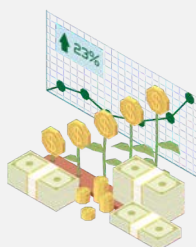




# Quarterly Gross Domestic Product Growth Rates

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## Introduction



Real Gross Domestic Product (GDP) is a key short-term macroeconomic indicator used to monitor and assess the current state of the economy. Quarterly changes, or growth rates [1], in real GDP provide a basis for assessing economic trends, gauging momentum, and anticipating turning points in an economy.

However, comparing quarterly changes is less straightforward than comparing annual changes for two main reasons. Firstly, different quarters within a year vary in the number of working days and are subject to seasonal patterns in production and consumption. Secondly, even the same quarter can differ from year to year due to calendar effects, such as leap years or moving holidays (e.g., Hari Raya Puasa). This article examines the strengths and limitations of three methods for measuring quarterly GDP growth rates and explains Singapore's rationale for selecting its primary measure.

## Measuring Quarterly GDP Growth Rates

National statistical agencies typically use one or more of these three methods to compute and present quarterly GDP growth rates. Each method has its strengths and limitations. The choice of method depends on the objective of the analysis.

1

**Year-on-Year Growth Rate**  
Compares a quarter with the same quarter in the previous year.

2

**Quarter-on-Quarter Seasonally-Adjusted Growth Rate**  
Compares a quarter with the preceding quarter, using seasonally adjusted data.

3

**Annualised Quarter-on-Quarter Growth Rate**  
Extrapolates the quarter-on-quarter growth rate to represent an annual rate.

## Year-on-Year Growth Rate

The year-on-year (y-o-y) growth rate measures the percentage change in real GDP compared to the same quarter in the previous year. It is also known as the non-seasonally adjusted (NSA) growth rate and is widely used in most European and Asian countries, including Singapore.

### Strengths

This method allows straightforward comparison with annual growth rates and implicitly accounts for seasonal effects. For example, the seasonally stronger fourth quarter (impacted by Christmas and year-end festivities) is compared to the same quarter in the previous year. Hence, this approach reflects underlying trends while capturing unexpected changes or deviations from typical seasonal patterns.

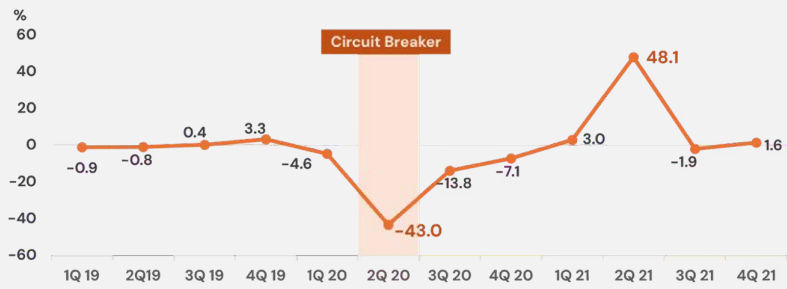
### Limitations

Y-o-y growth rates do not adjust for differences in the number of working days caused by calendar effects, such as leap years or moving holidays, as these variations can distort comparisons. For instance, growth may be stronger due to more working days, although the underlying economic trend is weakening.

[1] While this article focuses on quarterly growth rates, the principles and considerations discussed are equally applicable to other sub-annual growth measures, such as monthly growth rates.

**Chart 1: Real Value-Added of Food & Beverage Services, Year-on-Year Growth Rate**

This method is sensitive to base effects, in which a sharp contraction or expansion in a given quarter (often due to an unexpected shock) can result in a pronounced change in growth in the same quarter of the following year. This was observed in 2Q 2021, when the real value-added of Food & Beverage services surged 48.1%. The sharp increase reflected the low base in 2Q 2020, when the real value-added of the sector plunged 43.0% as dining-in was prohibited during the Circuit Breaker period to curb the spread of COVID-19 in Singapore (Chart 1).



Y-o-y growth rates tend to identify turning points in the economy more slowly than other methods. For instance, the real GDP of Singapore’s economy contracted by 3.9% on a y-o-y basis in 3Q 2020. However, the quarter-on-quarter (q-o-q) seasonally-adjusted (SA) change in real GDP was positive, indicating that growth momentum had already improved (Chart 2).

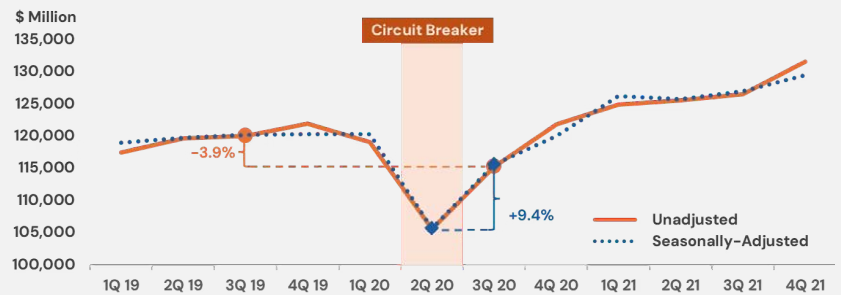
## Quarter-on-Quarter Seasonally-Adjusted Growth Rate

The q-o-q SA growth rate measures the change in real GDP compared to the preceding quarter, using SA data to remove regular seasonal effects. Without this adjustment, seasonal patterns can obscure true economic trends. This metric is computed and presented by many countries such as Australia and the United Kingdom as their primary measure. On the other hand, countries in the Asia region and Singapore present the q-o-q SA growth rate as supplementary information alongside the y-o-y growth rate.

### Strengths

Compared to the y-o-y growth rate, the q-o-q SA method has the key advantage of identifying turning points in the economic cycle earlier. For example, in 3Q 2020, real GDP expanded by 9.4% on a q-o-q basis, despite recording contraction on a y-o-y basis (Chart 2).

**Chart 2: Real GDP in Chained (2015) Dollars**



### Limitations

Q-o-q SA growth rates reflect changes over a three-month period and are therefore not directly comparable with annual growth rates. This shortcoming is addressed by the third method, which presents the q-o-q growth rate on an annualised basis.

## Quarter-on-Quarter Seasonally-Adjusted Annualised Growth Rate

The annualised q-on-q growth rate, also known as the seasonally adjusted annualised rate (SAAR), extrapolates the q-o-q growth rate over a full year. It is calculated using the formula:

$$a = (1 + r)^4 - 1$$

where:

- $a$  = annualised q-on-q growth rate
- $r$  = original q-on-q growth rate

This approach assumes the q-o-q growth rate in the current quarter continues at the same pace for the next three quarters. Countries such as the United States of America (USA) and Japan release annualised q-o-q growth rates.

### Strengths

By annualising the q-o-q growth rate, the SAAR retains the properties of the q-o-q SA growth rate while expressing growth on an annual basis. This facilitates easier comparison with the annual growth rate.

### Limitations

A key drawback of the SAAR is that it can amplify quarterly GDP changes when the q-o-q change in a given quarter is unusually large but unlikely to persist, as seen in 2Q 2020. By projecting the sharp contraction caused by the Circuit Breaker over the next three quarters, the SAAR magnified the decline based on the unrealistic assumption that such conditions would persist. As the SAAR is prone to misinterpretation, since 3Q 2020, Singapore has used the q-o-q SA growth rates instead of the q-o-q SAAR to supplement the y-o-y growth rate in GDP reporting.

## Selecting the Appropriate Method

The choice among these three quarterly growth measures depends on the analytical objective. Table 1 shows the primary measures used by various countries. Like Singapore, many countries use the y-o-y growth rates as their primary measure, supplementing information from q-o-q growth rates.

**Table 1: International Practice in GDP Reporting**

Primary Measure: Year-on-Year Growth Rates (Supplemented by Quarter-on-Quarter Seasonally-Adjusted Growth Rates)	Primary Measure: Quarter-on-Quarter Seasonally-Adjusted Growth Rates (Supplemented by Year-on-Year Growth Rates)
Hong Kong, China	Australia
Indonesia	Canada*
Malaysia	Germany
Philippines	Japan*
<b>Singapore*</b>	Korea
Thailand	Netherlands
	Switzerland
	United Kingdom
	United States of America**

Source: Websites of National Statistical Offices

\* Both SA growth rate and SAAR are published

\*\* Only SAAR is published

Economic statisticians generally agree that the y-o-y growth rate allows for objective and transparent international comparisons. In contrast, the q-o-q SA growth rate and SAAR are based on SA data, which can differ across countries depending on the methods used. These differences make direct comparisons more challenging. For example, some seasonal adjustments account for factors such as 'moving holidays' that affect the number of working days. However, without clear documentation, it is often unclear whether such adjustments have been made.

Another advantage of the y-o-y growth rate is that it tends to undergo fewer revisions than the other two methods. As more data points become available, estimates of seasonal factors may change substantially, leading to revisions in the SA series even if the underlying historical data was unchanged.

When the economy is growing steadily, the y-o-y growth rate generally provides a sufficient overview and less emphasis is placed on the q-o-q SA growth rate and SAAR. During periods of uncertainty or economic transition, the q-o-q SA growth rate and SAAR can be highly volatile, showing large fluctuations that may complicate the analysis of sequential growth. Nonetheless, these more sensitive measures can identify turning points in the economic cycle earlier, making them more relevant when the economy is at or nearing a turning point.

## Conclusion

There are three main methods for measuring quarterly growth rates. Among them, the y-o-y method is a suitable method for international comparisons due to its objectivity and transparency.

However, a key limitation of the y-o-y method is its ability to identify economic turning points more slowly. In contrast, the SA q-o-q growth rate and SAAR can identify turning points earlier, making it particularly useful when the economy is at or approaching a turning point.

Singapore uses the y-o-y growth rate as its primary measure, tapping into the q-o-q SA growth rate for supplementary information to better identify turning points in the economy.

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