ECO1400 Term Paper

The effects of oil price fluctuations on employment precarity and economic performance of Trinidad and Tobago

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Executive Summary

In this paper, we aim to study the effects of oil price fluctuations on the employment precarity, real economic activity and stock market prices of Trinidad and Tobago (TT), a small oil-producing economy in the Caribbean. There is a global push to decarbonization and a shift away from fossil fuels to renewable sources of energy. For economies heavily dependant on hydrocarbons, like TT, this scenario presents a risk to future economic development (Scheer et al., 2022). This impact of this dependence can be proxied by levels of employment in different sectors and by economic performance as proxied by stock prices of the local stock exchange and real economic activity. We use the similar assumption in Scheer (2022) that global oil price is not affected by the levels of oil production from TT given its negligible contribution to world-wide output.

We examine the exogenous effects of oil price on employment level by sectors and economic performance. Quarterly data from Central Bank of Trinidad and Tobago on employment in the oil and gas sector, construction and manufacturing, real economic activity, stock price index (TT Stock Exchange, TTSE), and West Texas Intermediate (WTI) oil prices were used in our analysis. Our model uses past values of these variables to assess the impact on current values to determine if there are any long term and short term relationships and trends.

Overall, we did not find any significant or strong effect on employment which is counterintuitive given that the economy is dependent on oil revenue. However, we did see some positive and significant relationship between oil prices and stock price index. We also noted a strong positive and significant relationship between real economic activity and oil prices. Therefore, we conclude oil price has a positive relationship with economic performance.

With respect to the insignificant or weak effects on oil price, we posit that this can be explained by the structural characteristics of the natural gas market. While international natural gas prices do fluctuate, natural gas are primarily determined through international contracts (Ason, 2022). The fixed nature of gas prices set forth in these contracts could have a stabilizing effect on the revenue over the medium term. This scenario offers some explanation, but given the nature of the economy, we would still expect to see some effect of oil prices on employment.

Ultimately, the paper generates interest for further investigation which could be improved if monthly data were available or through the application of different methods of analyses like impulse response functions. The short term response of oil price could also be investigated using other empirical techniques.

1 Introduction

Two key areas we will focus on in this paper are oil prices and job precarity not only within the sector but other key industries of Trinidad and Tobago as well as oil prices, its stock market and real economic activities. Our analysis uses autoregressive techniques of vector autoregression (VAR) and vector error correction (VEC) to analyse the data. We analyze time series data on sectoral employment in oil and gas, construction and manufacturing, stock price index (TTSE), real economic activity, and WTI oil price.

Given the concerns of climate change, greenhouse gas emissions, and the fact that there needs to be an eventual transition away from fossil fuels, an often overlooked scenario is what happens to those who work in the hydrocarbon industry. Workers in this industry have long faced job security risks as it pertains to the cyclical nature of the industry. However, this job security risk will evolve into one associated with a permanent shift away from the industry. It is important to consider what will happen to the may workers employed in oil and gas companies who will either need to be re-trained or compensated in some way. Analysis of this job precarity is therefore required to assess the scale of the risk associated with the transition away from hydrocarbons. In addition, there may be spillover effects for other industries that are supported by revenue from the hydrocarbon industry.

In addition to the effects on the labour market, oil prices have garnered considerable attention as a compelling economic and financial metric, leading to increased research efforts examining the dynamics of oil price behaviour within the broader framework of the macroeconomy and financial markets. Oil is a fundamental input in numerous economic operations, the second component of our paper dives into the relationship between oil prices, real economic growth and a small growing stock market. While some researchers stress a mirror response of the equity market to alterations in oil prices, contrasting viewpoints suggest variations in the outcomes observed between adverse and favorable oil price fluctuations. This research aims to adds to the ongoing discussion regarding the connection between oil, real economic activity and the stock market of Trinidad and Tobago.

In essence, understanding the complex relationship between oil prices movements, employment, real economic activity and the stock market in any economy can hold considerable importance for scholars as well as diverse stakeholders. We hope to offer some insights that can assist investors in making prudent decisions, helps policymakers in formulating impactful economic strategies and policies in the labour market and overall economy, and contribute to the expansion of knowledge/research in the field of macroeconomics and finance.

The subsequent sections of this paper are organized as follows. Section 2 will provide an overview of various research related to the dynamic relationship among oil prices, labour market for various sectors, real economic activity and stock prices. Next, we will outline the data used in this study along with the methodology applied. Section 4 will discuss the empirical results. Lastly, section 5 will serve as the conclusion of our paper.

2 Literature Review

A paper by Scheer et al (2022) examines job precarity in Alberta. The authors use data from the governments of Alberta and Canada which includes monthly West Texas Intermediate (WTI) and Western Canadian Select (WCS) oil prices and data on the employee levels of Alberta by sector. The identification assumption is that the WTI oil price is weakly exogenous and that the volume of Alberta oil production is too small to affect global prices. The paper sets up vector autoregression (VAR) models which examine the relationship between provincial employment levels and the global price of oil. Autoregressive distributed lag (ARDL) models are used to explore oil price employment effects at the sector level. The paper is distinctive in that it uses a mixed approach by combining the qualitative analysis with qualitative analysis of interviews from oil sands workers. The models analyses continuous monthly time series data which disentangles the effects of oil markets on Alberta's labour market. The analysis sheds light on the impact on Alberta workers due to the transition away from fossil fuels. The primary findings of the study show that higher world oil prices have a positive effect on Alberta employment in comparison to the oil price discount (WCS) which has no significant impact. It was also found that local factors like pipeline capacity and other new projects had little impact on employment. These findings imply that employment in Alberta is more influenced by external factors outside the control of the province. The implications are that the current dependence on the hydrocarbon sector results in job precarity which could leave the province vulnerable to the transition away from fossil fuels.

Lorde, Jackman, and Thomas (2009) explore the dynamic relationship between oil price shocks and major macroeconomic variables in the small open oil-producing country, Trinidad and Tobago (T&T). The variables under investigation was gross development product, government revenue, government consumption, gross investment, net exports and the price level in T&T. The present corpus of academic literature exhibits a lack of comprehensive studies examining the interplay between oil price fluctuations and their macroeconomic ramifications on nations that are net oil exporters, specifically focusing on Trinidad and Tobago. Due to T&T's scale and their considerable dependence on energy, variations in oil prices can profoundly impact economic growth, well-being, and poverty levels. This paper cited conclusions from Watson (2003), who assessed the implications of oil price fluctuations on the Caribbean region and evaluated the effectiveness of T&T's monetary policies. He found that after an oil-related shock, the exchange rate appreciated, and both prices and output increased. Lorde et al (2009) infers that country's oil industry accounts for 30% of its output and government revenue, unfavorable shifts in oil prices can lead to acute macroeconomic impacts. The study employs a Vector Autoregressive (VAR) model to simulate the long-term growth trends and the dynamic response of T&T's macroeconomy to changes in oil prices. Using the Granger-causality test, they examined if there were any short-term relationship between the variables.

It is essential to underscore that the paper recognizes that T&T's capital markets are still at an early stage of development thereby lacking sufficient liquidity to enable local investors to hedge against unpredictable fluctuations. A key result of the research demonstrate that the price of oil is a major determinant of economic activity of the country. Following a positive shock in oil prices, ex-post analysis revealed that there was an initial decline in output during the first two years, succeeded by eight periods of positive and growing response. The initial negative response indicated short-term contractions impacting the economy's trade partners; alternatively, there was an increase in gross investment, government consumption, government revenue, and the average price level. Overall, the research showed that the oil price is a major component for their forecast variations for most variables in their model.

Watson (2003) evaluates the effects of monetary policy measures. The author uses a dynamic VEC model using the structural cointegrating VAR methodology to describe the TT economy. Seven key variables are chosen - the domestic price level, the national income, the exchange rate, the rate of interest, money demand, the foreign price level and the real oil price. The findings demonstrate a stable long-run demand for money relation. This highlights, among other things, interdependence of the economy on oil and gas revenues.

3 Data

This study investigates if fluctuations in of oil prices correlates with several of Trinidad and Tobago's economic indicators such as Real Economic Activity, Stock Price Index, and Employment Levels based on three important industries: oil and gas, construction and manufacturing. The proxy used for global oil prices is West Texas Intermediate (WTI). We used the Composite Stock Price Index, which collectively measures the price movements of all of the companies on the Trinidad & Tobago Stock Exchange. This is a reliable indicator of economic activity and thus performance. When incorporating both Stock Price Index and oil prices into a model concurrently, we opted for a common transformation in econometrics and financial analysis, the log-transformation of each respective variable log-transforming. A benefit from this transformation is that it reduces the impact of extreme values or outliers, making the data less sensitive to extreme fluctuations.

The decision to investigate these variables in our study was determined by the availability of macroeconomic data with a large enough data set and was motivated by two papers that discussed similar interests, Scheer et al (2022) and Lord, Jackman, and Thomas (2009). Our study is based on quarterly time-series data, which utilizes a sequential collection of data points recorded at three-month intervals from June 1995 to March 2023, which is a total of 112 quarterly observations. The data set was obtained from the Central Bank of Trinidad and Tobago's Data center and is available online at: https://www.central-bank.org.tt/statistics/data-centre.

4 Methodology

4.1 Model Selection Approach

4.1.1 Autoregressive Techniques

A statistical model is autoregressive if it predicts future values based on past values. There are two key autoregressive model that we look at in this paper, Vector Autoregression Model (VAR) and Vector Error Correction Model (VECM). VAR models are an extension of the autoregressive model (AR) where multiple time series variables are modeled as linear combinations of their lagged values. VAR uses time series analysis to capture the relationship between multiple time series variables simultaneously. It models the behaviour of each variable as a linear combination of its lagged values and the lagged values of other variables in the system. VAR model was employed so that we can understand dynamic interactions among variables, and captures not only the correlations between variables but also the interdependencies and directional relationships among them across different time periods. VECM is an extension of the VAR and is commonly used to analyze long-term relationships and short-term dynamics among multiple time series variables. VECM is well-suited for analyzing non-stationary time series data especially when the variables in the model are found to be co-integrated. VECM corrects for non-stationary data via the error correction terms which is an adjustment mechanism that brings the variables back to their long-term equilibrium relationship when they deviate from it in the short term.

We assessed two separate models for our analysis:

1. Labour Model: Employment Levels of the three sectors - oil and gas (petro), construction (cons) and manufacturing (manu)- in relation to oil prices (WTI).

2. Economic Performance Model proxied by real economic activity (REA) and stock index prices (SPI) in relation to oil prices.

4.1.2 Testing Variables for Stationarity

Firstly, it is imperative to assess the stationarity of our data in order to ascertain the most suitable model for our study. We selected the Augmented Dickey-Fuller (ADF) test which is a widely used test for checking the stationarity of time series data sets. ADF tests for the presence of a unit root in the data. If the data passes the test, there exist stationarity, otherwise, if the data does not pass this test, there exist non-stationarity. Non-stationarity implies that the data has a stochastic or random trend component that exhibit persistent and non-reverting fluctuations over time without converging to a constant mean. Many statistical tests assume stationarity, therefore the unit root in the data violates this assumption resulting in unreliable statistical inference. If the data is stationary, we can proceed to with the VAR, if the data is non-stationary, we need to difference the data to achieve stationarity and then we can proceed with VECM.

4.1.3 Correcting Data Non-stationarity

Correcting data non-stationarity involves transforming the data to make it stationary. The methods that we used was first differencing, This is the process of computing the differences between consecutive observations in a time series data set. It involves subtracting the value of the previous period from the value of the current period. Mathematically, for a time series

$$\Delta y_t = y_t - y_{t-1}$$

This transformation is used to remove trends, i.e., eliminate non-stationarity in the data by capturing the changes between adjacent time points.

4.1.4 Finding the optimal number of lags

In time series analysis, it is crucial to find the optimal number of lags because it has a direct impact on the accuracy and reliability of statistical models. Including lags in our analysis allow us to examine the relationship between past values and current values to understand the dynamics and patterns within the data. To determine the optimal number of lags, we employed Akaike Information Criterion (AIC). This techniques aim to select a lag length that minimizes errors or criteria while avoiding overfitting of a model. Using VARSelect on the differenced data set (stationary data set), we are able to find the optimal lag length.

4.1.5 Testing for cointegration

When variables are cointegrated, it suggests that they share a common stochastic trend, implying a stable, long-run relationship among them. The variables might temporarily deviate from each other due to short-term shocks, but they eventually move back towards this long-term relationship. The Johansen test is a common statistical method used to test for cointegration and find the number of relationships among multiple time series variables. Cointegration indicates the presence of an error correction mechanism. The VECM is used as it includes error correction terms that capture this adjustment process, ensuring that the system returns to its equilibrium. When working with time series that are not stationary, spurious correlations can occur. This is where two variables appear to be correlated but lack a meaningful relationship. Testing for cointegration helps to distinguish between genuine long-term connections among variables and spurious relationships.

4.1.6 No cointegration with I(1) data (differenced data)

A time series is considered integrated of order 1(I(1)) if it needs to be differenced once to become stationary. First-order integrated series I(1) data, with no cointegration among the variables conveys that there are no long-term equilibrium relationships that exist among them. In such a scenario, VAR can still be applied to analyze the short-term relationships and dynamic interactions among the differenced variables. Even though there is no cointegration indicating a long-term relationship, VAR is still considered to be suitable for understanding the contemporaneous relationships and short-term dynamics among the differenced variables.

5 Empirical Results and Analysis

5.1 Model Selection Application

5.1.1 Testing Variables for Stationarity

While numerous methods exist to detect the existence of a unit root process, we opted to utilize an Augmented Dickey-Fuller (ADF) test. Using the ADF test on all variables in our data set, we observed that all variables exhibited non-stationary tendencies. Refer to results in Section 8.1 of the Appendix.

5.1.2 Correcting Data Non-stationarity

The time series data were made stationary after first differencing. See Appendix for results.

5.1.3 Finding the optimal number of lags

After employing AIC, we determined the optimal number of lags for the Labour Model to be 3 and the optimal number of lags for the Economic Performance Model to be 4. This is acceptable because higher number of lags may lead to model overfitting.

5.1.4 Testing for Cointegration

Using the Johansen Test, the trace test indicated one cointegrating relationship for our Labour Model. However, for our Economic Performance Model, we found no cointegration among its variables. The results from the cointegration test are presented in the Appendix. Therefore, with the presence of a single cointegrating relationship, there is evidence supporting a long-term relationship among the employment in various sectors and oil prices. Consequently, for the Labour Model we can implement a VECM to analyze the relationship between oil price fluctuations on the aforementioned macroeconomic variables. Refer to results in Section 8.2 of the Appendix.

5.1.5 No cointegration with I(1) data (differenced data)

Since there were no cointegration found among SPI, REA and WTI, for the Economic Performance Model. We acknowledge that it could be a spurious regression and thus will not utilize a VECM. It is important to note that the absence of cointegration indicates a lack of stable long-term relationships among the variables being analyzed. This does not negate the presence of short-term dynamics or relationships. Alternatively, VAR can still be applied to analyze the short-term relationships and dynamic interactions among the differenced variables. Refer to results in Section 8.2 of the Appendix.

5.2 Autoregressive Model Results

5.2.1 Labour Model using VECM

We used data from the original data set (non-stationary) for the VEC model. The lineVar command in R corrects for the non-stationarity of the data. The order of cointegration (1) and number of lags (4) were determined from previous tests.

To understand the effect of the West Texas Intermediate (WTI) variable on the other variables in the system, we can look at the coefficients associated with the lagged differences of WTI in each equation. The current as well as the lagged differences of WTI represent how changes in WTI at various time points (current up to three lags) affect the current values of the other variables. See Section 8.3 in the Appendix to see the results of the VECM model.

Based on our analysis, the current WTI has a statistically significant relationship with current cons at the 5% level. The coefficient of WTI is 0.1222 with standard error of 0.0540. The current WTI variable seems to have a positive relationship with the dependent variable, cons. It is important to note that even though there is statistical significance at the 5% level, the effect does not appear to be very strong given the small coefficient value.

For the other two sectors, manu and petro, individual analysis of each with current WTI showed that they were statistically insignificant. The separate examination of manu and petro in relation to the current WTI revealed that neither sector showed statistical significance. The lagged WTI values, ranging from one to three lags, in our Labor model were found to be statistically insignificant across all employment sectors.

It is important to note that statistical insignificance may not necessarily imply the absence of a relationship. It simply suggests that there is not enough evidence to establish a connection at the specified significance level.

5.2.2 Economic Performance Model using VAR

For the Economic Performance model, since there was no cointegration, we selected the VAR as the statistical model to provide analysis on the short-term effects. REA and log(SPI) as proxies for economic performance could provide practical insight within the context of broader economic dynamics.

The one-period lag of log(SPI) has an estimated coefficient of approximately 0.416 with a standard error of around 0.099. The t-value is approximately 4.206, and the corresponding p-value is very low (5.75e-05), indicating high statistical significance at the 1% level. There is a positive connection between the current and previous period log(SPI), for instance, if log(SPI) at lag once increases by one unit, there is an associated rise of approximately 0.416 units in current log(SPI).

Log(WTI) has an estimated coefficient of about 0.083 with a standard error of around 0.039. The t-value is approximately 2.092, and the corresponding p-value is 0.039, suggesting statistical significance at the 5% significance level. This implies that a one-unit increase in log(WTI) leads to an increase of approximately 0.083 units in log(SPI).There is a positive connection between the current log(WTI) and current log(SPI), for instance, if current log(WTI) increases by one unit, there is an associated rise of approximately 0.083 units in current log(SPI).

Both one-period lag of log(SPI) and current log(WTI) have a small positive relationship with current log(SPI). Based on our research and general understanding of the economy in Trinidad and Tobago, intuitively we anticipated that we would yield stronger results in regards to the correlation between current and lagged log(WTI) with log(SPI).

The one-period lag of REA has a small estimated coefficient of around -0.214 with a standard error of about 0.0904. The t-value is approximately -2.389, and the corresponding p-value is high (0.019), suggesting that this lagged variable (REA at lag 1) is statistically significant at the 5% level.

Similarly, the four-period lag of REA has a small estimated coefficient of around -0.301 with a standard error of about 0.088. The t-value is approximately -3.441, and the corresponding p-value is high (0.0009), suggesting that this lagged variable (REA at lag four) is statistically significant at the 0.1% level. Both lags of REA on itself, has a negative association with current REA. The fourth lag could possibly be capturing a seasonality effect which would need further investigation to verify if this is indeed the reason.

log(WTI) has an estimated coefficient of about 5.607 with a standard error of around 2.030. The t-value is approximately 2.762, and the corresponding p-value is about 0.007, suggesting statistical significance at the 1% or 5% significance level.There is a positive connection between the current log(WTI) and current REA, for instance, if current log(WTI) increases by one unit, there is an associated rise of approximately 5.607 units in current REA.

We find that lagged differences of log(SPI) and REA at the first lag are statistically significant. The contemporaneous value of log(WTI) is also statistically significant. The results suggest that past values of log(SPI) and REA are important in predicting? the current value of log(SPI) Additionally, the contemporaneous value of the first difference of log(WTI) also has a significant impact on log(SPI).

The log(WTI) is 0.0826 significant 1% on log(SPI). The first difference on the log(WTI) is 5.607 on REA significant at 1%. Log(WTI) has statistically significant relationship with both REA and log(SPI), though the effects are small.

Using VAR, this equation could suggest a model where the current movement in the stock price index(SPI) is influenced by its own past movements (momentum effect), past movements in another economic indicator (REA), and the immediate impact of the current WTI, crude oil price level.

While there is some evidence that WTI is correlated with SPI the evidence is not robust and warrants examination of the model to refine the results.The real economic activity shows a positive relationship between current oil price, though we did use lagged log(WTI) in the VAR model, that could be an interesting area to examine further.

All results are shown in Section 8.3 of the Appendix.

5.3 Limitations

Lütkepohl (1993) indicates that overfitting (selecting a higher order lag length than the true lag length) causes an increase in the mean-square forecast errors of the VAR and that underfitting the lag length often generates autocorrelated errors. This could lead to errors in calculation of the coefficients.

Sensitivity to Specification: Model results might be sensitive to the choice of variables, lag lengths, or inclusion/exclusion of specific factors, potentially leading to different conclusions. Other variables for economic activity like government revenue or trade levels could be used.

It would be useful to use Impulse Response Function which could capture the short term adjustment period for effects. This would shed more light on the particular effects of short term adjustment but would require at least monthly data. Consequently, monthly data may have been able to produce more meaningful results, however, we did not have access to that frequency for all variables.

SPI might not be a good proxy for economic performance since the Trinidad and Tobago Stock market is relatively small and still growing and thus the index composition might not represent the entire economy's diversity and dynamics.

Given the structure of the natural gas sector, it may be possible to identify and investigate the impacts of significant changes to contract prices for natural gas. A difference in differences approach could be applied if a renegotiation point with significant changes in natural gas contract price existed. This warrants further research.

6 Conclusion

Overall, we did not find any significant or strong effect on employment which is counterintuitive given that the economy is dependent on oil and gas revenue. However, we did see some positive and significant relationship between oil price and stock price index. We also noted a strong positive and significant relationship between real economic activity and oil prices. There appears to be a positive relationship between oil price and economic performance.

The global oil price fluctuations may have a less direct impact on employment as a result of the natural gas contracts and the negotiated fixed price which stabilizes employment levels. However, this proposition should be explored empirically.

Indeed, a significant portion of the economic challenges experienced by T&T in the past resulted from unsustainable government spending during periods of economic booms. If history serves as a guide, a substantial decline in current oil prices could result in severe economic hardship. Therefore, there is an urgent need for prudent management of energy wealth to prevent the recurrence of boom-and-bust cycles triggered by fluctuations in oil prices. (Lorde, Jackman, and Thomas, 2009)

Trinidad and Tobago undoubtedly benefits when there are higher global energy prices as it can result in a positive terms of trade windfall that improves the country's external and fiscal positions. These factors help to improve economic conditions, but with increasing inflation. However, diversifying the economy should still be a priority.

As the country experiences a decline in its technically recoverable reserves of gas and oil, seizing the current opportunity becomes pivotal. Strengthening policy frameworks, exemplified by the operationalization of planned reforms (such as the Revenue Authority, the Gambling tax, the Procurement Act, Special Economic Zones) becomes imperative. Additionally, there is a pressing need to fortify fiscal reserves and intensify efforts towards fostering an economic transformation that ensures sustainability and inclusivity within the economy. (IMF, 2023).

7 References

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7.1 Website Data Sources

Central Bank of Trinidad and Tobago - Data Centre:
https://www.central-bank.org.tt/statistics/data-centre

Data and R-code available at: https://github.com/quruis/ECO1400

8 Appendix

8.1 Stationarity Plots

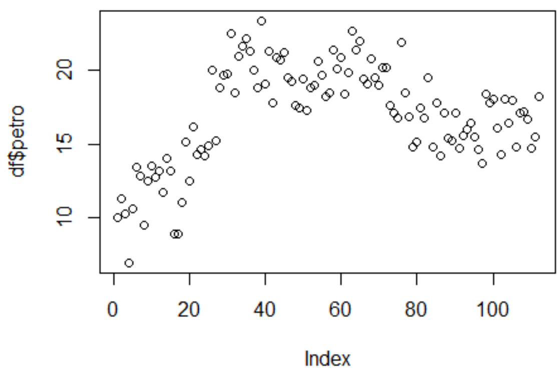

Figure 1: Plot of the time series of employment in the oil and gas sector

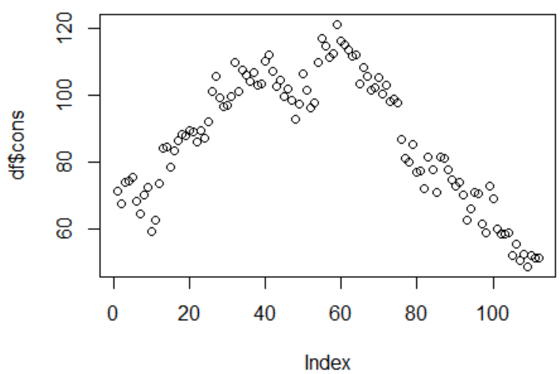

Figure 2: Plot of the time series of employment in the construction sector

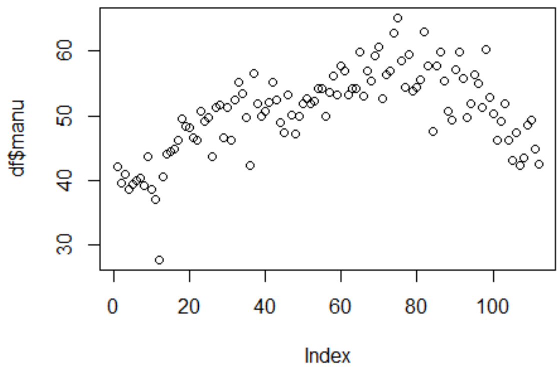

Figure 3: Plot of the time series of employment in the manufacturing sector

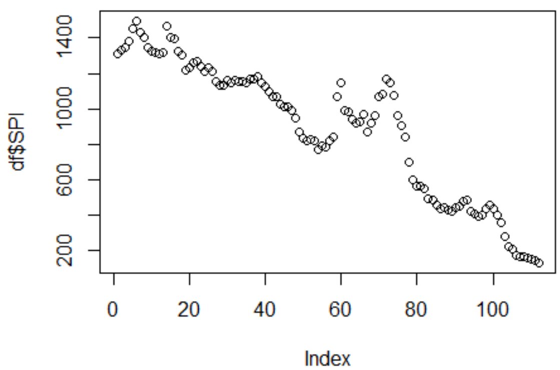

Figure 4: Plot of the time series of stock price index

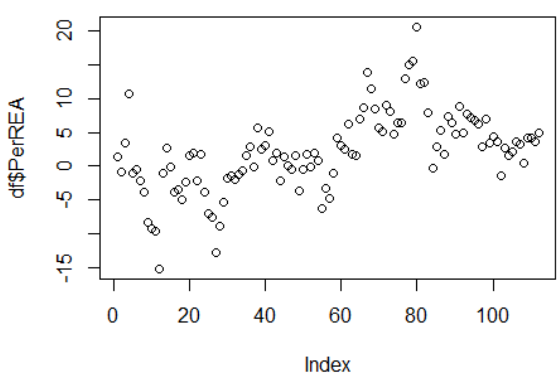

Figure 5: Plot of the time series of real economic activity

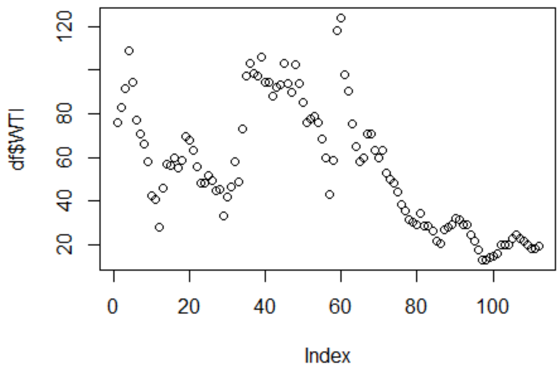

Figure 6: Plot of the time series of West Texas Intermediate

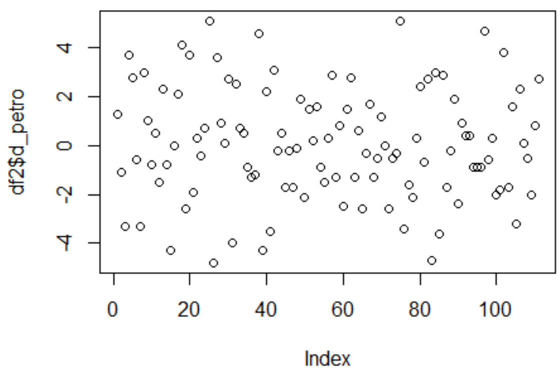

Figure 7: Plot of the first differenced time series of employment in the oil and gas sector

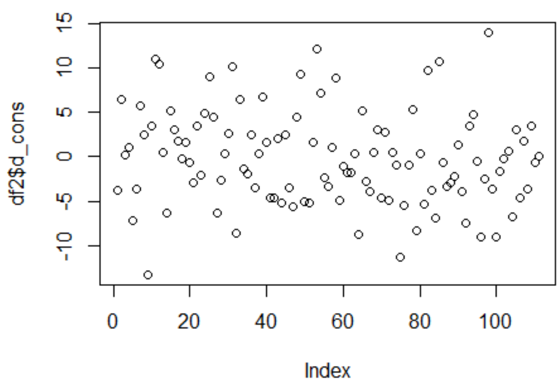

Figure 8: Plot of the first differenced time series of employment in the construction sector

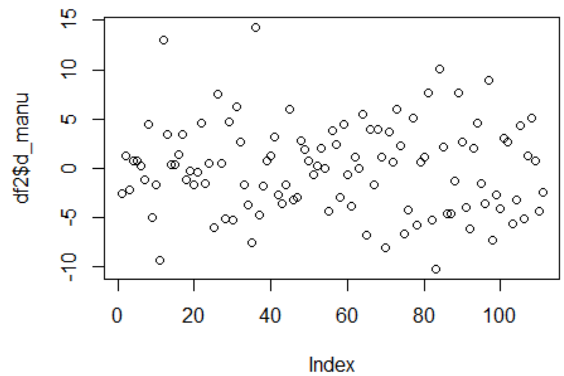

Figure 9: Plot of the first differenced time series of employment in the manufacturing sector

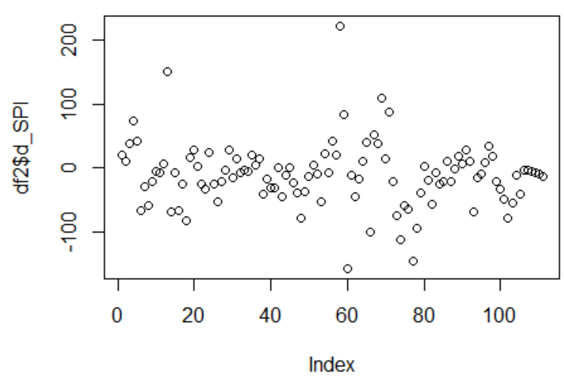

Figure 10: Plot of the first differenced time series of stock price index

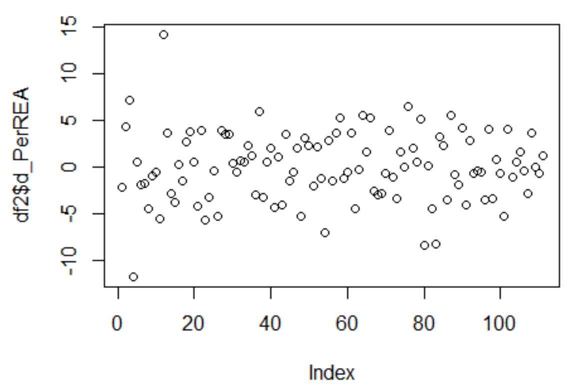

Figure 11: Plot of the first differenced time series of real economic activity

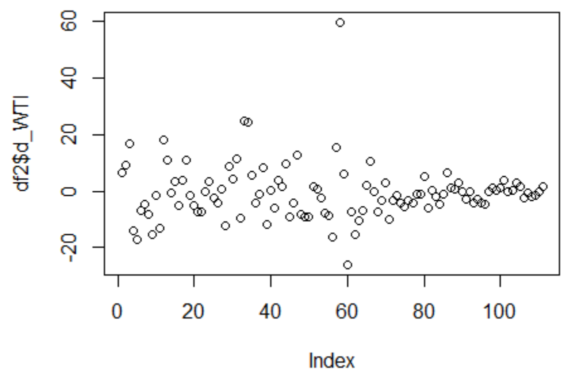

Figure 12: Plot of the first differenced time series of West Texas Intermediate

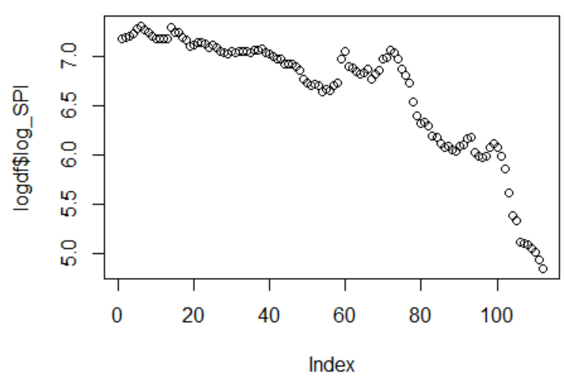

Figure 13: Plot of the time series of the log of stock price index

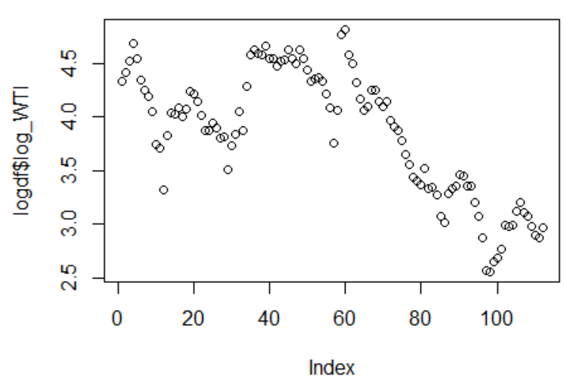

Figure 14: Plot of the time series of the log of West Texas Intermediate

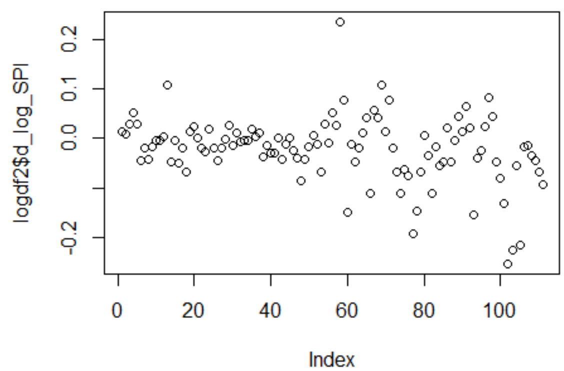

Figure 15: Plot of the first differenced time series of log of Stock Price Index

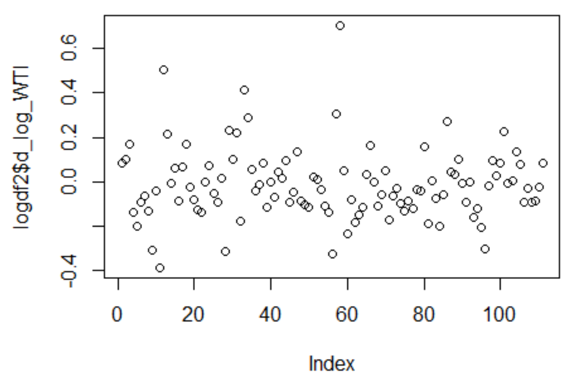

Figure 16: Plot of the first differenced time series of log of West Texas Intermediate

8.2 Selection of number of lags

Table 1: Results to select number of lags for employment model

AIC(n)	HQ(n)	SC(n)	FPE(n)
3	3	3	3

Table 2: Error minimization for employment model

1	2	3	4	5	6	7	8
-55.757	-58.887	-61.819	-55.992	-60.902	-61.736	-58.770	-58.554
-55.509	-58.472	-61.238	-55.246	-59.990	-60.658	-57.526	-57.144
-55.143	-57.863	-60.386	-54.150	-58.651	-59.075	-55.700	-55.075
0	0	0	0	0	0	0	0

Table 3: Results to select number of lags for economic performance model

AIC(n)	HQ(n)	SC(n)	FPE(n)
8	1	1	8

Table 4: Error minimization for economic performance model

1	2	3	4	5	6	7	8
-57.819	-57.662	-56.243	-56.889	-55.625	-55.128	-56.228	-58.415
-57.664	-57.413	-55.901	-56.454	-55.097	-54.506	-55.514	-57.607
-57.435	-57.048	-55.399	-55.815	-54.321	-53.593	-54.463	-56.420
0	0	0	0	0	0	0	0

Table 5: Results to select number of lags for economic performance model - log model

AIC(n)	HQ(n)	SC(n)	FPE(n)
4	1	1	4

Table 6: Error minimization for economic performance model - log model

1	2	3	4	5	6	7	8
-3.056	-3.013	-2.970	-3.079	-3.038	-2.991	-2.984	-3.010
-2.974	-2.889	-2.804	-2.872	-2.789	-2.701	-2.652	-2.637
-2.852	-2.706	-2.561	-2.567	-2.424	-2.275	-2.165	-2.089
0.047	0.049	0.051	0.046	0.048	0.050	0.051	0.050

8.3 Results

Figure 17: Johansen Procedure Results for Labour Model

```
Test type: trace statistic , with linear trend

Eigenvalues (lambda):
[1] 0.270793115 0.124377153 0.067684371 0.006791909

Values of teststatistic and critical values of test:

          test 10pct  5pct  1pct
r <= 3 |  0.74  6.50  8.18 11.65
r <= 2 |  8.38 15.66 17.95 23.52
r <= 1 | 22.86 28.71 31.52 37.22
r = 0  | 57.28 45.23 48.28 55.43

Eigenvectors, normalised to first column:
(These are the cointegration relations)

            cons.l1     manu.l1   petro.l1     WTI.l1
cons.l1   1.0000000  1.00000000  1.0000000  1.0000000
manu.l1  -2.6940799  0.83026141  2.4837841  0.7073565
petro.l1  0.5659517 -9.94285146 -3.9794015 -0.1836521
WTI.l1   -0.5989485  0.01345792 -0.8287654  0.1728878

Weights W:
(This is the loading matrix)

              cons.l1      manu.l1     petro.l1       WTI.l1
cons.d   0.1079395000  0.004344069 -0.031375686 -0.011841268
manu.d   0.1322669241  0.013012605 -0.017459523  0.008219029
petro.d -0.0008726521  0.029807296  0.008855873 -0.001054112
WTI.d    0.3073140023 -0.043633614  0.057818836 -0.010517615
```

Figure 18: Johansen Procedure Results for Economic Performance Model

```
Test type: trace statistic , with linear trend

Eigenvalues (lambda):
[1] 0.144041211 0.073087079 0.002834761

Values of teststatistic and critical values of test:

          test 10pct  5pct  1pct
r <= 2 |  0.31  6.50  8.18 11.65
r <= 1 |  8.50 15.66 17.95 23.52
r = 0  | 25.30 28.71 31.52 37.22

Eigenvectors, normalised to first column:
(These are the cointegration relations)

           log_SPI.l1   PerREA.l1   log_WTI.l1
log_SPI.l1  1.0000000  1.00000000  1.000000000
PerREA.l1   0.6190461  0.06156965  0.005425861
log_WTI.l1  2.4010231 -2.10047936 -0.498311558

Weights W:
(This is the loading matrix)

            log_SPI.l1   PerREA.l1   log_WTI.l1
log_SPI.d -0.000336108 -0.01180017  0.006636683
PerREA.d  -0.376299340 -0.34602310 -0.161179286
log_WTI.d -0.013381817  0.02112975  0.012874325
```

Figure 19: VEC - Labour Model

```
Full sample size: 112    End sample size: 108
Number of variables: 4   Number of estimated slope parameters 64
AIC -5992.286    BIC -5812.583   SSR 3765.994
Cointegrating vector (estimated by ML):
   WTI          cons          manu        petro
r1   1 -6.170805e-17 -4.100668e-16 4.386137e-16


               ECT                 Intercept             Trend
Equation WTI   -1.0000(2.2e-16)*** -1.0e-14(9.2e-15)     -1.3e-16(8.6e-17)
Equation cons  -0.1395(0.0532)*    3.6385(2.1938)        -0.0540(0.0205)**
Equation manu  0.0110(0.0432)      1.1552(1.7806)        -0.0185(0.0166)
Equation petro 0.0024(0.0216)      1.6011(0.8902).       -0.0165(0.0083).
               WTI -1                cons -1               manu -1
Equation WTI    3.6e-16(2.4e-16)     -2.5e-16(4.3e-16)     -1.2e-15(4.9e-16)*
Equation cons  -0.0197(0.0564)       -0.1603(0.1012)       0.0266(0.1161)
Equation manu  0.0312(0.0458)        0.0106(0.0822)        -0.5542(0.0943)***
Equation petro 0.0164(0.0229)        -0.0236(0.0411)       0.0505(0.0471)
               petro -1             WTI -2               cons -2
Equation WTI   -2.6e-15(9.9e-16)**  -1.3e-16(2.2e-16)     1.8e-17(3.9e-16)
Equation cons  0.4478(0.2356).      0.0849(0.0532)       -0.3948(0.0936)***
Equation manu  -0.2388(0.1913)      0.0155(0.0432)       0.0932(0.0759)
Equation petro -0.6180(0.0956)***   -0.0134(0.0216)      0.0222(0.0380)
               manu -2               petro -2
Equation WTI   -5.8e-16(5.1e-16)     -1.8e-15(1.1e-15)
Equation cons  -0.1763(0.1206)       0.0783(0.2690)
Equation manu  -0.5724(0.0979)***    -0.1905(0.2183)
Equation petro 0.0314(0.0489)        -0.3558(0.1092)**
               WTI -3                cons -3
Equation WTI    2.1e-16(2.2e-16)     -5.6e-16(4.1e-16)
Equation cons  -0.0557(0.0516)       -0.1637(0.0985).
Equation manu  -0.0142(0.0419)       0.0847(0.0800)
Equation petro -0.0044(0.0209)       -0.0464(0.0400)
               manu -3               petro -3              WTI
Equation WTI   -7.5e-16(5.0e-16)     -1.1e-15(1.0e-15)     1.0000(2.3e-16)***
Equation cons  -0.0934(0.1199)       0.3397(0.2475)        0.1222(0.0540)*
Equation manu  -0.4238(0.0973)***    -0.3938(0.2009).      -0.0096(0.0438)
Equation petro 0.0320(0.0487)        -0.4055(0.1004)***    -0.0127(0.0219)
```

Figure 20: VAR - Economic Performance Model (SPI)

```
VAR Estimation Results:
=========================
Endogenous variables: d_log_SPI, d_PerREA
Deterministic variables: none
Sample size: 107
Log Likelihood: -121.019
Roots of the characteristic polynomial:
0.7735 0.7735 0.6992 0.6992 0.5006 0.5006 0.4608 0.4608
Call:
VAR(y = logdf2[1:2], type = "none", exogen = logdf2[3], lag.max = 8,
    ic = "AIC")


Estimation results for equation d_log_SPI:
==========================================
d_log_SPI = d_log_SPI.l1 + d_PerREA.l1 + d_log_SPI.l2 + d_PerREA.l2 + d_log_SPI.l3 + d_PerREA.l3 +

              Estimate Std. Error t value Pr(>|t|)
d_log_SPI.l1  0.4157272  0.0988373   4.206 5.75e-05 ***
d_PerREA.l1   0.0004910  0.0017421   0.282    0.779
d_log_SPI.l2  0.1326730  0.1061823   1.249    0.214
d_PerREA.l2  -0.0008551  0.0017216  -0.497    0.621
d_log_SPI.l3  0.0116749  0.1069199   0.109    0.913
d_PerREA.l3  -0.0016535  0.0016897  -0.979    0.330
d_log_SPI.l4 -0.0219052  0.0989865  -0.221    0.825
d_PerREA.l4   0.0017416  0.0017023   1.023    0.309
d_log_WTI     0.0826145  0.0394881   2.092    0.039 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


Residual standard error: 0.06208 on 98 degrees of freedom
Multiple R-Squared: 0.2965,  Adjusted R-squared: 0.2319
F-statistic: 4.589 on 9 and 98 DF,  p-value: 4.575e-05
```

Figure 21: VAR - Economic Performance Model (REA)

```
Estimation results for equation d_PerREA:
=========================================
d_PerREA = d_log_SPI.l1 + d_PerREA.l1 + d_log_SPI.l2 + d_PerREA.l2 + d_log_SPI.l3 + d_PerREA.l3 +

             Estimate Std. Error t value Pr(>|t|)
d_log_SPI.l1 -0.96911    5.08052  -0.191 0.849115
d_PerREA.l1  -0.21397    0.08955  -2.389 0.018789 *
d_log_SPI.l2 -1.10422    5.45807  -0.202 0.840094
d_PerREA.l2  -0.08645    0.08850  -0.977 0.331049
d_log_SPI.l3  2.96214    5.49599   0.539 0.591134
d_PerREA.l3   0.04668    0.08685   0.537 0.592161
d_log_SPI.l4 -5.14809    5.08818  -1.012 0.314138
d_PerREA.l4  -0.30113    0.08750  -3.441 0.000852 ***
d_log_WTI     5.60729    2.02980   2.762 0.006851 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


Residual standard error: 3.191 on 98 degrees of freedom
Multiple R-Squared: 0.2529,  Adjusted R-squared: 0.1842
F-statistic: 3.685 on 9 and 98 DF,  p-value: 0.0005226



Covariance matrix of residuals:
          d_log_SPI  d_PerREA
d_log_SPI  0.003746  0.003862
d_PerREA   0.003862 10.182931

Correlation matrix of residuals:
          d_log_SPI d_PerREA
d_log_SPI   1.00000  0.01977
d_PerREA    0.01977  1.00000
```