How Does Energy Insecurity Influence Stock Market Returns in South Africa?

UNIVERSITY OF BATH

1 Executive Summary

Overview:
This policy brief explores the impact of energy insecurity, in particular load shedding, on South Africa's stock market. The study employs Structural Vector Auto-Regression (SVAR) to analyse the stock market's reaction to load shedding, and focuses on key factors: operational risk, bond yields/interest rates, and the exchange rate.

Key Findings:

- The South African Rand's exchange rate is closely linked to load shedding, so leading to depreciation.
- Bond yields and interest rates have surged because of capital flight and heightened country risk.
- Credit Default Swap (CDS) spreads have widened, which signals reduced confidence in the South African economy.

Stock Market Impact by Sector:

- Large and diversified indices such as the TOP40 and ALSI display minimal effects.
- The technology sector benefits from Rand depreciation.
- Banking and financial sectors experience short-term setbacks, but long-term gains are primarily driven by higher yields.
- Construction companies remain unaffected because of limited reliance on electricity.
- Small businesses, though vulnerable to load shedding, have little impact on stock market movements.

Policy Implications:

- Policymakers should assess load shedding's industry-specific impact, considering operational disruptions, financial metrics, and market sensitivity.
- Businesses should invest in backup power solutions and leverage financial hedging tools in relation to exchange rate and yield-curve movements.
- Financial firms, exporters, and highly leveraged companies should monitor exchange rates and interest rates.

2 Introduction

Energy security is at the heart of any nation's economic growth and stability (Iyke et al., 2021). In recent years, the narrative associated with energy has increasingly shifted towards its stability, accessibility, and diversification. These concerns have since accelerated following Russia's invasion of Ukraine. To appreciate the gravity of this, the situation of South Africa is considered – a nation that has experienced dramatic political, social, and economic shifts over the past few decades.

Most of the power needs of the nation are met by Eskom, the state-owned company accounting for 90% of South Africa's power generation (Eskom, 2021). Frequent power outages – rolling blackouts often euphemistically termed "load shedding" – pose a significant risk to South Africa's economy. Much of the existing research has focused on the impact on the economy (Goldberg, 2015; Ateba and Prinsloo, 2018; Lenoko, 2017). However, there is little research on the impact of load shedding on stock market returns.

As South Africa grapples with expanding its energy infrastructure amid environmental and geopolitical challenges, it offers a profound case study on the intricate relationship between energy insecurity and stock market dynamics. This brief seeks to delve deep into understanding of how energy insecurity, as witnessed in South Africa, affects stock market returns, thereby providing crucial insights to investors, policymakers, and stakeholders worldwide.

Using orthogonal impulse response functions constructed from Structural Vector Auto-Regression (SVAR), this brief shows that the stock market indices respond to energy insecurity in the form of load shedding based on exposure to three core factors:

- Operational/country risk caused by load shedding.
- The impact that load shedding has on bond yields/interest rates.
- The impact load shedding has on the exchange rate.

3 Brief Review of the Literature

The sampled literature draws from experiences of other countries and other forms of energy, while also bringing in the South African context.

3.1 Energy and Economic Growth

The stock market is a leading indicator for real economic activity (Sadorsky, 2009). Accordingly, it is vital to assess the real impact that energy insecurity has on the real economy before considering equity markets.

Energy plays a crucial role in economic development, as underscored by policy documents and the United Nations Sustainable Development Goals (Iyke et al., 2021; United Nations, 2015). The stability of energy supply is critical for economic growth and productivity (Ateba and Prinsloo, 2018).

Theoretical models suggest a strong positive link between energy consumption and economic growth (Lenoko, 2017). This is supported by LaCommare and Eto's study, estimating a $79 bn annual productivity loss in the United States due to power outages (2006).

In the case of South Africa, various studies have estimated that 1–2% of GDP is lost every year as a result of load shedding (Goldberg, 2015; Nest, 2015; Ngila, 2023). Walsh et al. (2021) estimate that the cost of load shedding is R9.53 ($0.50) for every kWh of energy that is lost. The study further explains that the costs are unevenly distributed across industries. Electricity-intensive sectors bore the highest costs.

Large companies and communities can invest in additional generation capacity, like diesel or solar, and consumers can opt for battery storage solutions or private generation (Goldberg, 2015). Despite these efforts, economic losses remain substantial. In Nepal, even with backup generation, load shedding still leads to a 3.4% GDP loss (Timilsina and Steinbuks, 2021). In South Africa, the use of diesel-powered generators costs up to R10 million ($0.625 million) per hour (Mantshantsha, 2021), affecting both economic output and investment. Load shedding in Nepal caused a nearly 33% drop in investment demand (Timilsina and Steinbuks, 2021).

Small businesses, lacking reserves and market dominance, struggle to absorb additional generation costs and suffer significantly due to load shedding (Orderson, 2023).

3.2 Energy Insecurity and Stock Markets

Much of the research on how energy insecurity affects stock markets has focused on oil rather than electricity (Kilian and Park, 2009; Sadorsky, 1999; Henriques and Sadorsky, 2008; Park and Ratti, 2008; Cong et al., 2008). Studies that focus on the impact of electricity insecurity primarily focus on temporary shocks to supply for limited periods (LaCommare and Eto, 2006; Blumsack and Ositelu, 2015).

In South Africa, energy insecurity has evolved from an occasional problem to a persistent issue, albeit with fluctuating severity. Despite this, these studies offer valuable insights into the connection between energy insecurity and stock markets.

Regarding oil's impact on stock prices, economists lack consensus (Kilian and Park, 2009). Studies on oil price shocks and stock market returns yield conflicting results, but there's agreement on key variables: interest rates, inflation, and industrial output (Kilian and Park, 2009; Park and Ratti, 2008).

In the context of electricity blackouts, stock market efficiency theories suggest that news about such events gets quickly factored into stock prices (Blumsack and Ositelu, 2015). Investors react to load shedding severity news rather than its implementation.

Prior research has primarily focused on load shedding's economic effects, neglecting its impact on equity markets. This study bridges that gap by drawing insights from prior research on energy sufficiency and stock markets, exploring the link between load shedding and stock markets.

4 The Analysis

This section considers the descriptive statistics of the variables under analysis to resolve the real-world impact that load shedding has had.

The data used in this study was derived from a diverse array of sources and was subsequently aggregated for analysis. EskomSePush was used for load shedding data (2014–2023), the Eskom Data Portal for energy production data (2019–2023), and Investing.com for stock market returns and financial data (2014–2023). This combination of data sources enriched the analysis by providing a broader and more comprehensive dataset. Unless otherwise stated, insights from the analysis that follows were derived from these data.

4.1 How Much Energy Has Been Lost?

In 2021, load shedding was sporadic, but in 2022 Q3, it escalated dramatically, resulting in over 3,700 GWh of electricity loss – enough to power 2.7 million American households for a year.

This decline in energy security is evident in the Energy Availability Factor (EAF) - a ratio of actual energy output over total installed capacity, which dropped to 53% in Q1 2023, far below Eskom's target of 70% (Eskom, 2023). The graph below illustrates the energy loss in GWh compared to the EAF.

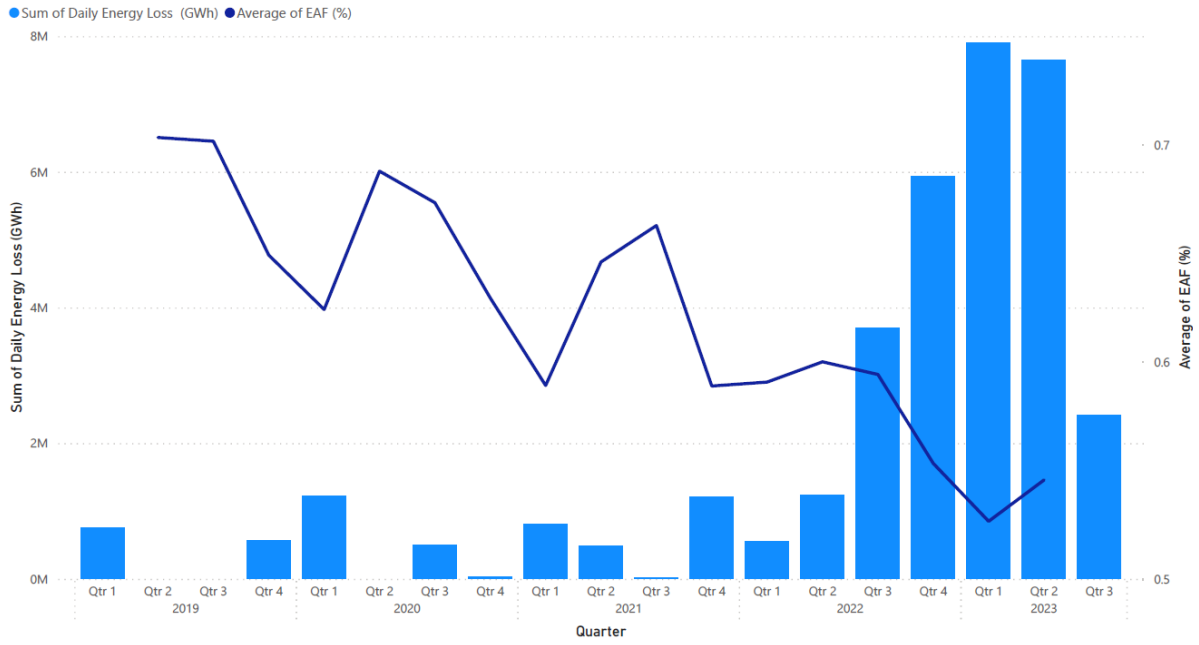


Figure 1: Sum of Daily Energy Loss (GWh) and Average of EAF (%) by Year and Quarter

Sources: EskomSePush, Eskom Data Portal

In 2022, a record-breaking 11,400 GWh was lost due to load shedding, surpassing the previous record of 2,500 GWh in 2021. Shockingly, 2023 has already seen 18,000 GWh lost at the time of this report.

4.2 The Curious Case of Currency

Exchange rates, influenced by money flows, are affected by load shedding challenges. The South African currency's strength is closely linked to the Energy Availability Factor (EAF). Figure 2 illustrates their strong correlation, with a 70% correlation from 2021 to 2023.

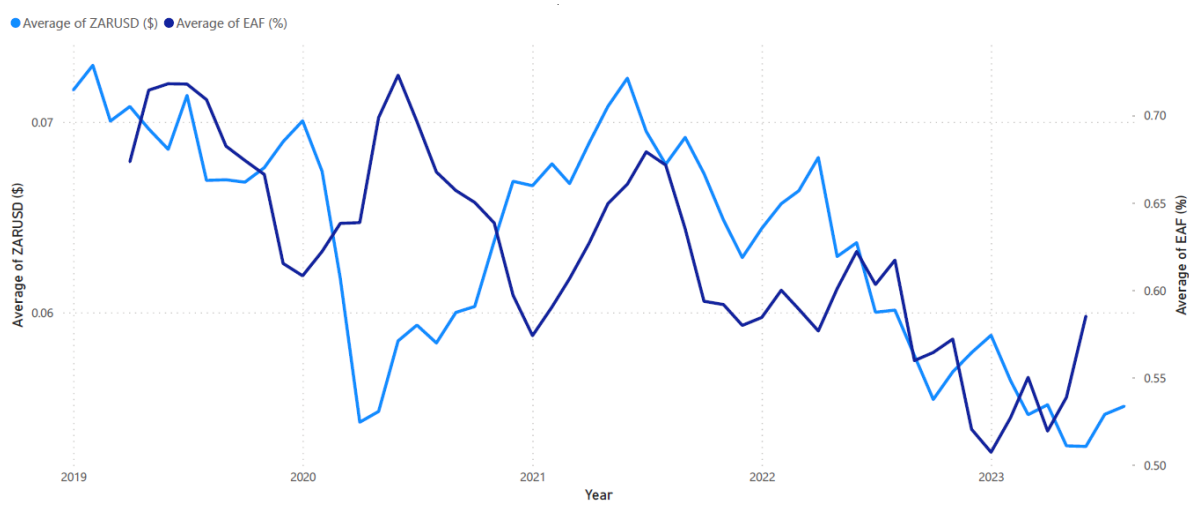


Figure 2: Average of ZARUSD ($) and Average of EAF (%)

Source: Investing.com; Eskom Data Portal

The South African Rand is a common gauge for emerging market currency risk due to its liquidity (IMF, 2019). However, when compared to the MSCI index for emerging currencies, the Rand has been steadily weakening. In the past year, while the Index strengthened, the Rand declined, coinciding with increased load shedding. Figure 3 underscores that the Rand's decline is primarily driven by domestic issues.

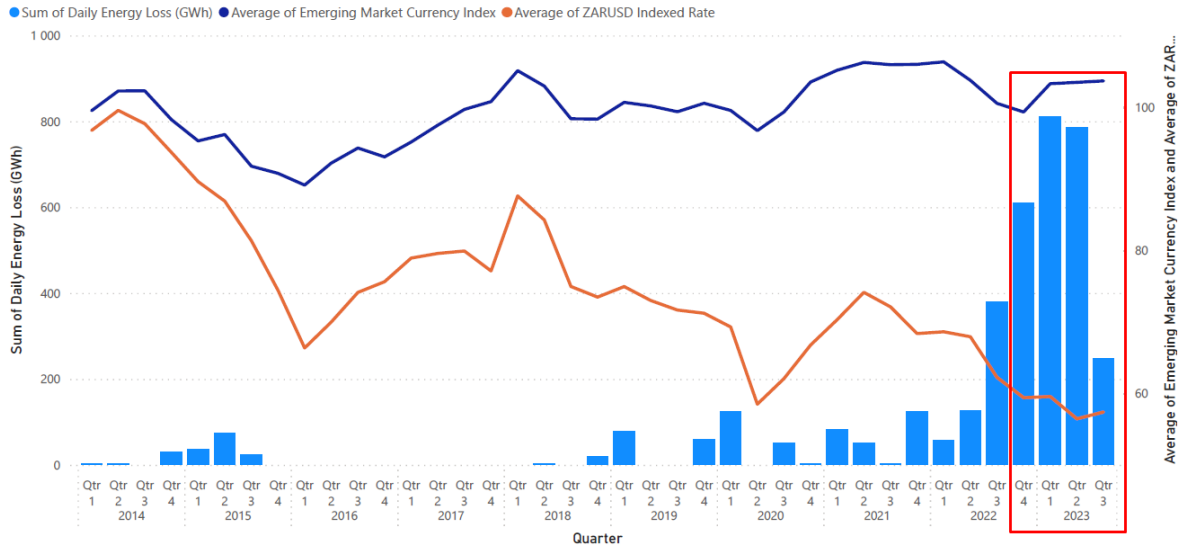


Figure 3: Sum of Daily Energy Loss (GWh), Average of Emerging Market Currency Index & average of ZARUSD Indexed Rate [Data Indexed to 100 at 2014]

Sources: Investing.com; EskomSePush.

4.3 Bond Yields/Interest Rates

Interest rate differentials between countries affect exchange rates (Segal, 2021). Higher bond yields generally attract international investors, strengthening the currency. In South Africa, however, bond yields are rising alongside a weakening currency and worsening energy security.

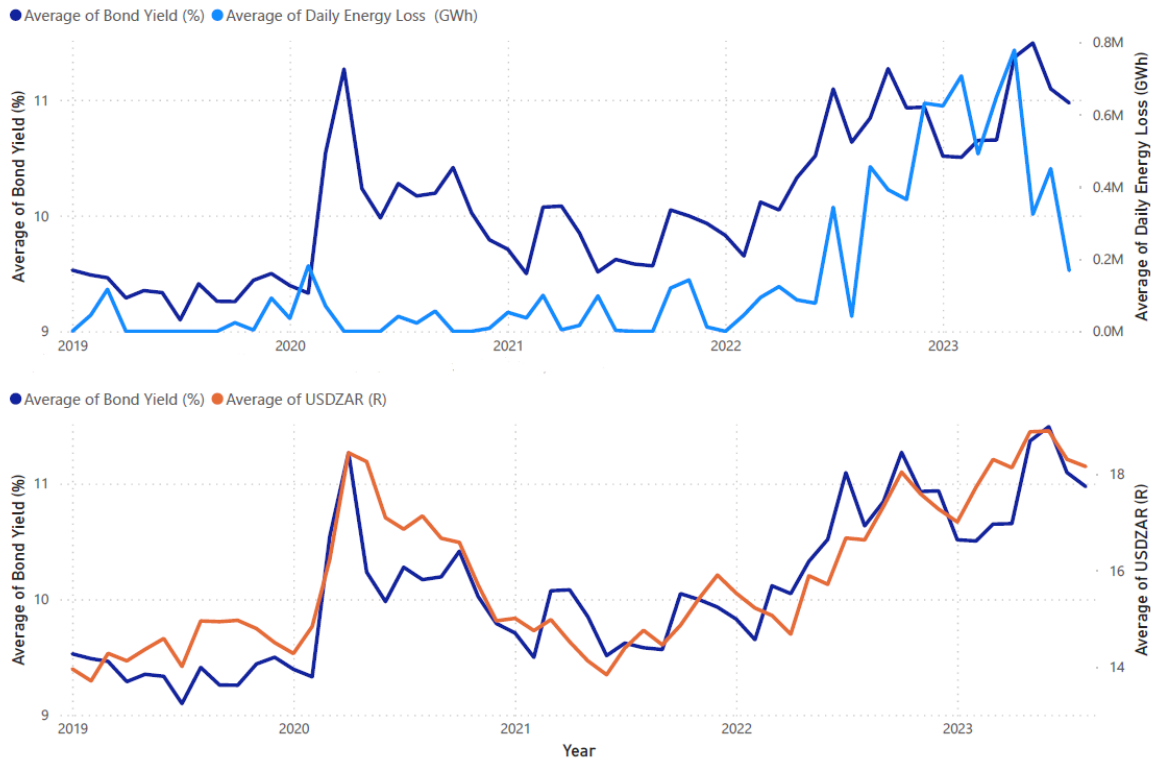


Figure 4: (Top) Average of Bond Yield (%) and Average of Daily Energy Loss (GWh)
(Bottom) Average of Bond Yield (%) and Average of USDZAR (R)
Sources: EskomSePush; Investing.com

Figure 4 indicates a parallel movement between average interest rates (bond yields), daily energy loss due to load shedding (top), and the Rand's depreciation (bottom). This implies that investors prioritize load shedding risks over higher bond yields, leading to capital outflow to safer destinations. Consequently, higher bond yields align with a weaker exchange rate. Higher interest rates will also put pressure on businesses that are highly leveraged.

4.4 Credit Default Swap Spreads

Spreads on the Credit Default Swap (CDS) on 10 Government Bonds are also seen to be moving and are at least partly influenced by load shedding. This is illustrated below in Figure 5, apart from the large movement in 2020 during the COVID outbreak, CDS Spreads increase as more energy is shed. The impact on CDS spreads further emphasises the impact that load shedding has on business confidence in the South African economy.

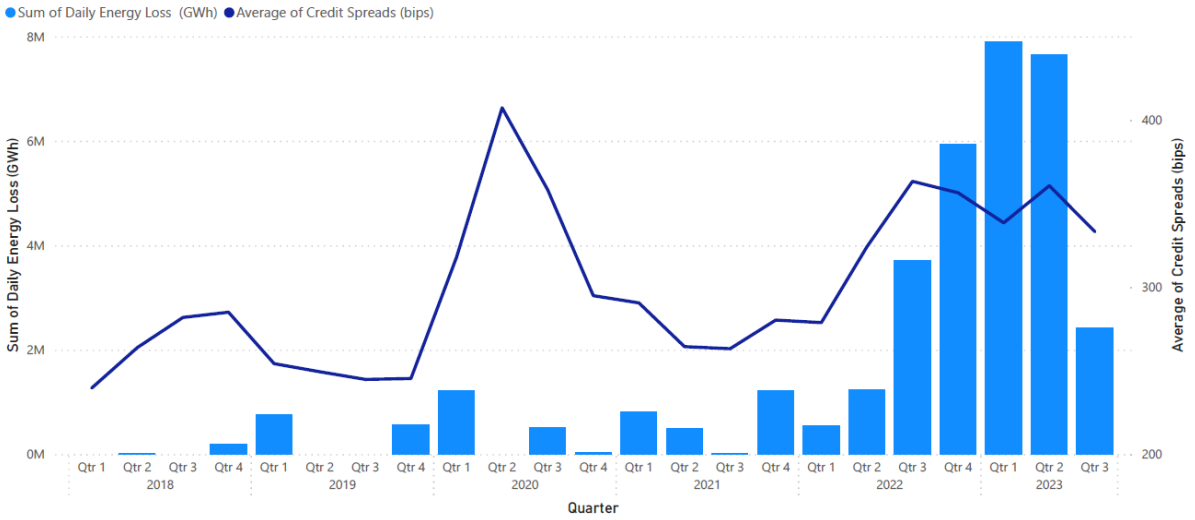


Figure 5: Sum of Daily Energy Loss (GWh) and Average of Credit Spreads (bips)

Sources: EskomSePush; Investing.com

Consequently, industries with great exposure to exchange rate fluctuations, interest rate movements and electricity consumption experience load shedding as a significant risk to their operations.

4.5 The Real Economy

Given the composition of South Africa's economy, the follow section argues that there will be asymmetric effects to different market players. The actual costs for different industries will be heterogenous. Similarly, stock market analysis should be segregated by indices comprising companies with similar market exposure.

4.5.1 Measuring the Actual Costs

The impact of load shedding on large, listed organisations is significant; however, the impact on profitability is limited. In the case of Shoprite, South Africa's biggest food retailer, the cost of load shedding was R1.3 bn ($69 mn) in 2022, and whereas sales increased 16.9% to R215 bn ($11.47 mn) (Fraser, 2023), the cost of load shedding only makes up 0.6% of total revenue. Overall, retailers will see a decline of 10% in profits if load shedding continues (Ghosh, 2023). This is significant; however, it is not a threat to overall business operations for companies with a healthy balance sheet. The year-on-year impact on GDP contribution for agriculture, forestry and fishing is 10%, while the impact on construction is 1.5% (Ghosh, 2023).

Load shedding has increased the cost of electricity for businesses that are operating in South Africa given that they must maintain operations, and need to invest in additional generation capacity, mostly through solar installations and diesel generators.

This prompts us to consider the cost of electricity in South Africa relative to other countries – focusing on the electricity cost for industrial uses.

The cost of electricity for industrial use sits at an average of $0.07 per kWh of energy as illustrated in figure 6 and 7. A relatively low figure when compared with other countries, in particular those in Europe.

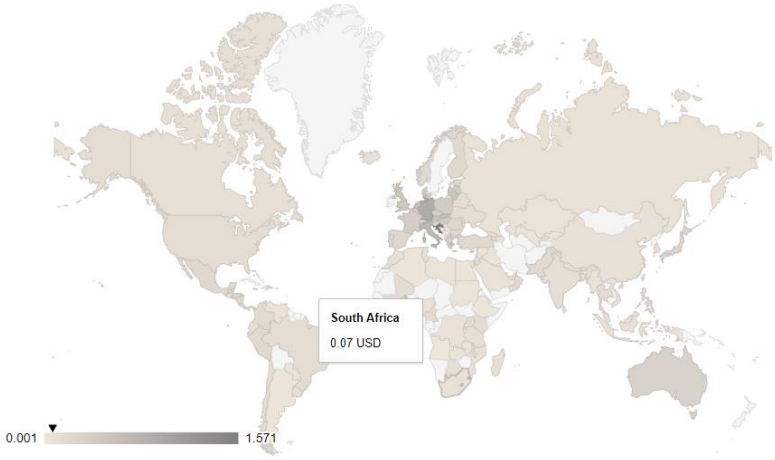


Figure 6: Electricity prices for households

Source: GlobalPetrolPrices.com

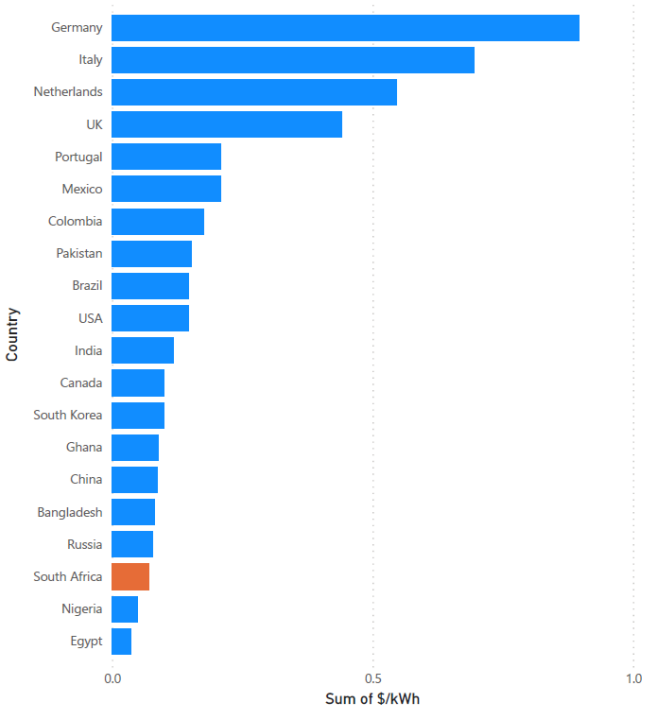


Figure 7: Sum of $/kWh by Country

Source: GlobalPetrolPrices.com

South Africa has high energy consumption per capita of 2.7 averages, compared to the regular global consumption of 1.8 average (Ateba and Prinsloo, 2018) . This result, coupled with the country's relatively high energy usage, suggests that multinational corporations with operations in South Africa have an opportunity to maintain current levels of production while using less energy, such that load shedding costs can be minimised (Goldberg, 2015).

4.5.2 Stock Market will Not Reflect Mirror of Real Economy

Load shedding has a greater toll on small businesses (Orderson, 2023). With a population of 60.6 million people and an unemployment rate of 32.6%, South Africa's labour force is only

15.8 million people, with 4.7 million of those working in the informal sector (StatsSa, 2023; Khuluvhe, 2023).

Up to 60% of this work force are employed by unlisted small businesses which make up more than 98% of business across the country, and contribute 39% towards GDP (Zawya, 2023; Reddy, 2022). As such, stock market movements are unlikely to closely resemble the real economy.

4.6 Statistical Analysis of The Stock Market

To analyse the impact of load shedding on stock market returns the brief focuses on market indices to appreciate the impact on different sectors.

4.6.1 The Model

The returns of key indices were analysed using Structural Vector Auto-Regression (SVAR). The resulting SVAR model was then assessed for Granger causality. Finally, Orthogonal Impulse Response Functions of a shock to load shedding on the interest rate, exchange rate, output, CDS spreads and each index were produced and analysed.

The model draws on the returns of weekly data from 2019-01-01 to 2023-04-23. Given the limited availability of weekly inflation data, the USDZAR exchange rate has been used as a proxy to capture the impact on the movement and relative value of money. A weekly estimate of economic activity from OECD (2023) is used to estimate weekly economic output.

The independent variable representing energy insecurity is the total energy lost to load shedding per week.

In addition, the brief used a secondary model that also brought in the impact to credit spreads as a measure of riskiness of the South African economy.

4.6.2 Impulse Responses

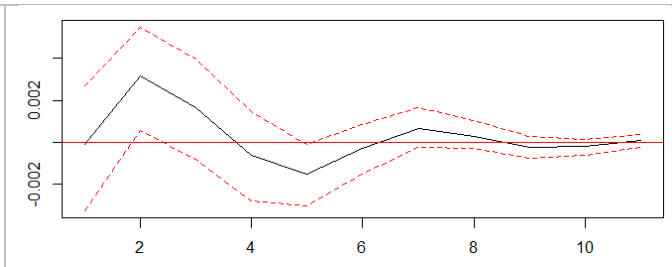
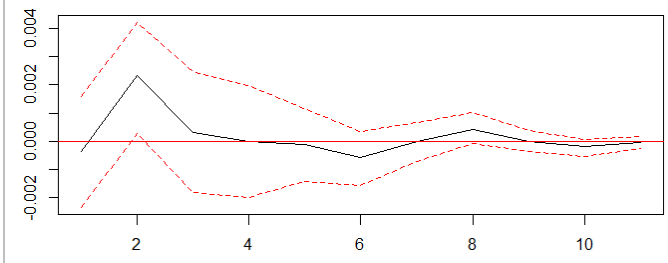
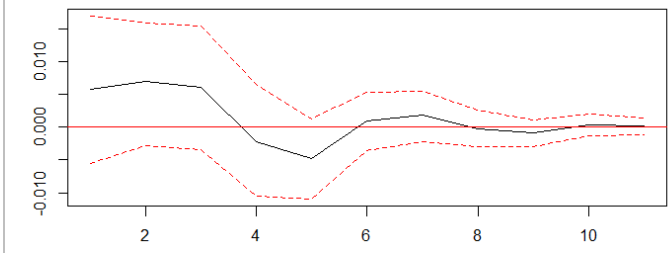
The following analysis is underpinned by the movements of core economic variables. All represent orthogonal impulse responses from a shock to load shedding. The red lines

represent significance at the 5% level. Below, I first highlight the impulse responses of the core variables before diving deeper into the analysis of individual indices.

At a p-value of 0.034, the results show that load shedding Granger causes interest rates, at the 95% level of confidence, while impulse responses show a positive statistically significant 1 period lag on interest rates following an impulse to load shedding. This observation suggests that following a load-shedding shock, there is a sell-off on bonds that applies upward pressure on yields.

Similarly, with a p-value of 0.032, the brief finds that load shedding Granger causes exchange rates at the 95% level of confidence. Impulse responses also observe a similar impact on the USDZAR exchange rate; a one period lagged statistically significant positive impact. This shows a depreciation of the Rand against the dollar, which suggests that money flow is moving out of the country.

Table 1: Summary of Orthogonal Impulse Responses on Daily Energy Loss

Interest Rates	
Exchange Rates	
Credit Spreads	

Credit spreads also show a widening following a shock to load shedding. However, this widening falls short of statistical significance. Notably, however, the impact on credit spreads is immediate, whereas we observed a lag in the impact on the exchange rate and bond yields.

Put together, the increasing yields, depreciating exchange rate and widening of credit spreads suggest capital flight away from the South African economy due to heightened country/operational risk.

4.6.2.1 Stock Indices

The above impulse responses reflect some interesting results both in the impact that is seen and in the absence of an impact. The great variation in the results also reflects the unique impacts on each of the industries assessed.

4.6.2.1.1 TOP40

The TOP40 index comprises the biggest 40 companies listed on the JSE. Impulse responses show almost no effect of load shedding on the combined returns of the top 40 companies. This is because of the heterogeneity present among these companies such that all the differences cancel themselves out.

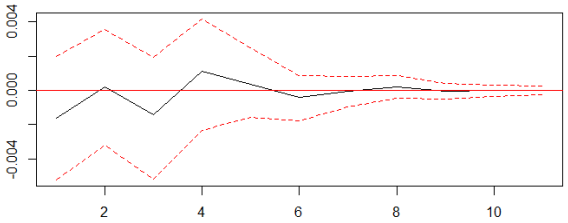


Figure 8: Impulse Response of TOP40 returns from Daily Energy Loss Shock

4.6.2.1.2 ALSI

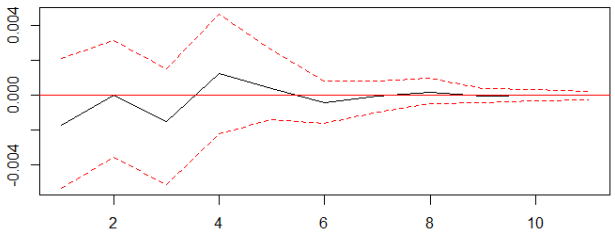


Figure 9: Orthogonal Impulse Response of ALSI returns from Daily Energy Loss Shock

We see a similar picture in the ALSI, which tracks the returns of all listed shares. There is no significant impact on ALSI returns from a shock to energy security in the form of load shedding.

4.6.2.1.3 Technology

The tech index is made up of 21 companies in the technology industry. However, an overwhelming majority of this index is made up of Prosus N.V., which is an international company headquartered in the Netherlands.

Impulse responses reflect positive moves in the weekly returns for tech stocks following a shock to load shedding, and then a gradual dissipation of the effect after a few weeks. Load shedding weakens the Rand, and consequently global companies with limited exposure to the country/operational risk posed by load shedding and which derive profits in a foreign currency will see an appreciation of returns in Rand terms.

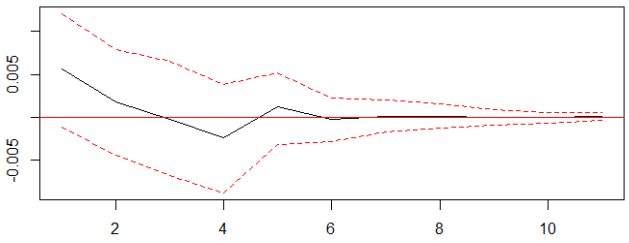


Figure 10: Orthogonal Impulse Response of Technology Stock returns from Daily Energy Loss Shock

4.6.2.1.4 Resources

The Resources Index is a combination of Oil and Gas, Basic Materials Industries, and the Financial Industry Group. This index is a combination of companies with domestic and global operations. Much of the goods they produce are exported across the world. Impulse responses reflect a sharp decline in the first period and a recovery thereafter.

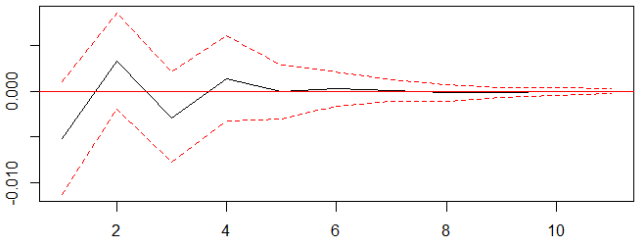


Figure 11: Orthogonal Impulse Response of Resources stock returns from Daily Energy Loss Shock

Although companies that comprise this index will benefit from a Rand depreciation, they face heightened operational risk as higher stages of load shedding are put in place. In particular, the costs for mining companies to install backup power are immense and the impact of loss of electricity is significant.

4.6.2.1.5 Mining

As articulated in the case of resource stocks, the Mining index is highly susceptible to movements in load shedding given the associated operational risk. Accordingly, mining stocks see a degradation in their share price given a shock from load shedding. Some

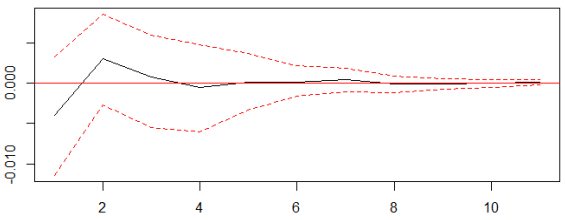


Figure 12: Orthogonal Impulse Response of Mining stock returns from Daily Energy Loss Shock

mining companies do not actually experience load shedding themselves as they are part of an exemption list. However, they do experience load curtailment. Instances of load curtailment are limited and are seldom reported. As such, this response is limited to risk rather than the realisation of power loss.

4.6.2.1.6 Agriculture

The impact on food producers appears to be positive at first. Since prices are quoted in dollars, this is likely driven by higher-than-expected export prices following a depreciation of the Rand. The effect then turns negative given negative impact farming operations, such as refrigeration and irrigation, take hold. These impulse responses, however, are not statistically significant.

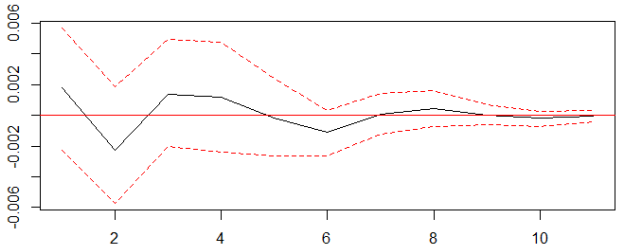


Figure 13: Orthogonal Impulse Response of Agriculture stock returns from Daily Energy Loss Shock

4.6.2.1.7 Banks and Financials

Financials in general and banks specifically generate the most significant lag effect of the indices analysed. While initially reflecting a negative response to the initial shock, the 2nd and 3rd periods show a strong statistically significant positive impact on banking stock returns.

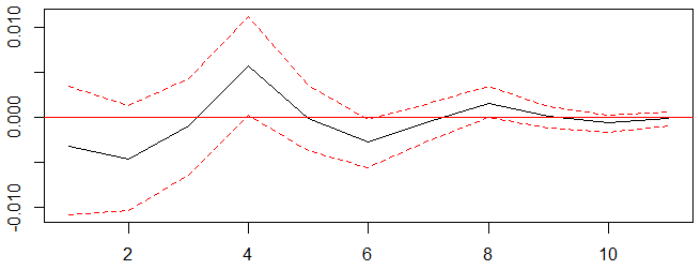


Figure 14: Orthogonal Impulse Response of Financial stock returns from Daily Energy Loss Shock

This is initially driven by a drop in business confidence against South African-based companies as seen in the depreciating currency, widening credit spreads, and increasing bond yields.

In the short term, the increase in yields also boosts the Net Interest Margin charged to clients. As these effects work themselves through the economy, heightened bond yields have a positive impact on the returns of bank

stocks. The cost of load shedding on financial institutions is relatively limited, with the focus being on the powering of office buildings, computer servers and laptops (Fraser, 2023).

4.6.2.1.8 Construction

In contrast, there appears to be no impact on construction companies, even though construction companies also use heavy machinery. This is because much of this machinery is diesel powered with limited use if electrically powered machinery.

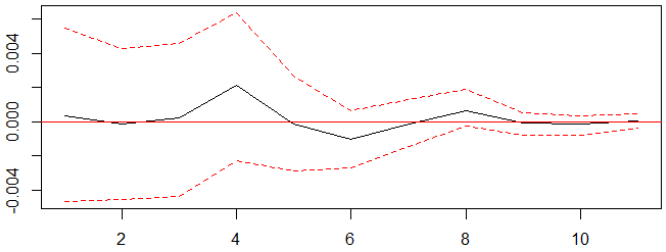


Figure 15: Orthogonal Impulse Response of Construction stock returns from Daily Energy Loss Shock

5 Policy Implications and Recommendations

For policymakers, it is important to identify the nature of the impact that load shedding is having on the industry or company being analysed. Depending on the dynamics there can be a positive or negative impact or no impact at all.

Further to this, it is also vital to distinguish between the direct impacts on operations from loss of power, and secondary impacts from financial indicators such at the exchange rate, bond yields and credit spreads.

Once these factors have been considered, one can then go further to assess the impact that one would expect to see on stock returns.

Where possible, all companies should install some form of backup power should they want to remain operational. Finding a cost effective off-the-grid solution is the most ideal. Failure to devise this will threaten the operational resilience of the business and this will be reflected in the share price. Small businesses are most at risk in this regard.

Blumsack and Ositelu (2015) noted that investors react differently to differences in blackout cause, size, and duration. This brief has also shown that investors also discriminate according to the impact that load shedding will have per company.

Table 2 (below) presents a summary of guidelines on the questions that policymakers should ask themselves when assessing the impact of load shedding on stock market returns for a particular industry.

Operational Impact	Bond Yield Impact	Exchange Rate Impact
• Does load shedding disrupt day-to-day operations? • Can you reasonably install backup power and remain profitable?	• Is the impact of increasing rates positive or negative for your business?	• How sensitive is your business to changing exchange rates?

Table 2: Energy Insecurity Impact Assessment Framework

Financial hedging tools can also be used to limit the impact of rising yields and weakening exchange rates.

5.1 Direct Impacts

Large companies with low energy use can protect themselves from load shedding; although backup power does contribute a significant cost, it is not a threat to direct operations. Media reports tend to over emphasise the impact of load shedding across the economy. However, as a direct measure, analysis should weigh appropriately the impact of load shedding on companies with relatively light electricity consumption versus those with high consumption.

Risks to direct operations range from very limited risk to significant risk across the indices.

5.2 Indirect Impacts

Financial firms, exporters and highly leveraged companies with limited energy usage will feel the impact of load shedding mostly from second-round indirect effects on the exchange rate, and interest rates.

A sustained increase in bond yield will have a negative impact on all listed stocks, as it would necessitate a higher discount rate to be applied to stock valuations in general.

6 Limitations

It must be noted that the increased levels of load shedding coincided with a period of heightened inflation. The impact of inflation was not considered in the above analysis. Accordingly, this is a field of further analysis that can broaden our understanding of the impacts of energy insecurity on stock market returns.

South Africa is a developing economy that still faces many other political and economic challenges, many of which were not explored in this brief. However, they still have a significant impact on stock market returns.

7 Conclusion

This study underscores the importance of assessing the specific impacts of energy insecurity on different industries, considering factors such as operational disruption, financial indicators, and market sensitivity. It also highlights the need for businesses to invest in backup power solutions and to use financial hedging tools to mitigate the risks associated with energy insecurity.

Ultimately, addressing energy insecurity is crucial for South Africa's economic stability and growth. Policymakers, investors, and stakeholders must collaborate to develop strategies that safeguard businesses and maintain market confidence in the face of these energy challenges. By doing so, South Africa can work towards greater energy resilience and a more robust stock market environment.

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