Special Feature B

The Reconstruction Of Singapore's GDP 1900–60: Estimates And Trends

by Ichiro Sugimoto[1]

Introduction

According to official statistics released since 1960, the Singapore economy has shown a sustained and relatively rapid pace of growth. Over the period 1960–2000, real GDP (at 1990 prices) expanded at an average compounded annual rate of 8.3%. With overall population growth at 2.3%, real per capita GDP increased by 5.9% on average each year. This phenomenon is frequently cited as an "economic miracle". In comparison, the economic performance of Singapore prior to 1960 was never quantified in the same manner due to the absence of comparable statistical indicators. Given the absence of data, the existing literature on the pre-1960 economic development of Singapore has been confined to studies on specific sectors. In order to fill this void, Sugimoto (2011) has reconstructed historical GDP estimates of Singapore for the period 1900–39 and 1950–60 and, based on these new estimates, several empirical studies have been carried out (Sugimoto and Tan, 2011; Choy and Sugimoto, 2013).

This Special Feature briefly describes the sources of the data and the methodology used to arrive at the new estimates of Singapore's GDP and its components prior to 1960, in both real and nominal terms.   These estimates are then presented graphically and some notable observations are made about their long-term trends.

Availability Of Statistical Data

Every step in the estimation procedure of historical GDP depends critically on the availability of statistical information. Hence, the collation of colonial statistical materials into a time series database constitutes a basic, but important step. Prior to World War II, Singapore's statistics were recorded as part of the Straits Settlements, together with Malacca and Penang. The most important statistical abstract published by the British authorities annually was the so-called *Blue Book*, *Straits Settlements*, which provided detailed information on trade, market prices, agricultural planting, demography and government finance. Complementing this were the *Annual Report* and *Departmental Reports*, which contained both economic data and documentation of socio-economic events.   Apart from these regular reports, special reports were also published from time to time.

The end of World War II and the Japanese occupation of British Malaya in 1945 marked the dissolution of the Straits Settlements as an administrative unit. Singapore was reconstituted as a British Crown Colony and continued to be so until 1955. This administrative transition ushered in an era whereby Singapore began collecting, compiling and publishing its own statistical data. The *Annual Report*, *Colony of Singapore* provided a wide range of economic data while the *Financial*

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Statement of Singapore and *Singapore's External Trade* contained detailed information on government finance and trade, respectively. Hence, the British colonial authorities had put in place mechanisms to collect and compile a wide range of statistical information, which improved over time.

The availability of detailed statistical information on government expenditure and merchandise trade made it natural to apply the expenditure approach, rather than the production or income approaches, to obtain historical GDP estimates of Singapore. Other than the two components of government final consumption expenditure and net exports of goods, however, no direct statistical data was available that complied with the requirements of international national accounting standards, as set out in the United Nations' *System of National Accounts (SNA) 1968*. Under these circumstances, alternative methods had to be devised, as described in the next section.

Methodologies Employed

Various creative methodologies conforming to the *SNA 1968* definitions were applied in the reconstruction of Singapore's national income estimates for the periods 1900–39 and 1950–60. The following sub-sections explain the procedures for estimating each GDP component in turn.

Private Final Consumption Expenditure (PFCE)

At present, household expenditure surveys and commodity flow tables are widely utilised for the computation of PFCE. However, these methods could not be employed here due to the dearth of such data for the colonial period. Consequently, two distinctive approaches were employed: direct and indirect. In the direct approach, data on consumption expenditures pertaining to opium, education, medical fees and utilities (gas, water supply and electricity) was gathered independently from a number of official sources.

The indirect approach involved estimating the PFCE on food, beverages and tobacco, clothing, rent, domestic servants and transport ("major objects of consumption"). Summing up the expenditures derived from these two approaches provides us with PFCE in current and constant prices.

The indirect estimation approach involved a number of steps. To begin with, six consumption standards were defined, based on the recognition that there were significant differences in consumption levels and spending patterns between the ethnic and occupational groups in Singapore. [2] Following this, the per capita expenditure on each major object of consumption was identified for each standard for a number of benchmark years, using available survey data. These figures were then deflated by the CPI for each major object of consumption to obtain expenditures in constant prices. (Table 1) Real per capita consumption expenditure on each major object of consumption for each standard was then interpolated for the other years by taking the changes in real income over time and multiplying them by the income elasticity of demand for each major object of consumption.[3] To obtain aggregate PFCE for each consumption standard, the real per capita expenditure on each major object of consumption was scaled up by the total number of people in each ethnic and occupational group. These aggregate figures were then inflated by the price indices to arrive at PFCE in current prices. Finally, PFCE by resident households was obtained by aggregating the expenditures on the direct and indirect components, after deducting direct purchases of non-residents in the domestic market.

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[2]   The six standards are European, Asian clerical, Eurasian clerical, Chinese labour, Indian labour and Malay labour.

[3]   Real income changes were estimated from changes in real wages while the income elasticity estimates were guided by empirical studies for the pre-war period.

Government Final Consumption Expenditure (GFCE)

GFCE was derived by deducting from the gross output of producers of government services, the sales of goods and services. The output of these producers was, in turn, computed by summing up the compensation of employees, the intermediate consumption of goods and services, and the depreciation allowances of all producers of government services. These estimates were compiled from the expenditures incurred by the Colony of Singapore, the Municipality/City Council of Singapore and Rural Boards. However, detailed expenditures recorded in the government accounts varied between administrative bodies, and also within each administrative body over time.

To satisfy the definitions of the *SNA 1968*, the following steps were taken to identify GFCE. In general, the government financial accounts presented the expenditures incurred by each department according to two major classifications: compensation of employees and other charges (annual recurrent and special expenditure). Unfortunately, the details within these broad classifications were not always systematically presented. In view of this, a coding system was set up to identify the compensation of employees, intermediate consumption, capital formation, transfers, and others. These standard procedures were then applied to the accounts of most, but not all, government departments due to data deficiencies in some cases. In all, more than 100 government departments were covered.

Gross Capital Formation (GCF)

The estimate of GCF includes investments made in construction, machinery and equipment (M&E), and 'cultivated assets'. It also covers inventories, or the stocks of goods held by producers to meet temporary or unexpected fluctuations in production or sales, as well as work in progress other than construction.

In the case of GCF in construction, total construction investment was first derived using the input-output coefficients of cement with respect to total construction output taken from the construction survey in 1972, in conjunction with net imports of cement. Total construction expenditure that went into fixed capital formation was then estimated by deducting from total construction output the expenditures incurred on repairs and maintenance.

For the case of investment in M&E, it was assumed that the M&E produced locally was negligible for the period under study. This means that total net imports valued at market prices was equivalent to total investment in M&E. Net imports of M&E at c.i.f. values i.e., inclusive of cost, insurance and freight, were obtained from the official trade statistics. No commodity taxes were levied against M&E, which meant that the c.i.f. and producers' values were identical. Trade and transport margins were added to producers' values to arrive at market prices. The final step was to determine the proportion of net imports to be capitalised, which was set at 90%, following similar studies.

In preparing the estimates on investment in cultivated assets, rubber and coconut were selected since investment on other perennial crops was negligible. All expenses sunk into perennial crops prior to their reaching bearing age were treated as part of capital expenditure. Three types of information were utilised, namely, newly planted acreage for each year, the number of years it takes for the crop to reach bearing age, and the annual cost per acre of bringing the crop into production.

The yearly estimates of expenditure on cultivated assets at different years of maturity were derived by multiplying the total immature acreage by the corresponding base year estimates of cost of investment per acre at different stages of maturity. These yearly figures were then aggregated to arrive at estimates of real capital expenditure. Lastly, total real investment in cultivated assets was inflated by the rubber tappers' nominal wage index to arrive at constant price estimates.

Inventory, as defined in the *SNA 1968,* consists largely of raw materials and finished or partly-finished products awaiting sale. The colonial records, however, do not provide sufficient

information to construct reliable estimates. Consequently, the official data after 1960 was used to derive a relationship between inventory changes and GDP growth. In particular, as there was a positive correlation between GDP growth and changes in stocks, the percentage contribution of changes in stocks to GDP growth during the colonial period was assigned values ranging from −3.0% to 3.0% points.

Exports and Imports of Goods and Services

Compared to the other expenditure components of GDP, estimation of the net exports of goods and services was more straightforward, as the *Blue Book* contained detailed export and import statistics.   Data on merchandise exports and imports was readily available from 1900–27. For the periods 1928–39 and 1950–60, Huff's (1994) estimates were utilised.   The value of services exports was then added to the estimates for merchandise trade by using port revenues and sales of bunker coal and petroleum as proxies.

Deflators

Real GDP figures were arrived at by deflating each component of aggregate demand in current prices by appropriate deflators (Sugimoto, 2011). As a result, constant price estimates with 1914 as the base year were obtained for the periods 1900–39 and 1950–60. Table 1 lists the various deflators used in the process.

Table 1
Deflators for Each Component of GDP

GDP Component	Deflators
Private Final Consumption Expenditure	
Direct Approach	Overall CPI
Indirect Approach	CPI Sub-index for each Major Object of Consumption
Government Final Consumption Expenditure	
Government Output	Overall CPI
Gross Capital Formation	
Construction	Import Unit Value Indices of Cement
Machinery and Equipment	UK Indices of Machinery and Plant
Cultivated Assets	Indian Rubber Tappers' Wage Index
Change in Stocks	Import Unit Value Indices
Exports of Goods and Services	
Merchandise Trade	Export Unit Value Indices
Port (Goods and Services)	UK Weighted Indices for Fuel and Light, Transport, Communication and Other Services
Imports of Goods and Services	
Merchandise Trade	Import Unit Value Indices

Some Observations On Long-term Trends In GDP

The estimates of Singapore's GDP and its components in real terms for the period 1900–39 and 1950–60 are presented graphically in Chart 1. The compounded annual growth rates of GDP for these two periods were 4.5% and 4.8% p.a., respectively. The corresponding rates of increase in per capita GDP were lower at 1.5% and 0.03% p.a., due to strong population growth.

The most salient characteristic of Singapore's economy in the colonial era is its high degree of openness to international trade. In view of this, the movements of imports and exports were closely related—a feature that has persisted to the present day (Choy, 2012). Indeed, Singapore is often described as a "very open re-export economy" due to her heavy reliance on entrepôt trade and the high import content in exports (Lloyd and Sandilands, 1986).

In the first decade of the twentieth century, average real GDP growth was relatively subdued, as entrepôt trade stagnated until the outbreak of World War I. The 1920s was the golden decade of this era as average GDP growth accelerated to 10.8% p.a. and capital formation increased by 15.0% annually to keep pace with the great expansion in trade. However, the upward trend in most components of GDP reversed from 1929–32 due to the Great Depression. The level of GDP fell by almost half and all expenditure categories contracted. By 1935, however, domestic demand

had recovered sufficiently for GDP growth to average 2.5% for the decade as a whole. After World War II, real GDP continued to expand at an average pace of 4.8% p.a. from 1950 to 1960.

An analysis of the share of each component in Singapore's historical GDP reveals some interesting features. (Table 2) Throughout 1900–39 and 1950–60, the average shares of the components were relatively stable, even though there were significant yearly changes. The average share of PFCE was 89% in the pre-war period, although it fluctuated between 77% and 95%. In comparison, the share of GFCE in GDP hovered around 7%. Not surprisingly, the share of GCF was the most volatile, rising to about 27% in the 1910s and then falling to 13% in the 1950s.

There were significant structural changes after the attainment of independence in 1965. In particular, PFCE's share in output fell sharply from about 89% of GDP in 1960 to around 40% by the end of the twentieth century and the share of GFCE to GDP rose after 1965, but remained relatively low. The share of GCF in GDP, however, increased after independence from 20% to around 40%, although it declined to 35% during the 1990s. The most remarkable change was observed in the net exports of goods and services. Net exports were in negative territory up to 1985, but turned positive thereafter and increased further in the 1990s.

Chart 1
Singapore's GDP (1914 Prices),
1900–39 and 1950–60
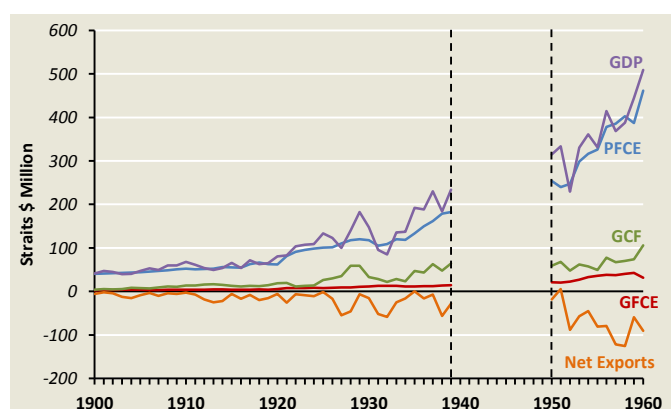
Note: Historical GDP estimates are not available for the period 1940–49 as data collection was disrupted during World War II and the period immediately after.

Table 2
Annual Average Share of GDP Components at Current Prices,
1900–39 and 1950–2000

(%)

	PFCE	GFCE	GCF	NET EXPORTS
1900–10	90.9	7.2	17.7	−15.7
1911–20	94.8	7.3	26.6	−28.7
1921–30	84.7	7.2	19.0	−11.0
1931–39	77.2	7.3	16.3	−0.7
1950–60	85.2	8.1	13.2	−6.5
1961–70	78.6	10.3	22.3	−11.9
1971–80	59.1	10.8	41.2	−10.7
1981–90	45.5	11.6	41.5	1.2
1991–2000	41.9	9.5	34.5	15.2
1900–1939	87.3	7.2	19.9	−14.4
1950–2000	63.0	10.0	29.9	−2.9

Source: Figures for the period 1900–39 and 1950–59 are estimated by the author while those for 1960–2000 are from DOS (1996) and ADB (2001).
Note: Figures may not sum to 100 due to statistical discrepancies.

Sum-up

Until recently, research on the quantitative economic history of Singapore has been hampered by the lack of GDP data for the colonial and early post-1945 periods. This Special Feature has presented a methodology to reconstruct GDP and its expenditure components in both real and nominal terms. In doing so, it has adhered closely to national income accounting conventions, within the constraints imposed by the availability of historical data.

The results suggest that Singapore experienced firm economic growth during the early part of the twentieth century, as well as the post-war period. Nonetheless, the rise in real income per capita was modest due to strong population growth. Moreover, compared to the modern period, the shares of expenditure categories in GDP were relatively stable, despite some volatility in investment spending.

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