International Journal of Advanced Engineering and Management Research

Vol. 10, No. 06; 2025

ISSN: 2456-3676

Automated Visualisation of Time Series Components of Singapore's Gross Domestic Product (GDP) and Forecast Rheostat Using Innovative Breed Technique.

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doi.org/10.51505/ijaemr.2025.1502 URL: http://dx.doi.org/10.51505/ijaemr.2025.1502

Received: Sep 17, 2025 Accepted: Oct 02, 2025 Online Published: Nov 07, 2025

Abstract

Singapore is one of the country in the world that is self-dependent and don't often go into taken loan from world bank or other countries, to know the reason and why Singapore economy is stable is uncovered in this study. This study studied examine the trend of Singapore financial strength growth known as growth domestic product GDP. This study examined the phenomenon, Structural change in the gross domestic product of Singapore and give recommendation. Singapore Gross Domestic Product (GDP) data was obtained from the data stream of National University Singapore e-library. In the methodology, Innovative Breed Technique (IBT) also known as BFTSC (Break for time series components) was used to examine the structural change, time series components present in the data (Singapore GDP) using software. BFTSC was created to capture the trend, seasonal, cyclical and irregular components as a combined image and to present them in a single plot. The result obtained, model acquired from the components (pattern) extracted using BFTSC was subsequently process for forecasting purposes and recommendation follows.

Keywords: Gross Domestic Product, break for Time Series Components, Forecast, Control, Trend change.

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1. Introduction

Singapore is an Asian country with one of the most stable economy in the world. The economy of Singapore is a highly developed mixed market economy with special characteristics. Singapore's economy has been consistently ranked as the most open in the world, the joint 4th-least corrupt, and the most pro-business. Singapore has low tax-rates and the highest per-capita GDP in the world in terms of purchasing power parity (PPP). The Asia-Pacific Economic Cooperation (APEC) is headquartered in Singapore(World Bank, 2020: World Economic Outlook 2024:Wikipedia, 2023).

Singapore's State percent of GDP The public sector is used both as an investor and as a catalyst for economic development and innovation. The government of Singapore has two sovereign wealth funds, Temasek Holdings and GIC Private Limited, which are used to manage the country's reserves. Initially the state's role was oriented more toward managing industries for economic development, but in recent decades the objectives of Singapore's sovereign wealth funds have shifted to a commercial basis (CIA World Fact Book history, 2019, p1019)

Government-linked corporations play a substantial role in Singapore's domestic economy. As of November 2011, the top six Singapore-listed GLCs accounted for about 17 percent of total capitalization of the Singapore Exchange (SGX). These fully and partially state-owned enterprises operate on a commercial basis and are granted no competitive advantage over privately owned enterprises. State ownership is prominent in strategic sectors of the economy, including telecommunications, media, public transportation, defence, port, airport operations as well as banking, shipping, airline, infrastructure and real estate (World Bank, 2020: World Economic Outlook 2024:Wikipedia, 2023).

As of 2014, Temasek holds S$69 billion of assets in Singapore, accounting for 7% of the total capitalization of Singapore-listed companies. In 2017, GSK shifted its Asian Headquarters to Singapore (39.40). All figures in billions of Singapore dollars. To maintain its competitive position despite rising wages, the government seeks to promote higher value-added activities in the manufacturing and services sectors. It also has opened, or is in the process of opening, the financial services, telecommunications, and power generation and retailing sectors up to foreign service providers and greater competition. The government has also attempted some measures including wage restraint measures and release of unused buildings in an effort to control rising commercial rents with the view to lowering the cost of doing business in Singapore when central business district office rents tripled in 2006 (World Bank, 2020: World Economic Outlook 2024:Wikipedia, 2023). Singapore is considered a global financial hub by many leading financial analysts, economists and politicians, with Singapore banks offering world-class corporate bank account facilities. In the 2020 Global Financial Centers Index, Singapore was ranked as having the sixth most competitive financial sector in the world, and the fourth most competitive in Asia. These include multiple currencies, internet banking, telephone banking, checking accounts, savings accounts, debit and credit cards, fixed term deposits and wealth management services(CIA World Fact Book history, 2019, p1019)

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Singapore has also attracted assets formerly held in Swiss banks for several reasons, including new taxes imposed on Swiss accounts and a weakening of Swiss bank secrecy. Credit Suisse, the second largest Swiss bank, moved its head of international private banking to Singapore in 2005. For this, the country has also been dubbed the "Switzerland of Asia". Singapore has been aggressively developing its biotechnology industry. Hundred of millions of dollars were invested into the sector to build up infrastructure, fund research and development and to recruit top international scientists to Singapore. Leading drug makers, such as GlaxoSmithKline (GSK), Pfizer and Merck & Co., have set up plants in Singapore. In 2006, GSK invested another S$300 million to build another plant to produce paediatric vaccines, its first such facility in Asia. Pharmaceuticals now account for more than 8% of the country's manufacturing production. In 2022, the biopharma industry of Singapore accounted for manufacturing output of USD 18 billion a year, a value that had tripled during two decades.[94]
Singapore is the pricing centre and leading oil trading hub in Asia. The oil industry makes up 5% of Singapore's GDP, with Singapore being one of the top three export refining centres in the world. In 2007, it exported 68.1 million tonnes of oil. The oil industry has led to the promotion of the chemical industry as well as oil and gas equipment manufacturing. Singapore has 70 per cent of the world market for both jack-up rigs and for the conversion of Floating Production Storage Offloading units. It has 20 per cent of the world market for ship repair, and in 2008 the marine and offshore industry employed almost 70,000 workers (CIA World Fact Book history, 2019, p.1019)

Singapore has limited potential for renewable energy mainly due to its small surface area; solar power holds the greatest potential. The government set a target of generating solar power to cover 350,000 households in 2030, that would equal to 4% of the country's electricity demand in 2020. As a financial hub, Singapore can play an important role in attracting investment in renewable energy in the entire ASEAN region (World Bank, 2020; World Economic Outlook 2024; Wikipedia, 2023).

Further information: Public housing in Singapore. The Singapore government also owns 90 per cent of the country's land, as well as housing in which 80 per cent of the population lives. In July 2022, a report by Savills revealed that Singapore tied with New York City in recording the highest rental growth rate for luxury homes globally. Further information: Tourism in Singapore. Tourism plays an important role in the economy of Singapore. Singapore ranks among the most (CIA World Fact Book history, 2019, p. 1019).

Time series is the series of observations taken chronologically in a sequence interval of time, which can be fixed or non-fixed (Roy & Barman, 2016). This time series data is studied for the purpose of forecasting through careful examination of the four components involved. Forecasting is the process of making a prediction of the future for planning and control of event. Forecasting used the information acquired in the past and considering the information obtained at the present period of time to predict the future value of the same type of event. Good forecast helps the society to cope with some future events of interest (Box, Jenkins, Reinsel & Ljung,

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2015). Expert recommends forecasting techniques to be a very essential tool for prediction in the society today because it leads to good planning, such as in the case of prediction of disease epidemic, weather, crime control and other future uncertainty in the society (Zeileis, Kleiber, Krämer, & Hornik 2003, 109-123).

According to Box & Jenkins (1976: Cleveland & Tiao, 1976, basically there are four components of time series, they are also referred to as variations. The first component is the trend. The second component is the seasonal component. The third component is the cyclical component. The fourth component is the irregular component. The most common one is trend because of its flexibility to be used for extrapolation and to study the direction of change (Jamali, Jönsson, Eklundh, Ardö, & Seaquist, 2015 p156: Porter & Zhang, 2018; Tolsheden, 2018; Maggi, 2018, pp. 1-29)

According to Jong, Verbesselt, Schaepman, & Bruin (2012, trend component (Tp) at the time period (p) is described as the direction of movements which represent the general activities of a given process. The trend also represents long run growth or decline over a given period. According to Rikus,2018, p.2285-2310, the trend can also be defined as an escalation, growth in a given direction. Trend is also referred to as a decay, degeneration on a stable remarkable manner. It is the tendencies for a series of data to change position in either positively and also decrease negatively in a comparatively steadily manner over a given period (p) Verbesselt, Zeileis, Hyndman, & Verbesselt, 2012, p106-115. Trend can occur in a mixture with other components like seasonal component and random variations (Zhu, Park, Isola, & Efros, 2017: Zewdie, Csaplovics & Inostroza, 2017, 167-178).

Seasonal component (Sp) at time p is also known as a seasonal variation which was also observed in time series data. It can appear in mixtures form with other components of the time series (Verbesselt, Hyndman, Newnham, & Culvenor, 2010,106-115). Bornhorst, Dobrescu, Fedelino, Gottschalk, & Nakata,2011 view seasonal variation as an identical pattern in time series which flow over a period of time in a regular manner. A seasonal variation is forms of fluctuations that occur on a regular bases which are recurring from season to season at the same and equal period of time and stage of intensity. According to DeVries, Pratihast, Verbesselt, Kooistra, de Bruin, & Herold, 2013) deseasonalizing is a necessity in some cases.

Cyclical component (Cp) at time p was observed as a periodic fluctuation around the trend components (Box, Jenkins, Reinsel & Ljung, 2015). The cyclic disturbance is common swing of a given sequence in an unpredictable period of time. It is the unbalanced and irregular changes observed in a sequence of data which is due to changes that occur in each series. Bohn, 1995; Cipra & Romera, 1997; Caiado, 2009; Cesta, Cortellessa, Pecora & Rasconi, 2005; Chen, 2006, stand to consider some relevant statistics which should give an index that mimics cyclical and also irregular components only. The cyclical period is generally more elongated than the seasonal period. Cyclical components are more obvious in yearly time series data but seasonal

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components are more obvious in monthly. If cyclical components are successfully determined, it is also necessary to estimate the irregular components to produce a reliable forecast (11).

The last components is the irregular components (I) which is considered as the sporadic movement of sequence of time series data Ewing, & Malik, 2013: Flicek, & Birney, 2009: Jain, Duin, & Mao, 2000 p108, It was also observed that irregular component (I) are any form of fluctuations which is not classify as one of the trends, seasonal and cyclical. Irregular component of the time series statistics is complex to define, so it is unpredictable. Assessment of irregular component is expected to occur only when the variance of the data is not large or else decomposition of the series may not be possible. Data with a large magnitude of deviation, the extrapolation for the future data will not be accurate due to the large deviations (Gorelick, Hancher, Dixon, Ilyushchenko, Thau, & Moore, 2017, p202).

Mok, Wu, Ahn, Garassino, Kim, Ramalingam & Lee (2017, observed that to determine the common irregular variation in a data level, the seasonal index must be calculated in a succession of irregular series. Theoretically, natural data always contains four components but the deseasonalized data would still contain irregular variation, cyclical variation and trend components.

The four-time series components (trend, seasonal, cyclical and irregular) are very important in univariate forecasting due to the model building in stage 1 . Stage 1 is models estimation which requires several forecasting techniques to be used on the same data set because forecasting The technique BFAST was for recognizing breaking points with the help of seasonal and trend decomposition using loess (STL), it facilitates the detection of trend change in a given information. The elementary standard of the BFAST technique is the splitting of time series into seasonal, trend and also remnants element by the approach for breaks detecting software in R Studio Core 2012 (10). BFAST trend breaks is the automated technique utilized in identifying the Singapore Gross Domestic Product (GDP).

2. Materials and Methods

BFAST is the technique used in analyzing the generality of time series data by extracting the trend and seasonal pattern during time series decomposition. Given the general time series additive model of the form of equation 1.2 (Ajare & Ismail, 2019, p

995; Ajare & Ismail, 2019, p. p1005: Ajare & Ismail, 2019, p2826)
From equation (1.2), BFAST takes all other components relatively trend and seasonal component to be randomized (R_p) and the equation was expressed as

$$Y_p = T_p + S_p + R_p \tag{1.2}$$

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The residual random consists of cyclical and irregular component.
To generate trend components using BFAST, we need a piecewise linear model approach. Suppose T_p is a piecewise linear model with an actual slope and intercept on q+1 segments broken with q breakpoints and P period; $p_1^{\mp}\ p_q^{\mp}$ then T_p can take the form as follows

$T_p = \alpha_k + \beta_k P$

where $p_{k-1}^{\mp} < p \leq p_k^{\mp}$

and If k = 1,…..,q then $p_0^{\mp} = 0$ and $p_{q+1}^{\mp} = n$.

The slope of the change before the breakpoints β_{k-1}, and the slope of the breaks after the change breakpoints are β_k. The intercept and the slop of the linear model $\alpha_k \beta_k$ and with time period p and it will be used to derive the magnitude and direction of change Mok, Wu, Ahn, Garassino, Kim, Ramalingam & Lee, 2017, p629-640.:Maus, Câmara, Appel, & Pebesma, 2017).

To generate seasonal components using BFAST, we need a simple harmonic model.
Thus, S_p can be represented by a simple harmonic model with j terms; j = 12….J and time t.

$$S_p = \sum_{j=1}^{J} \omega_{k,j} \ \mathrm{Sin}\left(\frac{2\pi jt}{F} + \sigma_{K,j} \right) \qquad (1.3)$$

where k = 1… q, $p_{k-1}^{\mp} < p \leq p_k^{\mp}$ and also $\omega_{k,j}$, $\sigma_{K,j}$ are the segment amplitude and F is the frequency (1,2,3).
To generate random components, any data that does not belong to trend nor seasonal is classified random R_p.

$$Y_p = \underbrace{\{\alpha_k + \beta_k P\}}_{T_p} + \underbrace{\left\{\sum_{j=1}^{J} \omega_{k,j} \ Sin\left(\frac{2\pi jt}{F} + \sigma_{K,j}\right)\right\}}_{S_p} + \underbrace{R_p}_{R_p} \qquad (1.4)$$

$$Y_p = T_p + S_p + R_p$$

The new technique called GFTSC considered splitting the random into cyclical components and irregular components which is an extension of BFAST. This was done through the inclusion of two new components.
To calculate cyclical components, center moving average is involved (Ajare & Adefabi, 2023; Ajare, Adefabi & Adeyemo, 2023).
Derivation of cyclical code, let CMA be the center moving average of t objects, then CMA can be computed as follow

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$$\text{CMA} = \sum_{t}^{n} \frac{Yt}{nt} \tag{1.5}$$

$$C_p = \frac{CMA}{\hat{CMA}} \tag{1.7}$$

After extracting the trend, seasonal and cyclical components, the left out components is called irregular components, the new equation becomes

$$Y_p = \underbrace{\{ \alpha_k + \beta_k P\}}_{} + \underbrace{\{ \sum_{j=1}^{J} \omega_{k,j} \quad Sin\,(\frac{2\pi jt}{F} + \sigma_{K,j} \,)\}}_{} + \underbrace{\{ \frac{CMA}{\hat{CMA}} \}}_{} + \underbrace{\{ I_p \}}_{} \tag{1.8}$$

$$Y_p = \quad T_p \qquad + \qquad S_p \qquad + \qquad C_p \quad + \quad I_p$$

For identification of Y_p , S_p , C_p , and I_p (See the papers: Ajare & Adefabi, 2023: Ajare, Adefabi & Adeyemo, 2023).

The first stage in forecasting is to view the data and to examine all the components of time series present in that data in order to select the most appropriate forecasting technique. The Singapore yearly quarterly GDP data components identification was carried out with the help of the new technique called BFTSC. This new technique helps to have a clear image of the entire variations presents in the time series data (Ajare & Ismail 2019, p995; Ajare & Ismail, 2019, p. p1005: Ajare & Ismail, 2019, p2826).

Manual identification approach of time series components is an approach that involves deep understanding on the behaviours of the data. The process of manual identification starts with plotting the data using time series plot (Abbes & Farah, 2017).

The second step is the investigation on the patterns of the time series plot linking to in-depth understanding of the data behaviours. The third step is relating the behaviours with the four time series components. Seasonal component is usually spotted in non-yearly data while trend, cyclical and irregular are more obvious in yearly data. Thus, transformation (non-yearly to yearly) is needed if we want to see clearly the patterns and understands the behaviours. The fourth step is the confirmation of time series components identification based on the behaviours. Using these four steps, the following are the process of manual identification approach conducted on Singapore GDP.

The free fitted value and the real data of the Singapore Gross Domestic Product (GDP). This reveal that for the next two years period, the Singapore Gross Domestic Product (GDP show no evidence of decline and the fitted value fit well and match intact to the original Singapore Gross Domestic Product (GDP) data so the model can be applied for prediction of more years GDP of Singapore. The empirical data is yearly data of Singapore Gross Domestic Product (GDP) from 1965 until 2024 which comprises of almost 60 years (59yrs).

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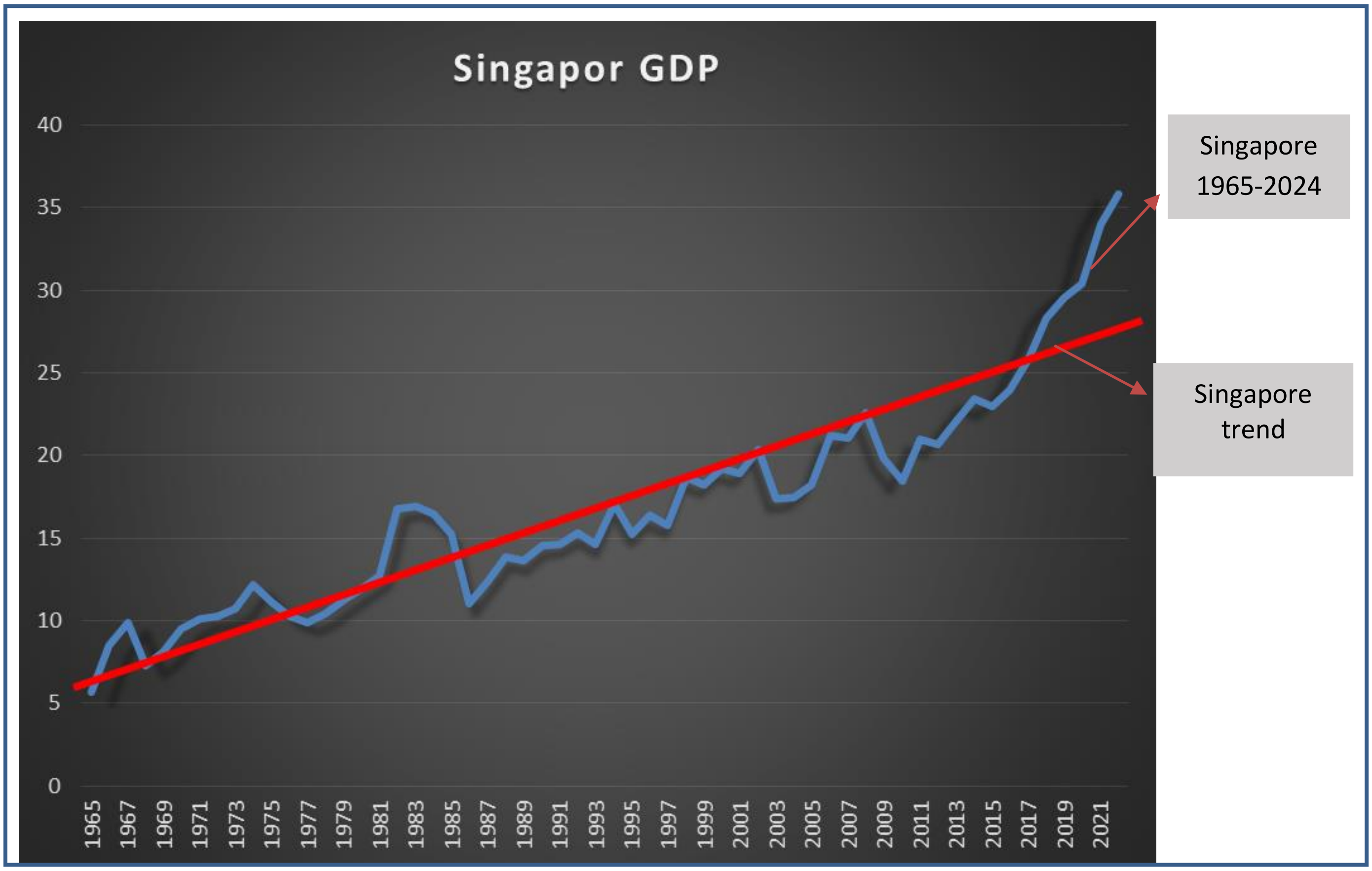

Figure 1. Original Manual Singapore Gross Domestic Product (GDP) plot.

Figure 1. Is the original manual Singapore Gross Domestic Product (GDP) plot. The Singapore GDP as the total value of finished goods and services produced in Singapore where it measures economic growth. If the GDP are increasing, then the economy is growing and vice versa. Four main sectors contributed to the GDP are services in Singapore, Singapore manufacturing, Singapore construction and tourism.

Figure 1. The free fitted value and the real data of the Singapore Gross Domestic Product (GDP). This reveal steady growth of GDP, such that for the next two years period, the Singapore Gross Domestic Product (GDP show no evidence of decline and the fitted value fit well and match intact to the original Singapore Gross Domestic Product (GDP) data so the model can be applied for prediction of more years GDP Singapore.

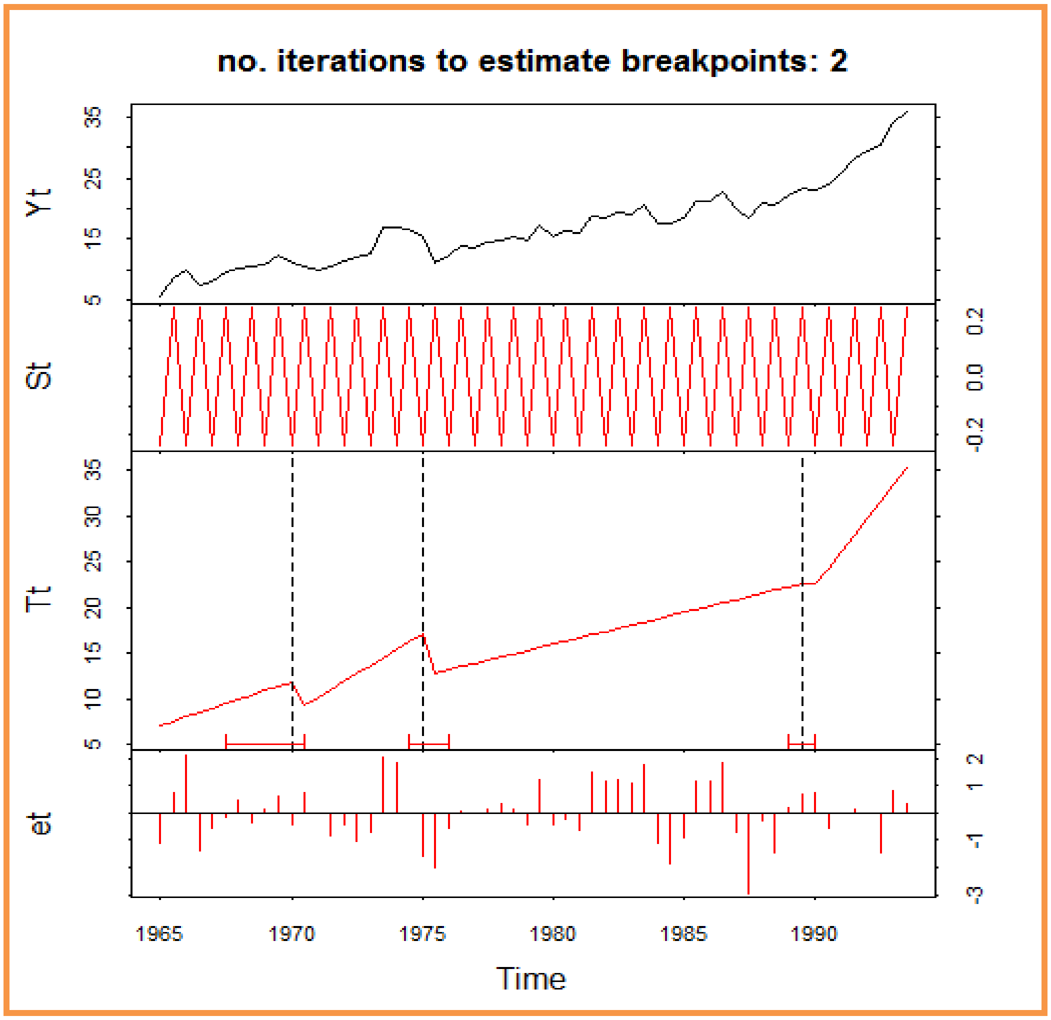

Figure 2. BFTSC for Singapore Gross Domestic Product (GDP).

Figure 2 shows the plots produced by BFTSC when identifying the time series components in Singapore Gross Domestic Product (GDP) data. BFTSC combined the time series components simultaneously for easy, straight forward and fast identification process. The first plot was the original plot of actual Singapore Gross Domestic Product (GDP) data; the second plot was showing the seasonal movement; the third plot are the linear trend; the fourth plot was the extraction of the left-over remnant. These findings were the same as manual identification approach as in previous section. Figure 4.2 presents the plots created by BFTSC in identifying the time series components based on Singapore data. The identification results obtained by BFTSC was perfect automated identification and this was done using the same theoretical derivation as detailed in Chapter 3.

3. Results

The observations from figure 1, figure 2, After automated visualization of time series components of Singapore's Gross Domestic Product (GDP) using Innovative Breed Technique known as Break for Time Series Components. Observation from Figure 4.1 shows that the Singapore's GDP keep growing but never drop due to the stable Singapore's economy over the years from 1965 upt0 2024. Figure 4.2 automated visualization of time series components of Singapore's Gross Domestic Product (GDP) using Innovative Breed Technique known as BFTSC (Break For Time Series Components) likewise shows that the Singapore's GDP keep growing due to the stable, there was only three breaks located in circles as C1, C2, and C3 and after the breaks the GDP rise speedily. This study agreed with Adams, Hayes 2024 who examined time series and analysis and forecasting using Singapore GDP, Singapore's economy over the years shows that the Singapore's GDP keep growing but never drop due to the stable Singapore's economy over the years Singapore economy is built on business friendly regulatory environment and strong investments in infrastructure, education, healthcare and public serviced, Singapore also have a deep base of corporate and growing of innovative start-ups (Adams, Hayes. 2024). This country had little or no foreign debt, consistently high government revenue and a positive surplus, this statement was the economic strength that drive policy effectiveness that assures business stability. Singapore is a small country yet wealthy and rich because of its strategic location which made it an ideal hub for international trade and commerce. The main export includes electronics, chemicals, and serviced. Singapore is the regional hub for wealth management. The service sectors contribute over 70% of GDP and employed 85% of active population (World Bank 2023). The country port is one of the most important in the world. Singapore had lowest tax rate and third highest per-capita GDP in the world in terms of purchasing power parity (PPP). Singapore is rank has the 1st easiest country in the world to do business**. Never the less** Singapore needs improvement can be establish to improve on the yearly Singapore GDP. The contribution of this study to the scientific community is that the BFAST gives good results that improve the weaknesses of the existing manual approach. BFAST forecast output is more reasonable for effective policy making. Note: The data, BFTSC and BFTSC can be made available based on request from the original author of this paper Dr Ajare Emmanuel. The data utilized in this study is available freely if the author is contacted. The BFTSC or GFTSC can be acquired with $10,000 from Dr Ajare Emmanuel. The forecast of Singapore GDP can likewise be acquired with $1000 per year per forecast. This forecast is very good for policy making and economic development.
(ajareoloruntoba@gmail.com and **ajare_emmanuel@ahsgs.uum.edu.my**).

4. Discussion

The technique was for recognizing Breaks for Additive Seasonal and Trend (BFAST). This technique helps to recognize trend breaks enclosed by the series. The essential guide of the BFAST technique is the decomposition of time series component into seasonal, trends and miscellany elements with the technique for recognizing structural similarity and difference. Ajare and Ismail 2019, Recommended that the technique of BFAST is for identifying topographical pattern and also for improvement to be applied in other related disciplines (Adewoye & Chapman, 2018: Box, Jenkins, Reinsel, & Ljung, 2015; Bai, & Perron, 2003).

(29,30) describe BFAST as not being capable of identifying topographical vegetation basic component perfectly, though satellite sensor image have made topographical vegetation data available for so many years but yet the detection of topographic trend and variation is not yet clearly defined. (Verbesselt, Hyndman, Newnham, & Culvenor, 2010, p106-115) Suggested that, this may be due to the limited number of available trend and change detection techniques accessible, algorithm suitable in identifying and characterizing abrupt changes without sacrificing accuracy and efficiency.

Based on previous studies, BFTSC can be utilized for any time series data but BFAST is used for topographical green forest picture data at certain specific time. Introducing BFAST to time series data and how to implement BFAST on time series data which contain only one variable for each time is another form of challenge. BFAST is a technique that take in data and processed to extract each component point of the data, it would be reasonable to use BFAST for time series components identifications . (Zdravevski, Lameski, Mingov, Kulakov & Gjorgjevikj, 2015, pp. 381-388: Zhao, Li, Mu, Wen, Rayburg, & Tian, 2015, pp. 1331-1343).

BFAST approach give a very considerable outcome and was recommend as a modern instrument for statistics information decomposition and detections but could not separate random noise and is a customized additive decomposition method, from all indication observed so far, it reveal that BFAST need to be extended for the purpose of coping with other varieties of uses (Verbesselt, Hyndman, Newnham, & Culvenor, 2010, p106-115).

Based on every result BFAST is extended to BFTSC and this was the best and most appropriate for linear time series components identification for this reason. BFTSC is recommended for public use. Note: This paper serve as forecasting guide and make it easier for anyone that want to forecast GDP or stock exchange or otherwise both the technique used and the forecast values can be acquired with little money to support the authors academic development.

5. Conclusion

Details about development of time series components identification is as follows. Pure manual approach period. (Verbesselt, Hyndman, Newnham, & Culvenor, 2010, p. p106-115) was one of the first researchers that struggle to clearly identify time series component using time plot. This first information in the form of data was plotted on a time plot using manual technique and the behavior of time series data was observed. However, the limitation of this technique was the complexity, it was very complicated to differentiate the time series components using casual manual time plot and the manual technique may be extremely difficult for non-experts.

Manual approach and automation period, developed DBEST (Detection Breakpoint and Estimating Segment Trend) which was modified from BFAST. DBEST take in (NDVI) normalizes difference vegetation index data. The limitation of DBEST technique is that, the algorithm was built to solve the problem of topographical vegetation trend identification and cannot identify cyclical and irregular components of time series statistics. It is not flexible time series component identification technique and this is still a problem that needs to be fully addressed.

Verbesselt, Hyndman, Newnham, & Culvenor, 2010, p106-115 argue and contributed to the body of knowledge by investigating the collective change identification called BFAST. The technique called BFAST is used for acknowledging breaks for additive seasonal and trend in order to justify for seasonal disorder and also enables the identification of breaks that take place in trend within the system. The technique is accessible in BFAST pack for R (R developments Core Team, 2012). Package 'bfast'which portrays the main scope of BFAST. Many scholars employ the use of BFAST in identifying trend in topographical data.

Ajare and Ismail, 2023. Describe BFAST as complicated in technique, this lead this study to seek out for transparency regarding BFAST. (24) Recommend a new technique for broad trend detection for image classification and representative, the technique is called Break for Additive Seasonal and Trend known as BFAST. This technique integrates the decomposition of time series components into the conventional elements of the series such as data, seasonal, trends and remnants, it was done with the help of the technique for identifying change which is embodied in the system of BFAST (Jong, Verbesselt, Schaepman, & Bruin, 2012).

Other techniques such as Break for Time Series Components and Group For Time Series Components were likewise created to capture components of time series clearly and forecast automatically (Ajare & Ismail, 2019).

6. Conclusion

The basic recommendation of this paper is that Singapore government need to improve on its economy, improve on local production, local processing and also increase in export or else the economy may suffer set back tremendously**.** After automated visualization of time series components of Singapore's Gross Domestic Product (GDP) using Innovative Breed Technique known as Break for Time Series Components. Observation shows that the Singapore's GDP keep growing but never drop due to the stable Singapore's economy over the years from 1965 to 2024. So on scientific evidence of drop in Singapore economy. automated visualization of time series components of Singapore's Gross Domestic Product (GDP) also shows that the Singapore's GDP keep growing due to the stable, there was only three breaks located in circles as C1, C2, and C3 and after the breaks the GDP rise speedily. Note: The data used for this paper can be gotten freely from the authors Dr Ajare Emmanuel (ajareoloruntoba@gmail.com) also the BFAST technique can be acquired from same author freely. But the forecast values can be acquired from the author likewise but not free, $1000/year forecast. If Singapore government can purchase the forecast data for 10 years it would be very beneficial and advantageous for domestic GPD growth **(**ajare_emmanuel@ahsgs.uum.edu.my)**.**

This paper serve as forecasting guide and it makes it easier for anyone that wants to venture into forecasting GDP or els otherwise both the technique used and the forecast values can be acquired per-year with a little money to support the author's academic development.

Note BFTSC and GFTSC is license to allow it to be incorporated into software pack but already in EZEE forecasting software. BFAST is already in R pack. As soon as it is in R then anyone can freely use it. Contact the author for BFAST, BFTSC, GFTSC and Angola gross domestic product data if you need it (ajareoloruntoba@gmail.com/ajare_emmanuel@ahsgs.uum.edu.my) Copies are also available at Universiti Utara Library (Section 546727 research bank 23).

7. Recommendation

Recommendation goes in line with Adams, Hayes 2024 who examined time series and analysis and forecasting using Singapore GDP (1) for Singapore's economy to keep growing then they must keep population below gross domestic product, population of Singapore should be maintained inline to resources, population should be proportional to GDP (i.e. as GDP increase in respect to population). (2) For Singapore economy to remain stable, Singapore must not go into war, nor allow insurgency or crises which can crash economic growth rate. (3) Singapore's must consistently be built on business friendly regulatory environment and strong investments in infrastructure (4) Singapore education must be consistently quality in both science and social science, (5) Going out of Singapore for healthcare is throwing away resources, so the country healthcare must be fantastic eg healthcare and public serviced, Singapore also have a deep base of corporate and growing of innovative start-ups. With all the above the country would be consistent in little or no-zero foreign debt, consistently high government revenue and a positive surplus, this statement was the economic strength that drive policy effectiveness that assures business stability. Singapore is a small country yet wealthy and rich because of its strategic location which made it an ideal hub for international trade and commerce. The main export includes electronics, chemicals, and serviced. Singapore is the regional hub for wealth management. The above recommendation should also be implemented in Nigeria by Nigerian government.

8. Future Research

This study is narrowed one of the smallest country in the world known as Singapore. The study is based on only Singapore GDP but in the near future it can be expanded to other stable countries such as Germany and Canada.

9. Limitations of the Study

Although BFAST, BFTSC and GFTSC is as good as manual approach in identifying the times series components embedded in data that exhibited a linear trend, but the manual approach has more ability to provide reasons (or explanations) behind the time series components values. Thus, users of BFTSC and GFTSC are advised to find these reasons when referring to the BFTSC and GFTSC automatic plots. This is to obtain deeper meaning of the time series

ISSN: 2456-3676

component values related to real world application (e.g., global warming or economic crisis etc.) which are very useful for the next several forecasting stages such as in selecting the appropriate forecasting techniques and also in justification of the forecast values accuracy if modification is needed due to cyclical reason if it is expected to happen in the near future. Other complex simulation conditions can be considered in evaluating BFTSC and GFTSC robustness.

10. Weakness and Future Research

The issue of how large is large and maximum sample size to be accepted by BFAST is yet to be addressed [28]. Likewise the issue of maximum sample size for Manual method of time series identification. BFAST are not being fully utilized addressed because it's a new automated time series identification technique and depends on the nature of individual research and interest. More automated and innovated time series components identifications is a welcome development. Model that can predict epidemic like flood, fire outbreak, earthquake etc should be encouraged. A special technique that can forecast irregular time series component automatically is a good and welcome innovation in forecasting field.

11. Authors' Contributions

Dr Ajare Emmanuel Oloruntoba: Analyzing,producing the results and writing the paper. Dr Adefabi Adekola & Wilson Simon Barguma: works on the contents and structuring, flow of the paper and type setting and Proof reading. Job Eunice Ohunene helps in preparing a suitable topic and finding solution to the problem of Angola GDP, Dr. Shobanke Dolapo Abidemi contributed immensely in the aspect of technical writing.

12. Ethics

This is the original manuscript prepared by three authors; there will be no expectation of any ethical problems after the publication. The three authors have read and approved the manuscript.

13. Acknowledgement

The authors thank the Universiti Utara Malaysia and National University Singapore for making library resources materials available for this study.

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