A Report: Sierra Leone Economic Data Analytics Tool

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Directorate of Science, Technology, and Innovation

in collaboration with

Statistics Sierra Leone, Bank of Sierra Leone, and Ministry of Finance

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DIRECTORATE OF SCIENCE
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Foreword

The vision for Sierra Leone in the New Direction is a united, progressive, dynamic, and happy nation where citizens have unlimited access to jobs, food, education, and health services; and where there is equal justice and equal opportunity for all, on track to becoming a Middle Income Country by 2039. A vital building block to achieving this level of inclusive and sustainable development is the economy- both macro and micro.

His Excellency, President Julius Maada Bio on assumption of office in 2018 separated the Ministry of Finance and Economic Development into the Ministry of Finance and the Ministry of Planning and Economic Development. Both ministries collaborated actively in the development of the National Medium Term Development Plan titled "Education for Development". The President also established the Directorate of Science, Technology, and Innovation (DSTI) to use science, technology, and innovation to support the Government of Sierra Leone to deliver on this plan. In line with this mandate, my Ministry and other Ministries, Department, and Agencies (MDAs) across Government have been collaborating with DSTI on several projects to enhance public service delivery. One such project is the web-based Sierra Leone Economic Data Analytics Tool (SLEDAT).

Since I was appointed Minister of Finance, my mantra has been evidence-based policymaking. I led the unbundling of the erstwhile Economic Policy Research Unit into the Macro-Fiscal Division and the Research and Delivery Division. Both divisions are collaborating with strategic partners, including DSTI, to generate evidence for policy making, especially within the economic management space.

The Sierra Leone Economic Data Analytics Tool (SLEDAT) hosts time series data on inflation, foreign exchange, imports, and exports from the last ten years. It enables users to convert currencies, carry out simple visualisations, and analyse trends amongst these variables. While the tool does not provide explanations for the drivers of the 'dips' and 'peaks', it provides the data and visualisations that one would need to initiate deeper thinking and engagement with partners, especially the Ministry of Finance, the Bank of Sierra Leone, Statistics Sierra Leone and the private sector. In essence, DSTI has developed a tool that would support decision-making and drive economic research work. We will continue working together to expand the scope of variables used in this tool and further develop additional economic tools to be used by the Government and its partners.

The New Direction administration believes in and is committed to the reforms we have initiated. The use of evidence, data, science and technology is at the centre of our reform agenda and we welcome the Sierra Leone Economic Data Analytics Tool. Use it, share feedback and ask questions.

Jacob Jusu Saffa, Minister of Finance

Introduction and Executive Summary

In His Excellency President Bio's first State Opening of Parliament Address in May 2018, he announced the establishment of the Directorate of Science, Technology and Innovation. In that same address, he discussed the economic challenges of Sierra Leone. Over the following year (2018-2019), the economy of Sierra Leone was hampered by growing inflation, rising foreign exchange rates, and increases in prices for basic commodities.

Since its official establishment in October 2018, the Directorate of Science, Technology, and Innovation (DSTI) has collaborated across the government in pursuit of its goal to primarily support the Government of Sierra Leone (GoSL) deliver on its National Development Plan. One of the central pillars of DSTI is 'Data for Decision-making' to enable real-time decision support for public officials through state-of-the-art analytical methods and visualisation. As such, through discussions with senior leaders of the Government, scientists at DSTI received data from various government agencies to develop forecasting models and proper visualisation platforms to analyse national economic data.

The Sierra Leone Economic Data Analytics Tool (SLEDAT) is a web tool designed and developed by DSTI in collaboration with others for learning and exploring using actual economic data from Sierra Leone over a ten year period. The ten-year period 2008 - 2019 was used for two reasons: (i) Consistency and availability of data across several domains; and (ii) Ten years provided enough historical records to train and develop models for forecasting while still staying relevant to our present-day economy. The datasets used are owned wholly by our collaborating entities of government. DSTI either downloaded the data from institutional websites or received it directly from them.

1. **Consumer Price Index**: The consumer price index (CPI) is calculated, maintained, and disseminated by Statistics Sierra Leone. CPI in Sierra Leone measures several different price baskets including, "health", "education", "transportation", and "clothing and footwear".
2. **Import and Export Values**: The import and export values represent the major materials and items that drive the economy of Sierra Leone. From gems and minerals to chemicals and machinery; rice and cocoa to fuel and vegetable oil, the Bank of Sierra Leone and Ministry of Finance maintain the records and values of these items in the economy.
3. **Foreign Exchange**: United States Dollars (USD), Euros and British Pounds are the main foreign currencies traded in the Sierra Leone foreign exchange market. The daily "buy"/"sell" rates are provided and maintained by the Bank of Sierra Leone.

While there are several other macroeconomic variables and data items that can be added to get a more detailed sector-specific analysis for broader understanding of the economy, these four variables - CPI, Forex, Import, and Export, over a ten-year period are able to provide citizens, experts, researchers, investors and policy-makers the fundamental analyses and visualisations to support decision-making and research work. Our models and visualisations have been built so that even non-expert citizens can better understand the economy for increased accountability.

While the tool is for learning and exploring, in this report, we highlight the major features of SLEDAT; the key findings and results; and present questions to the community for further research. We believe that if citizens are provided with analytical tools in a simplified way, they will be able to use them to engage with their leaders for better national development. This belief inspired our pursuit of a user-centred design approach in the development of SLEDAT. We engaged with senior government officials, development partners and staff at the Ministry of Finance to understand how these data can be used. We further incorporated design and other suggestions from academics and citizens. Some use cases that we have identified for the categories of Researchers, Policy Makers and Citizens are as follows:

Researchers: can download the datasets to evaluate the forecasting models used on the tool (we utilized an ARIMA model) or develop their own models. The images and charts are all exportable, making it easy to write reports and ask more questions.

Policymakers: can explore trends for imports and exports and study the broader effects of socio-political and environmental factors on unique items in the economy.

Citizen: can get the daily forex values as provided by the Bank of Sierra Leone and complete conversions in real-time; and study forex and other economic data trends for engaging in public discourse.

This first version of SLEDAT is designed and hosted by DSTI but future versions may have different owners. For further inquiries (including submission of new datasets), please contact us at the Office of the President, State House, Tower Hill, Freetown, Sierra Leone, or by email to **edat@dsti.gov.sl**

We thank you for your feedback.

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Yakama Manty Jones (PhD)- Director, Research and Delivery Division, Ministry of Finance
Moinina David Sengeh (PhD)- Chief Innovation Officer, DSTI

Chapter 1: Highlights of the Economic Data Analytics Tool

The SLEDAT is a webtool optimised for varying devices including laptops, notebooks and smartphones. The data covers the periods between 2008 and 2019. Each section has available data for download.

From the **Home** page, there is a quick real-time currency converter for the main foreign currencies used in Sierra Leone (US Dollars, Euros, British Pounds). The rates are accessed in real-time from the website of the Bank of Sierra Leone. From the **Home** page, a user can see further summary descriptions of the 5 major components of the platform which individually exist as tabs described below.

Summary:
The **Summary** page is used to explore and compare aggregate data for inflation, import, export and forex values. The dataset is broken into individual components to allow a researcher to study specific export materials for example, against certain import materials.

Foreign Exchange:
The **Foreign Exchange** page has a dedicated section for converting various foreign currencies to Leones and a real-time list of the Buying/Selling rates from the Bank of Sierra Leone. This page also contains a trained [ARIMA](#) model using the previous month's data for forecasting USD exchange rates. This model was used to forecast and compare the previous six (6) month values to the reported Bank of Sierra Leone values. The USD exchange rates can also be longitudinally studied across any two periods of time between 2008 and 2019. Year-on-Year comparisons are possible and charts for calculated seasonality are presented.

Consumer Price Index:
The **Consumer Price Index Page** contains CPI price baskets. This page also contains a trained ARIMA model which uses the previous month's data for forecasting the CPI 'all items' basket. The CPI variables can also be longitudinally studied across any two periods of time between 2008 and 2019. Year-on-Year comparisons are possible, and charts for calculated seasonality are presented.

Export:

The Export values can be longitudinally studied across any two periods of time between 2008 and 2019. Year-on-Year comparisons are also possible and charts for calculated seasonality are presented.

Import:

The Import values can also be longitudinally studied across any two periods of time between 2008 and 2019. Year-on-Year comparisons are possible and charts for calculated seasonality are presented.

Dataset Download:

For each dataset available for download, some information is requested to understand how the tool is used. This data will inform how updates and optimisations are done in the future. Users are asked to provide their Full Name, Profession, Country, Email and Reason(s) for downloading the data. Only Profession and Email are required fields for the downloads.

Chapter 2: Key Findings, Discussions, and Research Questions

The understanding of complex datasets varies across domains. As data scientists, we focus on abstracting correlations, developing models to forecast or predict certain features and visualising those results. The datasets presented here are specific to the economy of Sierra Leone. The objectives are to format, analyse and present varying forms of the data to allow people with deeper domain knowledge to ask more intriguing questions and to pique the interests of novices to ask new and more questions.

A Tale of Metals and a Virus: A nation's economic strength as represented by the Gross Domestic Product (GDP)is impacted by export and import values over a given period. Sierra Leone's exports are largely minerals and gems. Between 2008 and 2012, the maximum monthly export values did not reach 20 million USD for any items, with the highest being Gems and Diamond exports (Fig 1.).
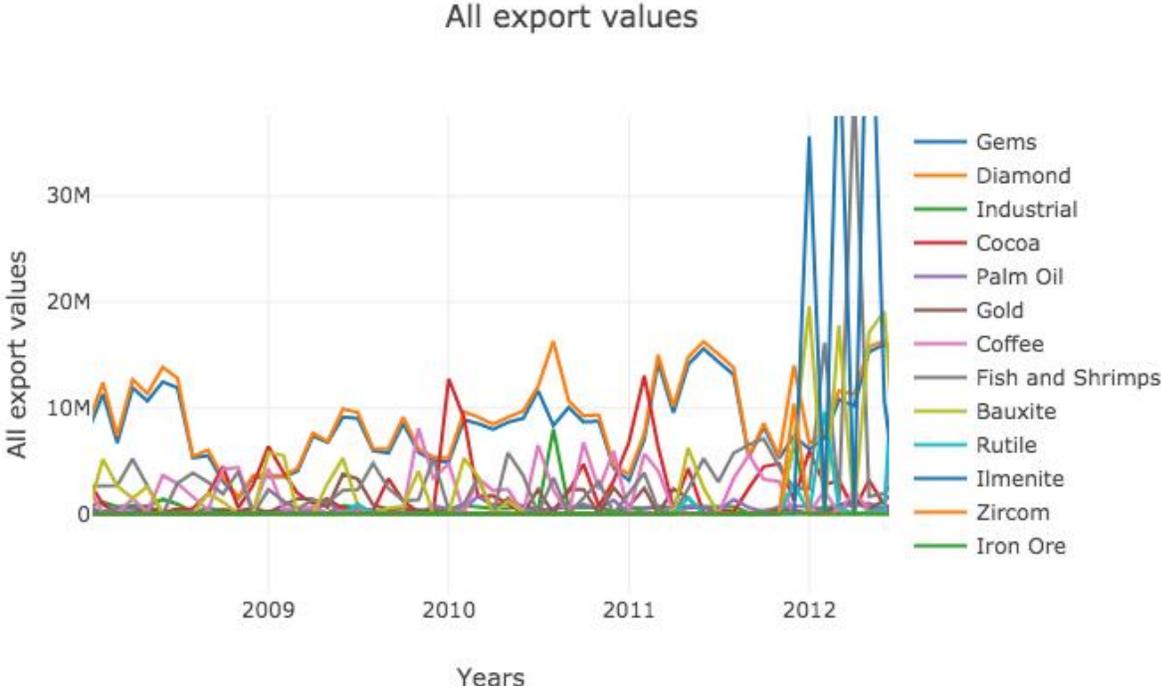

Fig 1. Monthly export values between 2008 and 2012

Sierra Leone started mining and exporting Bauxite, revamped its Rutile and other Gems mining and periodically exported over 100 million USD between 2013 and February 2014 (Fig 2.). However, these numbers were halved and ultimately reduced by 90% after July 2014 when the Ebola disaster was at its peak. Coupled with global price fluctuations in iron ore, since 2015, the maximum monthly export values have not increased beyond or exceeded 20 million USD (Fig 3.).
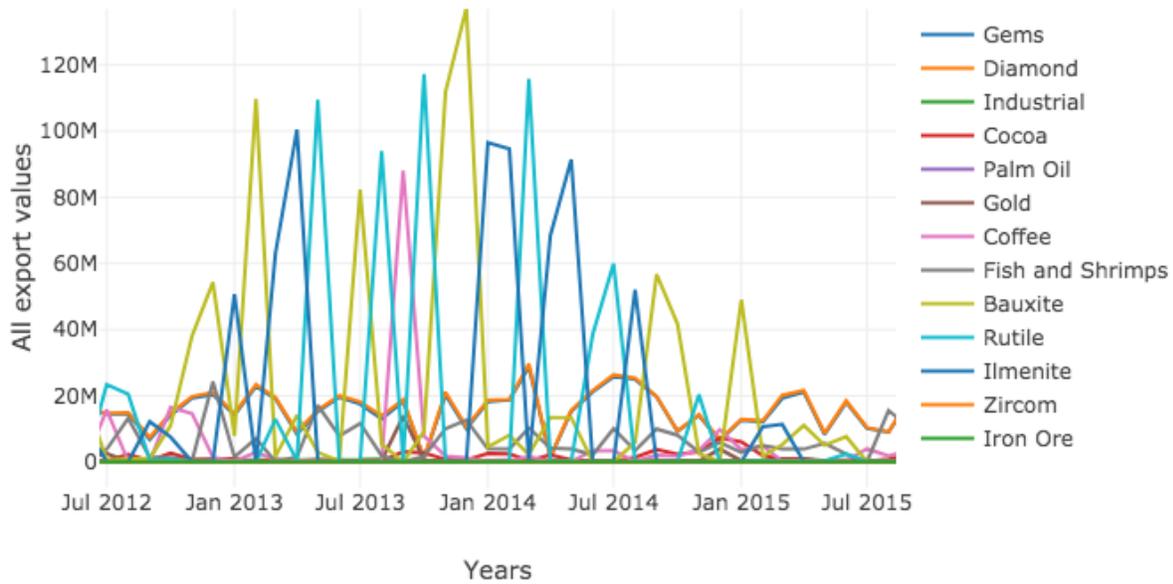
Fig 2: Export values between 2012 and 2015 from Bank of Sierra Leone

The Sierra Leone economy is heavily reliant on the mining sector yet, the broader macroeconomic conditions are volatile. This vulnerability means the economy is at the whims of global mineral prices and any unforeseen occurrences that might result in a slowdown in mining activities.

Leading up to and in support of the Bauxite boom in Sierra Leone, the importation of 'Machinery and Transport' equipment increased to record levels hitting over 190 million USD in November 2011 (Fig 4.). During the same period, imports of 'Food and Rice' peaked in the middle of the Ebola crisis as food shortages were felt in the country.
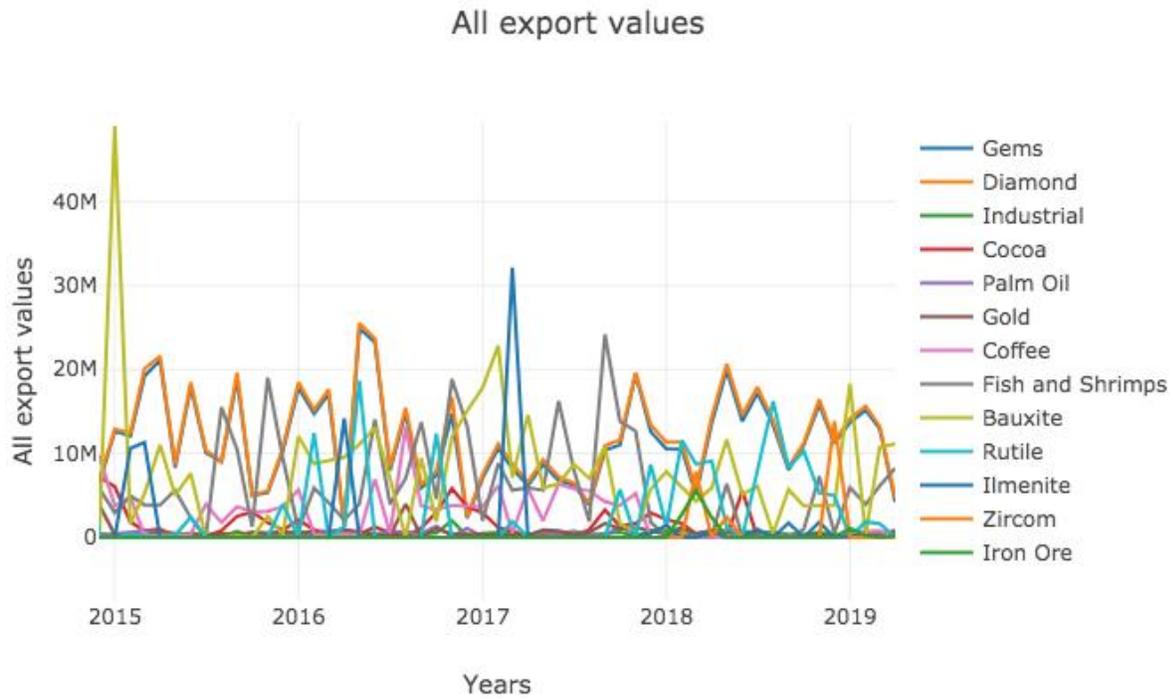
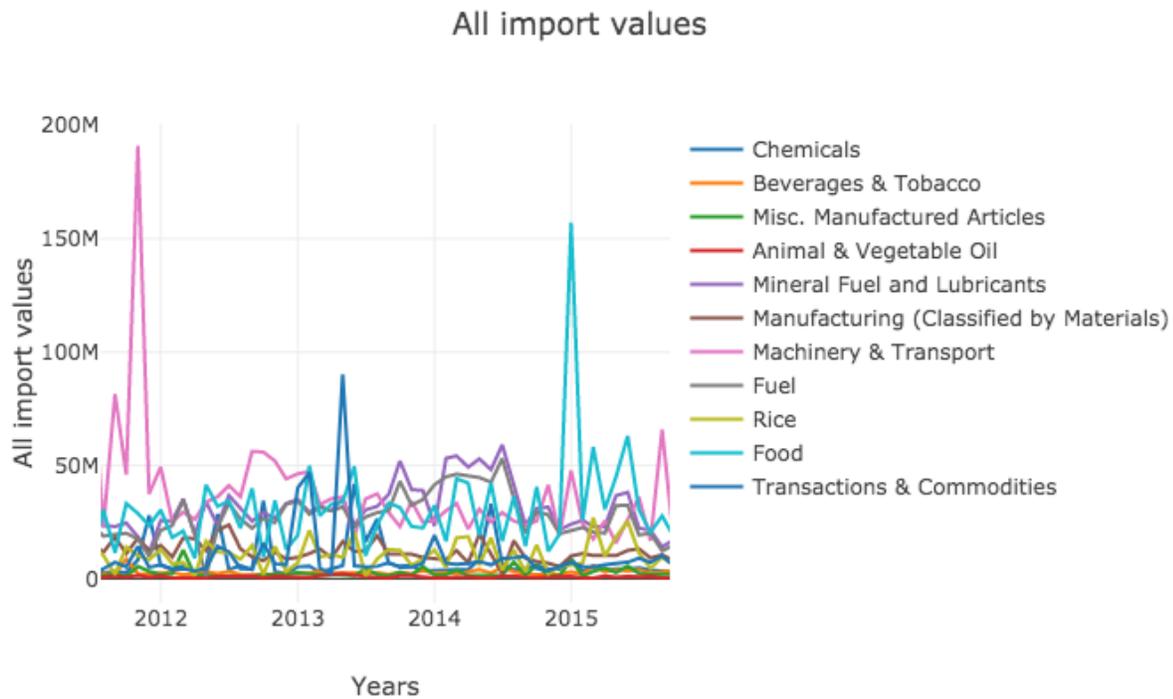Fig 3: Export values between 2015 and 2019 from Bank of Sierra Leone

Fig 4: Import values between 2012 and 2015 from Bank of Sierra Leone

Increasing Price and Cost of Economic and Policy Reform: Initial analysis shows that the economy is being affected by the economic policies of the New Direction Government especially as they relate to the productive sectors.

The maximum export values of non-mineral items are about one-fifth of related minerals of which 'Fish and Crustaceans' have slowly increased since 2009. There was about a one-fifth drop in non-mineral related exports between 2017 and 2018 (Fig 5.). The export of 'Fish and Crustaceans' dropped from over 100 million USD in 2017 to under 20 million in 2018 and continued to decrease through 2019. A first-ever fishing ban and series of policy reviews, contract licenses, and monitoring strategies affected exports.
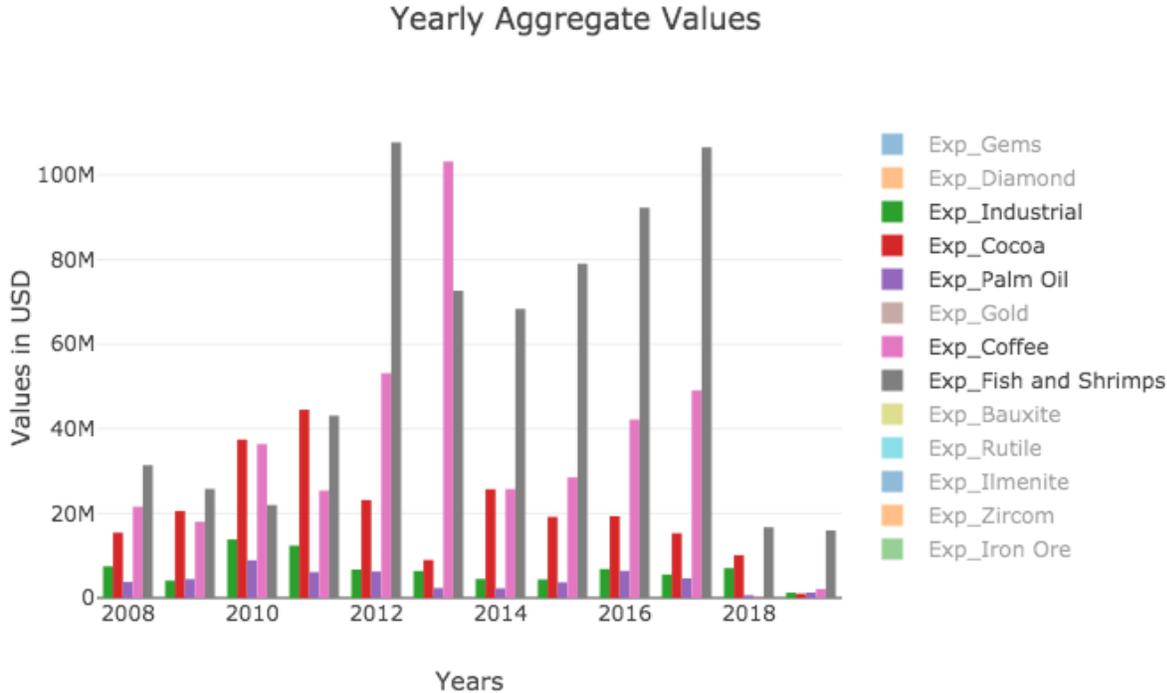

Fig 5: Yearly aggregate export values for non-mining commodities (2008-2019)

The mineral sector is the primary export sector in Sierra Leone. Export values of Bauxite and Iron Ore slowly increased from 2008 and then more than doubled between 2012 and 2013 boosting the economy (Fig 6.). However, that period was short-lived as drastic declines followed between 2014-2017. The export values of Gems and Diamonds have remained relatively consistent across time indicating that there is little innovation and creativity in the industry.

While projections in 2019 show potential for growth, the output might remain low due to the ongoing reforms within the sector being implemented by the Government. These reforms include a nation-wide geophysical survey; an audit and review of all mining licenses; and proper monitoring of all mining activities across the country.
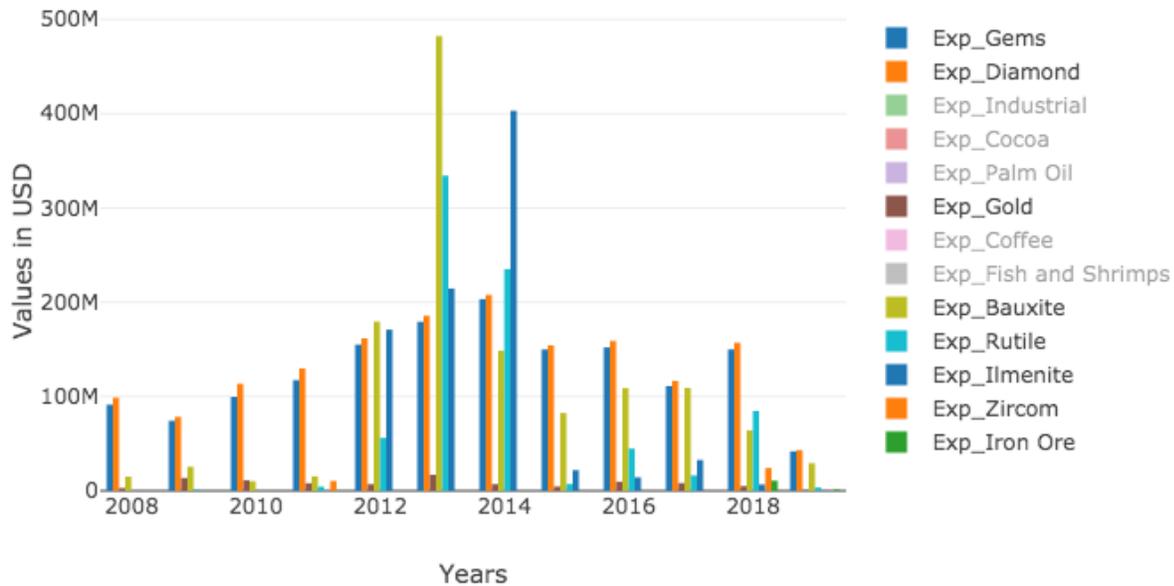
Fig 6: Yearly aggregate export values for the mining sector

Originally, 2017 was supposed to be an election year in Sierra Leone. Hence, all baskets of commodities measured had a sharp increase in November 2016 (Fig 7.).
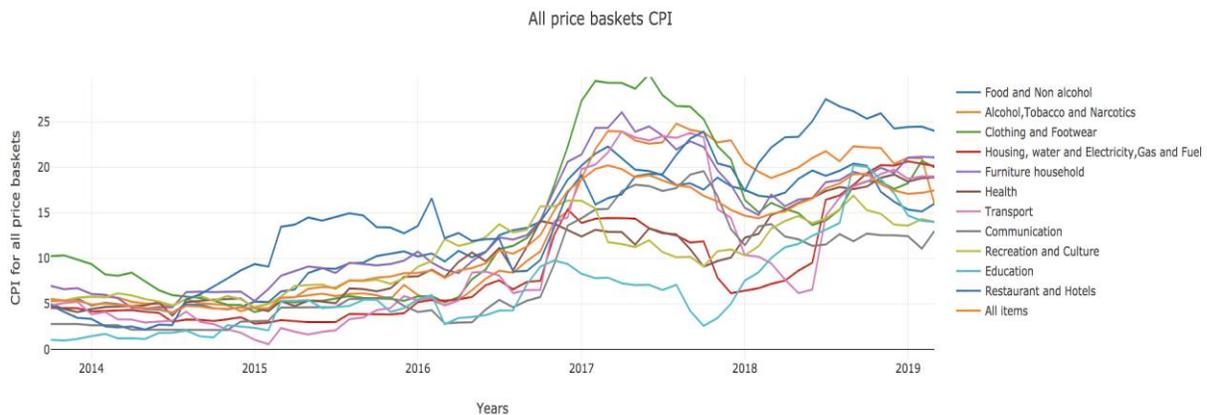

Fig 7: Consumer Price Index (2008-2018) show sharp price increases in mid-2016

While basket prices have since decreased and remained flat, they have generally remained above the levels prior to 2016.

Innovative fiscal and economic policy needed to slow down forex: Foreign exchange rates in Sierra Leone are an enigma to many citizens and researchers. To the professionals and development partners, there is no consensus on the factors that determine local exchange rates. The data reveals a sharp increase in the Leone-US Dollar exchange rate after 2015 and this trend continues to persist. However, it must be noted that the 2019 depreciation of the Leone against major currencies, especially the US Dollar is lower than that of other West African states outside the CFA zone.

For a period of two years (between 2012 and 2014), the foreign exchange rates remained stable. This stabilisation was also reflected in the CPI trends which stayed flat in this period right through the end of 2014 (Fig 8.). Nonetheless, the Leone-US Dollar exchange rate accelerated after 2014. This could be attributed to several factors: global iron ore bubble burst, Ebola virus outbreak in Sierra Leone, a weak and undiversified economy, etc. Even within this period, there were steeper increases between 2016 and 2017.
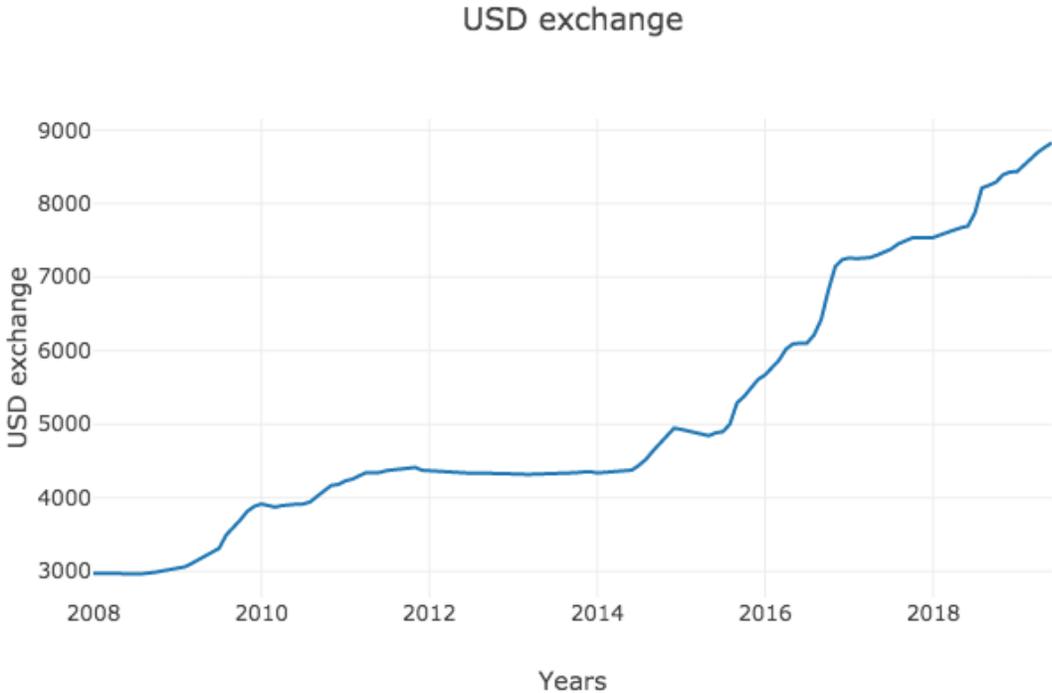

Fig 8: USD exchange rates between 2008 and 2019 increased 3-fold

The underlying economic variables and attributes that drive the macroeconomy in Sierra Leone have not changed in over a decade. Sierra Leone is an import economy that exports unprocessed and unrefined natural products (minerals and gems; fish and shrimp; coffee, etc). While the Government is pursuing fiscal consolidation and domestic revenue-enhancing policies, there is an immediate need to diversify the economy on a foundation of robust value addition to our exports; targeted investments and interventions on the

local cultivation of the key commodities that we import (rice and other foodstuff, like onions); and implement new, bold policies to deepen the financial sector.

Research questions: The SLEDAT does not have answers by itself. Nor does it have all the data needed to ask refined questions. However, it does present a unique opportunity for policymakers and researchers to ask new questions and delve into old ones. We developed a model to forecast monthly US dollar exchange rates using data from Bank of Sierra Leone (Fig 10.) and we hope that others can develop many more models to share with the community.
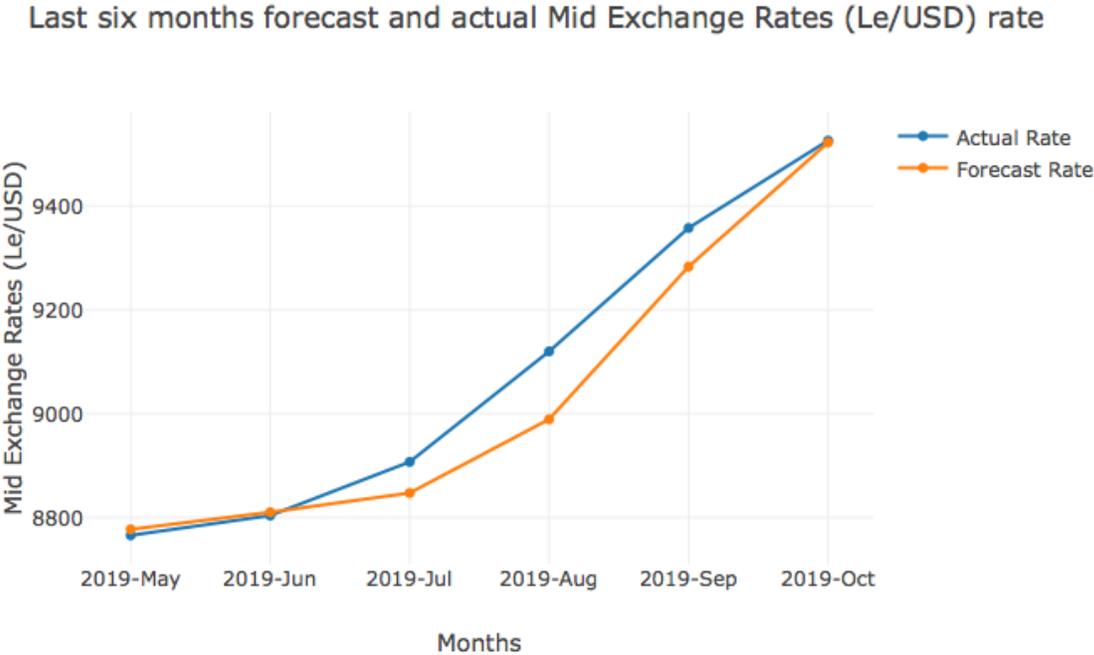

Fig 10: USD forecast vs actual rates from Bank of Sierra Leone

- What are the relational functions that define and link CPI, forex, imports and exports?
- How significant is the impact of other socio-cultural and socio-political events on the economy?
- What can we do as a government, citizens, the private sector and development partners to bootstrap and develop foundational support for the economy?

Chapter 3: Conclusion and Acknowledgments

Conclusion

This report is not a comprehensive economic analysis for Sierra Leone. It is written by data scientists who have access to a snapshot of economic data. It is a report on the Sierra Leone Economic Data Analytics Tool than it is a report on the economy. However, the lessons and questions asked here are real and reflective of the data shared by our partners. We presented the features and capabilities of the tool and highlighted initial key observations and research questions as a start to the conversation and not a conclusive end. One of the DSTI pillars is data to support decision making across all levels and we hope this tool can contribute to the debates on the economy of Sierra Leone.

Acknowledgements

In no particular order, we would like to thank the following institutions and their teams for their timely feedback, data sharing, and suggestions that went into the design of this tool.

- Statistics Sierra Leone
- Bank of Sierra Leone
- Research and Delivery Division, Ministry of Finance
- Banti Gheneti
- Office of the President

This project is important to the Directorate of Science, Technology, and Innovation because it demonstrates beautifully the power of data. With data, one can probe and ask deeper questions. With data, one can see correlations that may not be obvious in the abstract. With data, one can make a hypothesis that might just change the nation. We would like to thank everyone, especially citizens of Sierra Leone who will use this tool in multiple ways, because it is ultimately for them that it was built.

Sincerely,
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