Information Paper Series

Quarterly Estimates of Output-Based GDP

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QUARTERLY ESTIMATES OF OUTPUT-BASED GDP

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QUARTERLY ESTIMATES OF OUTPUT-BASED GDP

I Introduction

1 The Singapore Department of Statistics (DOS) compiles estimates of GDP using all three approaches, viz. output, expenditure, and income. Each of the three approaches views GDP from a different perspective. Taken together, these three approaches provide a more complete picture of an economy than any single approach could.

2 Annual real and nominal GDP estimates using the output approach are available from 1960, while the quarterly estimates are available from 1975. The quarterly estimates are important short-term indicators of Singapore's economic performance. This paper outlines the data sources and methodology adopted by DOS for the compilation of timely, quarterly estimates of output-based GDP.

II Concepts and Definitions

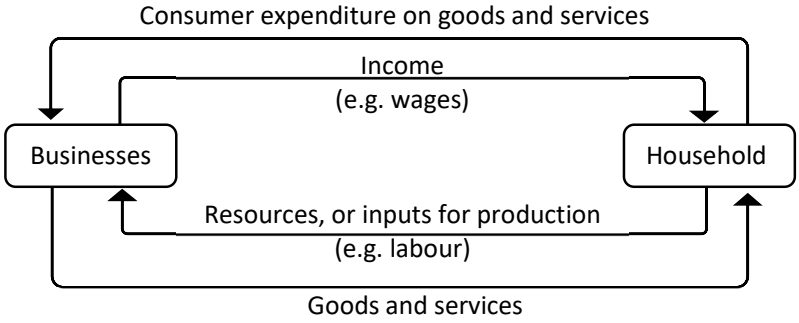
Concept of production

3 Production is an activity carried out under the control and responsibility of an institutional unit[1] that uses inputs of labour, capital and goods and services to produce outputs of goods or services. A purely natural process without any human involvement or direction is not production in an economic sense, e.g. unmanaged growth of fish in international waters is not production as opposed to fish farming.

4 Activities undertaken by households that produce services for their own use are also excluded from the concept of production as these services are not produced for the market. Thus, there are no suitable market prices to value such services and they are excluded from the production boundary for practical reasons and to avoid difficulties in interpretation. Services provided by owner-occupiers of dwellings are included in production, as an exception, for international comparability to avoid distortions in comparing economic output in one country from another due to differences in the proportion of rental housing. Services produced by employing paid domestic staff (e.g. nanny to care for the child) are included in the production boundary.

[1] The institutional unit assumes responsibility for the production process and owns the resulting goods or is entitled to be paid or compensated for the services provided. Institutional units comprise five mutually exclusive types: non-financial corporations, financial corporations, government units including social security funds, non-profit institutions serving households, and households. Together, they make up the total economy.

Three approaches to GDP



5 The economy can be represented by a circular flow diagram with the flow of income in one direction and expenditures on goods, services and resources going in the opposite direction. Resources 'flow' through businesses to produce goods and services. To enable this, businesses purchase resources, e.g. labour, from households, thus generating the income 'flow' from businesses to households. Then, the income 'flows' back to businesses when households purchase goods and services from them, representing their expenditures.

6 The total value of goods and services produced in the economy (or gross domestic product) can therefore be measured either in terms of output, expenditure or income generated.

7 The *output approach* to GDP considers the goods and services produced by the various industries in an economy. The value added of the goods and services produced by an industry is computed as its output less the value of the inputs used. Viewed from this perspective, GDP is the sum of the value added of all industries.

8 The *expenditure approach* to GDP views GDP from the demand perspective. Final demand is the sum of the aggregate expenditure in each final demand component, i.e. private consumption expenditure (PCE), government consumption expenditure (GCE), gross fixed capital formation (GFCF), exports of goods and services and changes in inventories. Expenditure-based GDP is simply final demand less imports, i.e. GDP is the sum of PCE, GCE, GFCF, net exports of goods and services and changes in inventories.

9 The *income approach* regards GDP as the sum of the income received from the domestic production of goods and services. It includes compensation of employees (renumeration as return to labour of the households), gross operating surplus (profits as return to capital of corporations) and taxes less subsidies on production and on imports. The value added of each industry is equal to the sum of these components.

10 DOS compiles quarterly and annual real GDP estimates using the output and expenditure approaches, and annual nominal GDP estimates using all three approaches. In theory, these three approaches to GDP should yield the same estimate. However, as they are compiled independently from different data sources, it is inevitable for differences to arise. DOS considers the output approach to be the main approach and regards the difference between expenditure-based and income-based GDP from output-based GDP as statistical discrepancies.

Classification system

11 GDP by the output and income approaches are classified in accordance with the Singapore Standard Industrial Classification 2020 (SSIC 2020). It is the national standard for classifying economic activities undertaken by economic units and adopts the basic framework and principles of the International Standard Industrial Classification of All Economic Activities (ISIC) developed by the United Nations (UN) Statistics Division.

12 The ISIC is a classification with a hierarchical structure. At the highest level of aggregation, there are 22 broad categories known as "sections", each comprising one or more "divisions", as shown below. An overview of the classification structure of SSIC 2020, including the principles, structure and changes from the previous edition are available in the publication "Singapore Standard Industrial Classification 2020"[2].

Section		Division
A	Agriculture and Fishing	01-03
B	Mining and Quarrying	08-09
C	Manufacturing	10-32
D	Electricity, Gas, Steam and Air-Conditioning Supply	35
E	Water Supply; Sewerage, Waste Management and Remediation Activities	36-38
F	Construction	41-43
G	Wholesale and Retail Trade	46-47
H	Transportation and Storage	49-53
I	Accommodation and Food Service Activities	55-56
J	Information and Communications	58-63
K	Financial and Insurance Activities	64-66
L	Real Estate activities	68
M	Professional, Scientific and Technical Activities	69-75
N	Administrative and Support Service Activities	77-82
O	Public Administration and Defence	84
P	Education	85
Q	Health and Social Services	86-88
R	Arts, Entertainment and Recreation	90-93
S	Other Service activities	94-96
T	Activities of Households as Employers of Domestic Personnel	97
U	Activities of Extra-Territorial Organisations and Bodies	99
V	Activities not adequately defined	00

Nominal and real GDP estimates

13 *Nominal GDP* is the total value of the goods and services produced in an economy at current prices. Changes in current price or nominal GDP result from: (i) changes in prices; and/or (ii) changes in the volume of economic activity.

[2] Detailed information on the Singapore Standard Industrial Classification is available on www.singstat.gov.sg/standards-and-classifications/ssic.

14 The assessment of economic growth requires the removal of price effects, or equivalently, the compilation of GDP at constant prices. Constant price or *real GDP* estimates are essentially volume indices, which measure changes in the volume of economic activity while maintaining relative prices constant. However, as the prices of goods and services change, the relative price weights of a particular year become less representative over time. It is therefore necessary to update the relative price weights to a more recent year periodically.

15 Consistent with the System of National Accounts (SNA)[3] recommendation, DOS has compiled annually reweighted chain volume measures[4] (CVM) of GDP since 2019[5]. As compared to the previous method of updating the relative price weights on a five-yearly basis, the annually reweighted CVM of GDP better reflects prevailing economic conditions.

III Compilation of Quarterly Estimates of Output-Based GDP

Methods of compilation

16 The compilation of quarterly GDP estimates for the production approach requires an extensive number of timely and reliable short-term economic indicators of the level of economic activity in each industry. The use of proxy indicators of inputs or outputs for the compilation of quarterly national accounts is an internationally accepted practice[6].

17 Proxy indicators should have an observable and stable relationship with the value-added of production in the various industries. The stability of this relation will, in general, be greater the more homogenous is the industry. *Input indicators* measure the quantity or value of one or more inputs used by the specific industry, e.g. employment, wages. *Output indicators* measure the quantity or value of output of the specific industry, e.g. passenger-kilometres for the passenger air transport sector. Output indicators, being direct indicators of production, are preferred to indirect input indicators as the latter do not reflect productivity changes. However, in the absence of suitable output indicators, input indicators would have to be used.

18 The indicators used can also be categorised into *value* and *volume* indicators. *Value indicators* measure the value of the output, material inputs or the wage of the workers employed. *Volume indicators* measure the quantity (or volume) of output produced, material inputs or employment. Trends of general price indices like the Consumer Price Index (CPI) and GDP deflator or wage indices may be

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[3] The SNA is a statistical framework that provides a comprehensive, consistent, and flexible set of macroeconomic accounts for policymaking, analysis, and research purposes. It has been produced and is released under the auspices of the UN, the European Commission, the Organisation for Economic Co-operation and Development (OECD), the International Monetary Fund (IMF) and the World Bank Group.

[4] Calculated by measuring GDP using the price level of the preceding year. These annually reweighted volume change measures are then linked together to produce a time series of CVM of GDP.

[5] Detailed information on the CVM is available in the information paper on the "Benchmarking of Singapore's National Accounts to Reference Year 2015" on Singapore Department of Statistics website (www.singstat.gov.sg/-/media/files/publications/economy/ip-e46.pdf).

[6] Collection of detailed information from businesses on a quarterly basis imposes substantial respondent burden, as compared to annual collection. Furthermore, it is not practical and resource-intensive to process and analyse the huge amount of information collected each quarter.

used to proxy price changes when more appropriate price indices are not available. Refer to Annex for an illustration of methods to derive nominal and real estimates.

19 Data sources and methodologies for the compilation of quarterly GDP estimates are regularly evaluated to ensure the relevance and reliability of the indicators used. New indicators have also been developed through rigorous research and monitoring to capture the activities from new and emerging sectors of the economy.

Data Sources

20 DOS relies on high frequency administrative data which are reliable, comprehensive and imposes minimal respondent burden. However, administrative data by themselves are insufficient. They are supplemented with data from monthly or quarterly surveys conducted by DOS or the research and statistics units of other government agencies.

21 To ensure timeliness and reduce respondent burden, the surveys generally collect minimal information from a relatively small number of companies or establishments. These surveys include:

a. Monthly Survey of Manufacturing Activities
b. Monthly Survey of Retail Sales / Food & Beverages Services
c. Quarterly Business Expectations Survey of the Services Sector
d. Monthly and Quarterly Survey of Financial Institutions
e. Survey of Monthly and Quarterly National Income Estimates
f. Quarterly Survey of Services

22 DOS has continuously explored the use of administrative data as well as high frequency indicators. This is especially crucial in monitoring of economic activities during times of instability or uncertainty, such as the outbreak of Covid-19 in 2020, which disrupted business operations and impacted survey responses. For example, DOS incorporated non-traditional or higher frequency data such as Google Search trends and credit card spending.

Overview of Data Sources by Major Economic Sector

Manufacturing

23 The Index of Industrial Production, compiled by the Economic Development Board from data collected through the Monthly Survey of Manufacturing Activities, is the key indicator for the quarterly estimation of real GDP for the manufacturing sector. Nominal estimates are derived by inflation of real estimates with the Singapore Manufactured Products Price Index.

Construction

24 Data on monthly certified progress payments by type of construction work, collected by Building and Construction Authority, is the main data source for quarterly estimation of nominal GDP for the construction sector. Additional estimates are made for renovation, maintenance and repair works, based on indicators such as occupied space of offices and shops and the number of new flats and houses sold. The nominal estimates are deflated by price indicators such as the Tender Price Index and CPI to obtain real estimates for the sector.

Utilities

25 Real estimates for the utilities sector are compiled from volume indicators such as electricity, gas, and water consumption. Nominal estimates are derived from income and expenditure statements of utilities companies.

Wholesale & Retail Trade

26 The Wholesale Trade Index (WTI), which measures the sales performance of wholesale trade activities and merchandise trade data, are used to estimate the value added of the wholesale trade sector. The Retail Sales Index (RSI) which measures the sales performance of retail trade activities is the main data source for estimating the value added of the retail trade sector. Both WTI and RSI are available as nominal and real indices.

Transportation & Storage

27 Revenue and expenditure data from major transport companies are the main data source used in the quarterly estimation of nominal GDP for the transportation and storage sector. Real estimates are compiled from volume indicators like public transport ridership data, cargo handled and air passenger-kilometres. Price indicators include the CPI, Sea Freight Transport Price Index, Cargo Handling Price Index, Warehousing and Storage Price Index, and the Freight Forwarding Price Index.

Accommodation

28 Real estimates for the accommodation sector are compiled from volume indicators such as gross hotel lettings (room-nights occupied) and visitor arrivals statistics from the Singapore Tourism Board. Nominal estimates are derived by the inflation of real estimates with price indicators such as the CPI and average room rates.

Food & Beverage

29 The Food and Beverage Services Index (FSI), which measures the sales of food and beverage activities, constitutes the main data source for estimating the real value added of the sector. Estimates are also made for producers, such as hawkers, who are not included in the FSI. Nominal estimates are derived by the inflation of real estimates with price indicators such as the CPI.

Information & Communications

30 Revenue and expenditure data of companies are the main data source for quarterly estimation of nominal estimates for the information and communications sector. Real estimates are obtained from the deflation of nominal estimates with price indicators such as the Telecommunications Services Price Index and the Computer Consultancy and Information Services Price Index.

Finance & Insurance

31 Revenue and expenditure data are collected through the Monthly and Quarterly Survey of Financial Institutions, which covers most financial institutions such as banks and insurance companies. Additional indicators include credit card statistics, foreign exchange turnover, and goods and services taxes turnover. These constitute the main data sources for the compilation of nominal estimates for the finance and insurance sector. Real estimates are obtained from the deflation of nominal estimates with price indicators such as the CPI or general GDP deflator.

Real Estate

32 Nominal estimates of the real estate sector are compiled from certified progress payments data and the income and expenditure statements of companies. Real estimates are derived from deflating the

nominal estimates with price indicators such as the CPI and Urban Redevelopment Authority (URA)'s Rental Index and Property Price Index.

Professional Services

33 Revenue and expenditure statements of companies from quarterly surveys are used in the quarterly estimation of nominal estimates for the professional services sector. Real estimates are mainly obtained from the deflation of nominal estimates with price indicators such as the Accounting Services Price Index.

Administrative & Support Services

34 Revenue and expenditure statements of companies from quarterly surveys and employment data are the key data sources in compiling nominal estimates for the administrative and support services sector. Volume indicators such as employment statistics and administrative data on rental cars and goods vehicles are also used in the estimation of real GDP for this sector.

Other Services Industries

35 Real GDP estimates for the other services industries sector are mainly compiled from government finance statistics on employment and remuneration for public administration & defence activities, and other administrative data such as outpatient attendances to clinics and admission tickets to attractions for education, health, and recreation services. Revenue and expenditure data from major service providers are also used in the quarterly estimation of nominal GDP for this sector.

IV Benchmarking Quarterly Estimates of Nominal GDP

36 The annual estimates of nominal GDP are based on detailed industry accounts compiled from more comprehensive and reliable data sources instead of being simply the sum of its quarterly estimates. This includes data collected from annual surveys, which generally cover a larger sample of firms and collect more details, henceforth more representative of the prevailing economy. As such, the annual estimate derived from the sum of its quarterly estimates would not be equivalent to the annual estimates compiled independently using annual surveys.

37 Therefore, it is necessary to re-align or benchmark the quarterly estimates with the annual data. The benchmarking of quarterly estimates to annual estimates ensures temporal consistency between both sets of estimates, allowing optimal use of quarterly and annual data in a time-series context while preserving as much as possible the quarterly movements of the short-term indicators.

38 The approach to derive a series of re-aligned quarterly estimates is through proportional Denton benchmarking, which adjusts the quarterly series so that the yearly sums of the adjusted values are equivalent to the independently compiled annual totals. It also removes any artificial discontinuities between the years from the adjusted quarterly series. This method is built on a principle of movement preservation where the adjusted series maximises the preservation of movement in the original series.

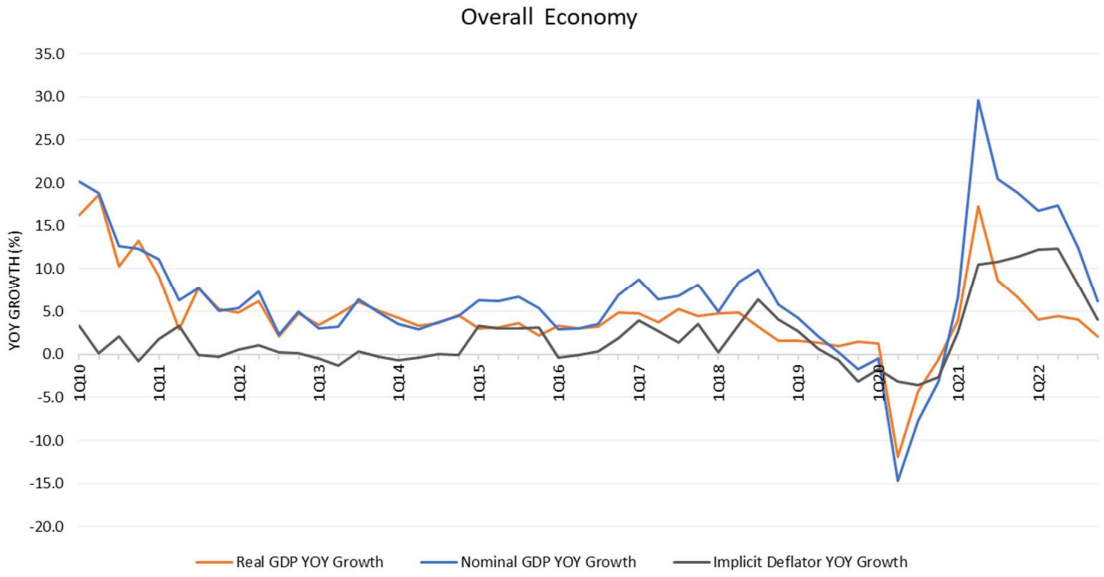
39 Thus, this approach has an additional advantage of preserving the seasonality and other short-term fluctuations of the original series[7].

[7] Detailed information on Denton Benchmarking is available in the IMF Quarterly National Accounts Manual – 2017 Edition, Chapter 6: Benchmarking and Reconciliation

V Recent Trends

40 With steady economic expansion in the last decade, quarterly GDP rose from S$77.9 billion in 1Q 2010 to S$160.7 billion in 4Q 2022 in nominal terms. Overall GDP had fallen steeply in 2Q 2020, registering growth of -14.7 per cent and -11.9 per cent in nominal and real terms respectively, due to the outbreak of Covid-19 which quickly evolved into a pandemic. The economy was severely impacted by worldwide lockdowns, which affected global trade and travel, and was further exacerbated by circuit breaker measures implemented in 2Q 2020 which resulted in work disruptions and stoppages. Correspondingly, nominal, and real GDP grew 29.6 per cent and 18.6 per cent respectively due to the low base in 2Q20.

41 The implicit GDP deflator is derived by dividing the nominal value of GDP by its real value. Movements in the implicit deflator reflect changes in price and composition of goods and services in the economy; it provides a broad measure of the change in the overall level of prices of the goods that make up GDP. The implicit GDP deflator had been rising since 1Q21 as the economy recovered from the onset of Covid-19 in 2020. However, the growth of the implicit GDP deflator moderated in the second half of 2022.



VI Conclusion

42 Quarterly GDP estimates are important short-term indicators of Singapore's economic performance. The advance output-based, CVM of GDP are compiled from data for the first two months of the quarter and serve as an early indication of GDP growth for the quarter. They are released no later than two weeks after the end of the reference quarter. Subsequently, more comprehensive data are incorporated in the preliminary nominal and CVM of GDP estimates, which are released no later than eight weeks after the end of the reference quarter and published in the Economic Survey of Singapore (ESS).

43 The latest data and press releases on the Economic Survey of Singapore are available on www.singstat.gov.sg/find-data/search-by-theme/economy/national-accounts. A half-yearly-ahead advance release calendar on dates of upcoming releases is published on the SingStat Singapore (www.singstat.gov.sg/whats-new/advance-release-calendar).

44 The complete series starting from 1960 is available on the SingStat Table Builder, an online public database on various topics from public sector agencies (www.tablebuilder.singstat.gov.sg/publicfacing).

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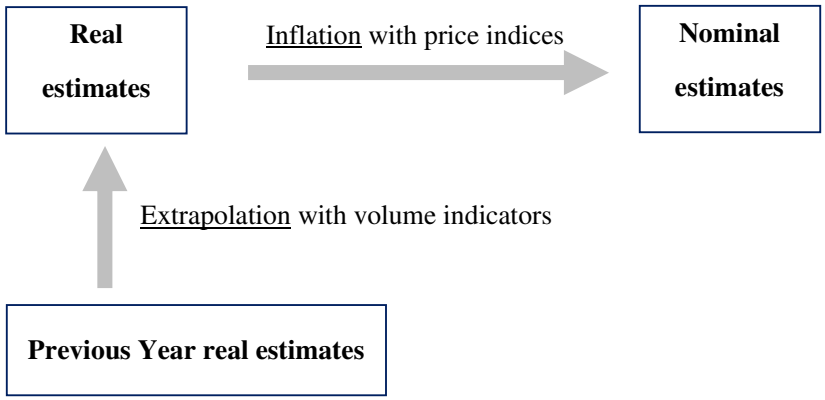
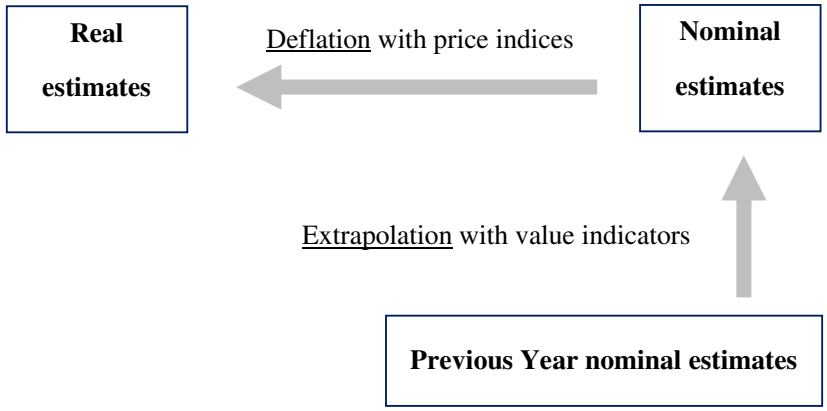
ANNEX: Methods to derive nominal and real estimates

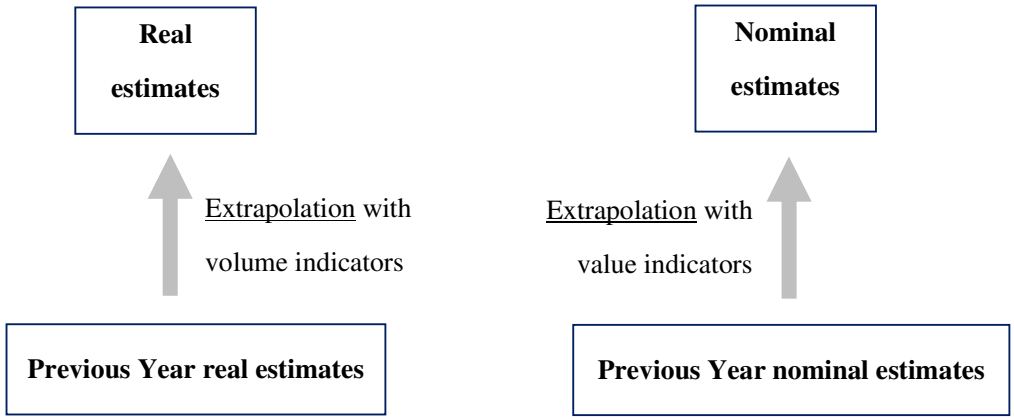
(i) Use of volume and price indicators



(ii) Use of value and price indicators



(iii) Use of volume and value indicators



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