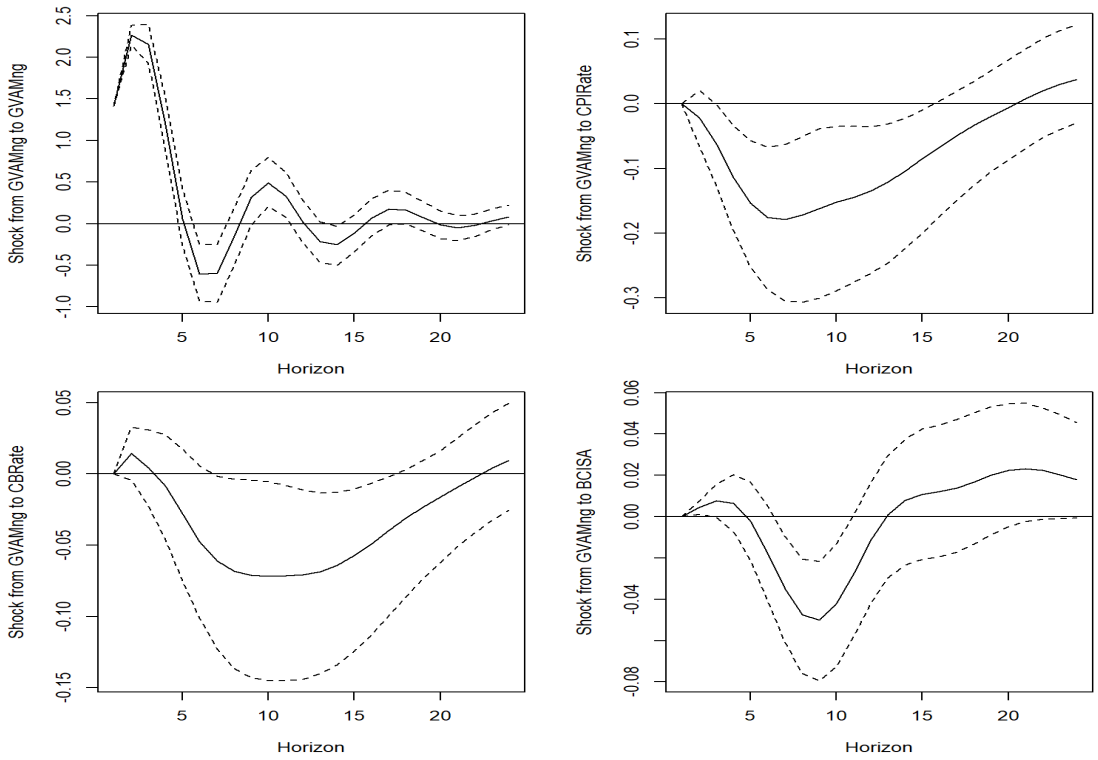

Notes: Data sourced from Statistics South Africa, South African Reserve Bank and the World Bank. Mining and quarrying output is denoted $GVAMng$, consumer price inflation rate, is denoted $CPI$, central bank monetary policy interest rate, is denoted $CBRate$ and $BCISA$ denotes business confidence. The x axis depicts the horizon of the Impulse Response Functions (IRFs).

Figure 2: Impulse Response Functions (IRFs) with shocks from output of the minerals industry

minerals industry on consumer price inflation is statistically significant between 3 and 16 months.

Following an unexpected, or surprise, 1 percentage point increase in output of the minerals industry, the central bank monetary policy interest rate initially increases and peaks at 0.01 percentage points after 2 months. Central bank monetary policy interest rate subsequently decreases steadily and bottoms out at -0.07 percentage points after 10 months. Central bank monetary policy interest rate subsequently increases progressively, tends towards and fluctuates around, its equilibrium, or steady state, level after 23 months. The effect of the surprise increase in output of the minerals industry on consumer price inflation is, however, only statistically significant between 7 and 18 months. Following an unexpected, or surprise, 1 percentage point increase in output of the minerals industry, business confidence initially increase slightly and then decrease rapidly, bottoming out at -0.05 percentage points after 9 months. Business confidence subsequently recovers and peaks at 0.02 percentage points after 20 months before it progressively, tends towards and fluctuates around, its equilibrium, or steady state, level. The effect of the surprise increase in output of the minerals industry on thre indicator of business confidence is, however, only statistically significant between 1 and 2 months as well as between 7 and 10 months.

Changes in business confidence, as discussed, have had important implications for macroeconomics fluctuations, affecting the economic agents' decision making on investment, employment and expansion plans. Such economic agents' decision making is premised on rational expectations, adaptive expectations and self fulfilling animal spirits hypotheses. In particular, the "animal spirits", first introduced by Keynes (1936), refer to the irrational, emotional and instinctive factors that drive the economic agents' decisions, often leading to self fulfilling prophecies and adverse market fluctuations. The self fulfilling animal spirits theory is discussed in Koppl (1991), Ng (1992), Farmer (1999, 2012, 2013) and Blanchard et al. (2013), Nowzohour and Stracca (2020) provide an overview of the recent literature. According to the European Central Bank (ECB) (2013), the recent crises and the consequential recessions have given a prominent role to significant movements in confidence as a key driver of economic developments. Heightened uncertainty about the future and the associated pessimism has constrained the macroeconomic drivers of economic recoveries, where households and firms have preferred a wait




Notes: Data sourced from Statistics South Africa, South African Reserve Bank and the World Bank. Mining and quarrying output is denoted $GVAMng$, consumer price inflation rate, is denoted $CPI$, central bank monetary policy interest rate, is denoted $CBRate$ and $BCISA$ denotes business confidence. The x axis depicts the horizon of the Impulse Response Functions (IRFs).

Figure 3: Impulse Response Functions (IRFs) with shocks from output of the minerals industry

and see attitude in the face of uncertainty before engaging in decisions that could be costly to reverse.

The results provide evidence of a statistically significant effect of an increase in business confidence on output of the minerals industry, which peaks at 0.59 percentage points after 5 months. The effect of an increase in business confidence on output of mining and quarrying is statistically significant up to 7 months. The results are consistent with the information based rational and adaptive expectation hypotheses, while they are in contrast to the self fulfilling animal spirits hypothesis. The information based expectations hypotheses mean that when businesses, investors and consumers are optimistic about the future, they are more likely to extend their expansion plans, hire, invest and consume, leading to increased economic activity and growth. The results have also shown that a statistically significant effect of an increase in output of mining and quarrying on business confidence, which initially increase and then decrease, bottoming out at -0.05 percentage points after 9 months. The effect of this increase is statistically significant between 1 and 2 months as well as between 7 and 10 months. This shows feedback effect between business confidence on output of the mining industry, where, vise versa, changes in business confidence lends support to changes in output of the mining industry.

# Conclusion

This paper analysed the reaction of the minerals industry to business confidence *developments* in South Africa. This was achieved by augmenting a Taylor (1993) rule type central bank monetary policy reaction function with the indicator of business confidence. The results provide evidence of a statistically significant effect of an increase in business confidence on output of the minerals industry, which peaks at 0.59 percentage points after 5 months. The effect of an increase in business confidence on output of mining and quarrying is statistically significant up to 7 months. The results are consistent with the information based rational and adaptive expectation hypotheses, while they are in contrast to the self fulfilling animal spirits hypothesis. The results have further shown a statistically significant

effect of an increase in output of mining and quarrying on business confidence, which initially increase and then decrease, bottoming out at -0.05 percentage points after 9 months. The effect of this increase is statistically significant between 1 and 2 months as well as between 7 and 10 months. Several economic indicators, such as the monetary policy interest rates, Government expenditure and taxation, foreign investment, prices of financial assets as well as foreign exchange rate, affect economic activity, at least theoretically, hence it's important for future research to analyse their impact on the minerals industry.

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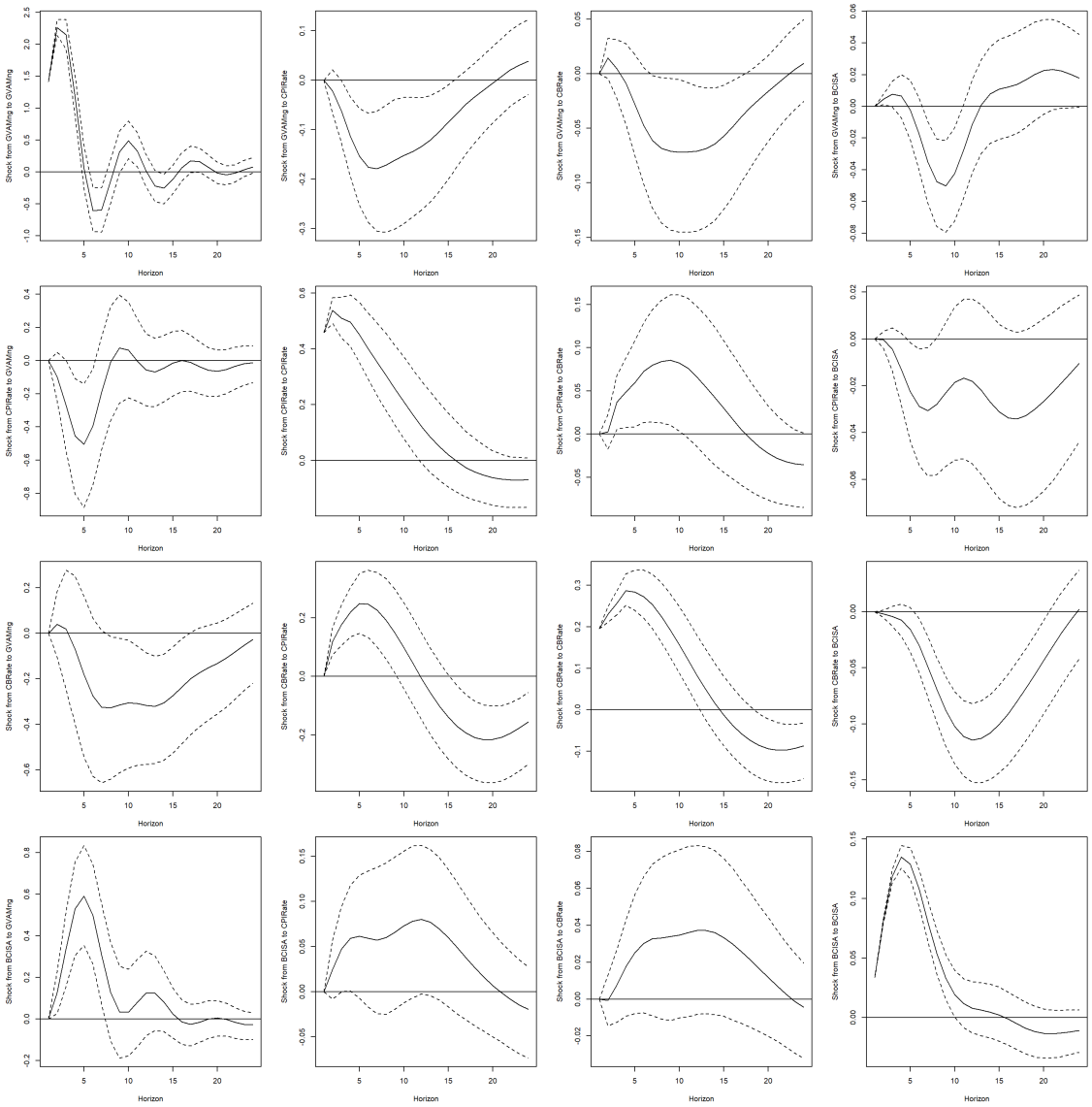
# Appendix

## Appendix 1. Complete Impulse Response Functions (IRFs)

The complete Impulse Response Functions (IRFs) of the Vector Autoregression (VAR) model with business confidence are shown in Figure 4. This Figure is not intended to be a part of the paper, but is included to demonstrate the completeness of the analysis.




Notes: Data sourced from Statistics South Africa, South African Reserve Bank and the World Bank. Mining and quarrying output is denoted $GVAMng$, consumer price inflation rate, is denoted $CPI$, central bank monetary policy interest rate, is denoted $CBRate$ and $BCISA$ denotes business confidence. The x axis depicts the horizon of the Impulse Response Functions (IRFs).

Figure 4: Complete Impulse Response Functions (IRFs) with business confidence