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ESTIMATES OF LONG-TERM NATIONAL ACCOUNTS STATISTICS OF TAIWAN, 1912–90

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INTRODUCTION

THIS paper has been written first in response to the need for long-term economic statistics concerning Taiwan. During the 1990s, excellent research was published on the Taiwanese economy under Japanese occupation under projects intending to trace a century of economic development since Taiwan was separated from mainland China in 1895. Since it existed as a relatively independent economic unit until the 1990s, excluding the period from 1945 to 1948. Estimates of national accounts covering the century can greatly help in describing the general economic performance during this period and forming the foundation for detailed studies of various economic activities in Taiwan.

Another reason for this paper is the start of the large-scale Center of Excellence (COE) Project at the Institute of Economic Research, Hitotsubashi University to construct a database of historical statistics in Asian countries. It is well known that the development of techniques for long-term estimates of national accounts has contributed much to the economic analysis of developed countries. In Japan, the Long-Term Economic Statistics (LTES) Project was begun in the early 1960s to estimate accounts from 1885 to 1940. This series is linked to official estimates by the Government of Japan covering the period after 1955 by some researchers, including the author, and has enabled us to understand a century of economic development in Japan and compare its pattern to the experience of other developed countries.

Such research, however, has been late in coming for other Asian countries, a state of affairs the COE Project aims to correct. The first issue of the COE Project newsletter lays out the basic plan for the Asian Historical Statistics Project. While there are numerous details which cannot cover here due to limited space, the project plans to calculate national income statistics (especially flow accounting) and use the results to create and refine a long-term economic statistics database. The area covered by this project is regionally more extensive than Asia in the conventional sense since it includes Asian Russia, the People's Republic of China, North and South Korea, Taiwan, the ASEAN countries, India, some Middle Eastern countries, and Egypt.

This paper was originally written as a report to COE Project regarding Taiwan, stating that because the research on Taiwan is more advanced than other areas, the results can be regarded as an example or model of what the COE Project can expect in the future. Furthermore, we hope that this paper will contribute to the recent research on the long-term development of the Taiwanese economy.

I. STATISTICAL DATA AND THE RESEARCH TO DATE

A. *Data*

The basic intent of the COE Project is to search for information from the earliest period possible through 1990. Considering the amounts of statistical information available on Taiwan, we will divide its one-hundred-year economic history into the following periods:

Period 1. Pre-1894 (under the control of Ching Dynasty [1644–1911]): Very little statistical material available.

Period 2. 1895–1911 (first period of the Japanese occupation): Some statistical data compiled but none in systematic fashion.

Period 3. 1912–38 (middle period of the Japanese occupation): Advances in statistical gathering make systematization a possibility.

Period 4. 1939–50 (World War II and the Chinese Civil War): Some data kept secret under wartime policy, while other data is lost due to economic and social turbulence.

Period 5. 1951–60 (Taiwanese government begins to collect data): Essential data become available for the first time.

Period 6. 1961–90 (Taiwanese government systematizes data collection): Data gathering, including censuses and compilation of input-output tables, conforms to advanced-nation standards.

The above historical conditions underlying statistical data should be considered in any evaluation of the previous estimates of the System of National Accounts (SNA).

B. *Estimates for the Post–World War II Period*

National accounts statistics were published by the Directorate-General of Budgets, Accounting and Statistics (DGBAS) beginning in the early 1950s based on the 1953 SNA. While there were some problems in the earlier estimates, remarkable improvement made thereafter. In the early 1970s, DGBAS adopted the 1968 SNA and published a new series from 1951. The outline of the procedures is contained in the annual reports of national accounts.

Official statistics compiled since 1961 are highly respected in Asia for their reliability, and we therefore need only to adjust the figures to meet particular guide-

lines; however, efforts to upgrade capital-formation and capital-stock statistics have created some difficulties in the area of international comparison. It is also necessary to compile some additional estimates for period 5 (1951–60); but we can safely say that Taiwanese official statistics are on the whole sufficient for comparison with other Asian countries. The two major sources for periods 5 and 6 are ROC, DGBAS, *National Income in Taiwan Area* (1992) and *Statistical Yearbook* (various years).

The former provides flow accounting based upon the 1968 SNA recommended by the United Nations. It also provides nominal expenditure accounts for 1951–91, as well as real value accounts in 1986 prices for the same period. Nominal production accounts are also provided for 1951–91, but real value accounts are provided only from 1961. This data has been compiled in the COE database with the following notes.

1. While Taiwanese national accounts are based on the 1968 SNA, capital formation has been estimated using various data sources, including financial reports of enterprises. Note that 1968 SNA has proposed the use of the commodity-flow method in this area.
2. In *National Income in Taiwan Area* (ROC, DGBAS, 1992), a rigid balance was kept between the expenditure and production accounts in nominal terms. This means that statistical discrepancy is zero from 1951 to 1991.
3. The statistical discrepancy is also zero in real terms (1986 prices) in *National Income in Taiwan Area* (ROC, DGBAS, 1992). Based on agreement within the COE Project, the reference year for deflators has been changed to 1960, so that the discrepancies are no longer zero.
4. In order to estimate the long-term real value series, one of the options is to change the base years every ten years and compile time-series data by the link method of indices.

This final note is based on the recent trend in the theory of deflators to respect link-type indices as a proxy of Divisia-type deflators as is recommended in the 1993 SNA.

C. *Estimates to Date for the Pre-1940 Periods*

The main data sources for the study of periods 2 and 3 (1895–1911 and 1912–38) are the Government General of Taiwan, *Taiwan sōtokufu tōkeisho* [Statistical annual of the Government General of Taiwan] (GGT, various years), available for all years from 1899 to 1942. In 1912, the annual shifted from vertical to horizontal writing, at which time the content of the statistics was improved and expanded. This means that a detailed statistical database can be compiled only from 1912, although data is available for certain areas, such as agriculture and foreign trade, from as far back as 1895. Taiwanese and Japanese researchers have already made extensive use of this statistical material to produce some important findings. Two important

pieces of research based on the SNA and including national income statistics on the production accounts are the appendix to Lee (1966) and "Hsing estimates" (Hsing 1963), cited in Ho (1978). However, it is not quite clear what methods were used to compile the estimates. We were informed by Taiwanese scholars that Lee's appendix was published in Chinese, and we had a chance to access the article after submitting this paper.

Another statistical research project was conducted in cooperation with Japanese researchers, primarily from Hitotsubashi University, in the late 1960s. The results appeared in the following two volumes: Shinohara and Ishikawa (1971) and Mizoguchi (1975). There were also research projects examining historical data not only on the production but also on the expenditure side of the SNA. The results were eventually compiled into a major collection, Umemura and Mizoguchi (1988). This collection included estimates of the expenditure accounts of the SNA. Although the preliminary estimates of production accounts are also shown, the statistical discrepancy remains relatively large.

D. *Linkage between Pre- and Post-retrocession Data*

The above three works cover only the period under Japanese occupation, but Mizoguchi attempted to compile long-term statistics beginning from around the time of retrocession from Japanese control and link them to the earlier time series in his article (1988). This article compares pre-retrocession expenditure data with post-retrocession data in real terms using price data. This means that two benchmark years were used to create a deflator, so that two periods were linked through the "indirect method" of a real base.

What really furthered this type of research was the long-term statistics series completed at the Department of Economics, National Taiwan University in the early 1990s. Among this multifaceted research, national economic statistics were handled by Wu (1991). This work assembles statistical estimates on production accounts of the SNA for 1910–50 using both nominal and real bases. The figures on expenditures for nominal gross domestic product, when compared to those compiled by Mizoguchi and Nojima (1988), are rather high, but the difference is within the 15 per cent range. On the other hand, when a real base is employed, Wu's estimated figures are rather lower, though the difference is certainly not decisive. This research has two distinctive features:

1. The "direct method" was adopted to link the time series of estimates for the period of economic chaos, including hyper-inflation, which occurred during 1945–51, at and just after retrocession.
2. Wu's production-side estimates were much more reliable than those of the past, and could be compared with Mizoguchi-Nojima's expenditure accounts of the SNA.

The task of compiling estimates was greatly advanced by the Evaluation Com-

mittee of National Income Statistics, DGBAS (ROC, DGBAS, ECNIS, 1995). This research used the 1968 SNA method to calculate production accounts for 1946–51, and might be regarded as "quasi-official materials." The new version of these estimates was published in Kuo et al. (1997). Let us hereafter call these figures "the DGBAS estimates." While these figures were very similar to their previous estimates, the new version has the advantage in the coverage of estimated period. These sources give figures for the gross national product (GNP) for 1946 that are lower than Wu's calculations. By investigating reasons for the discrepancies and revising Wu's previous figures, we may be able to reduce the discrepancy between Wu's previous estimates and those of Mizoguchi-Nojima.

We have been strongly encouraged by the progress made so far. The next task will be to use the official and the quasi-official time series of the DGBAS estimates, the expenditures tables of Mizoguchi-Nojima, and the production accounts tables of Wu to compile a long-term series incorporating both expenditure and production accounts of the SNA.

II. REVISED ESTIMATES OF LONG-TERM NATIONAL ACCOUNTS TABLES

A. *Nominal Production Accounts*

The major object of the COE Project is to estimate flow accounts in the 1963 SNA. Especially important are "gross domestic product (GDP) and gross domestic expenditure (GDE) accounts" of "consolidated accounts for the nation" and "GDP by industry." These accounts are composed of nominal accounts, real accounts, and a system of implicit deflators. However, owing to the lack of data for Taiwan's pre-retrocession period, a simplified system of tables has been adopted.

1. Since we have not completed estimates on the distribution of GDP, a future task, the expenditure accounts are directly balanced to the production accounts.
2. The industrial classification of the 1968 SNA is too detailed for pre-retrocession estimates. Following Wu's work (1991), we have classified industries into primary (agriculture, forestry, and fishery), secondary (manufacturing, mining, construction, and public utilities), and tertiary (other industries, governments, and nonprofit institutions).
3. In order to calculate GDP from the sum of gross value added, import duties minus imputed interest should be added to the latter. These items have been added to the production of the tertiary industries. Note that the production of the banking industry is nearly balanced by imputed interest and can be evaluated as nearly zero.

Our approaches to compiling estimates may be outlined as follows. For nominal

accounts we used DGBAS's official statistics for 1951–90 production and expenditure accounts. Remember that the statistical discrepancy between these two accounts is zero in the official estimates. Fortunately DGBAS's 1941–50 quasi-official production accounts materials have become available to the public. The reader is asked to refer to previous research, including Wu's recent work on production accounts for the pre-retrocession period, since our previous estimates are weak in this area, because our efforts were concentrated mainly on expenditure accounts.

For primary-industry production and gross value added we used Wu's estimates because these are consistent with the DGBAS figures for 1941–50. Note that Wu's estimates for agricultural production are a little larger than those of the Sino-American Joint Commission on Rural Reconstruction (JCRR) estimates, which are generally accepted as the most reliable data. Wu's estimates on the secondary industries seem to have been revised in two respects. First, his value-added ratios are much higher than the DGBAS data and our previous estimates. Second, Wu does not make adjustments for "downward biases" of the production figures in the statistical annual of the Government General of Taiwan pointed out by Shinohara (1971). Therefore, the 1941 DGBAS figure is used as bench-mark data and is linked to the nominal production index of the manufacturing industry used by Shinohara. Wu's nominal estimates have been used for production and gross value added for both the construction and public utility industries.

Some additional work is needed for the tertiary industries. Wu gives reliable data on the transportation and communication industries, but his estimates on government services seem to be underestimated, so new figures have been calculated from budgetary data. Other tertiary-industry production has been estimated by an indirect method based on regression analysis in the Wu's work. While we respect the results as one means of checking the data, we have tried to estimate them by a direct method. It is very fortunate for us that DGBAS quasi-official estimates give us 1941 data by detailed industry classification for the tertiary industries. These have been adopted as the bench-mark figure.

1. The nominal production index of the transportation and communication industries has been calculated from Wu's estimates and linked to the bench-mark figure.
2. We have calculated new estimates from budgetary data on our own, in order to be consistent with the quasi-official estimates for 1941.
3. To extrapolate the value added of the commerce industry, we needed a series of trade totals. The quasi-official report gives us 1941 figures for domestic wholesale, retail, and foreign trade. For the pre-retrocession period, data is available for foreign trade. The retail trade can be broadly estimated by linking the bench-mark data to the nominal index of private consumption using expenditure accounts. The wholesale data is estimated by the nominal index of total of nom-

inal production amounts of primary and secondary industries after deducting exports.

4. Regarding production figures for the banking, insurance, and real estate industries, as noted above, the value of the financial industry is nearly zero, if we subtract imputed interest. The value of the real estate industry is obtained by linking the nominal index of housing expenditure in private consumption to the bench-mark figure. This depends on a broad hypothesis that rent for business use moves over time in a similar pattern to that for private housing.
5. We have little information on the production of the service industry other than bench-mark values, but services for the household sector seem to occupy the major portion of service production during the pre-retrocession period. A proxy nominal service production value can be calculated from household expenditures on education, medical, and other personal services. This index has been adopted to link the bench-mark figure though we agree that the estimate is too broad to be used as a final figure.
6. The import tax, including adjustment items, has been obtained from foreign trade reports.

Combining these estimates, we can obtain the gross value added of tertiary industries. The production accounts are shown in Table I-A(2).

B. *Nominal Expenditure Accounts*

Regarding nominal expenditure accounts, DGBSA's official estimates have been adopted for the 1951–91 period. We will make estimates of only one portion of the nominal expenditure accounts for the 1941–49 period using the DGBAS's report: i.e., government consumption expenditure, imports, and exports. Estimates for consolidated accounts will not be made for this period, because a scarcity of data prevents application of the commodity-flow method for private consumption and capital formation.

The figures published by Mizoguchi-Nojima (1988), with slight adjustments, will be used for the 1912–38 expenditure accounts. Supplementary outside materials will be used to obtain preliminary estimates for the 1939–41 period.

1. Data is available regarding government consumption and foreign trade; so consistent series can be obtained for these items from 1912 (or if necessary 1890) to 1990.
2. The preliminary figures for private consumption have been calculated by linking the nominal wage index to 1938 private consumption.
3. Government capital formation from budgetary data has been used to obtain 1939–41 capital formation data from the 1938 data.
4. The 1941 expenditure accounts have been calculated to compare the 1941 production accounts via the DGBAS estimates.

Because the series of items 2 and 3 are expected to be replaced by future findings,

only the results for item 1 will be compiled in our database, as shown in Table I-A. According to our preliminary tests, information available through the DGBAS estimates can be used to link nominal figures for government consumption, imports, and exports directly to the pre-retrocession SNA series. It is difficult to obtain statistics on private consumption and gross domestic capital formation for 1942–50, but it is not impossible to directly link nominal figures for the pre–1941 data to post-retrocession data.

Regarding the Mizoguchi-Nojima estimates for expenditure accounts, explanations regarding the method of estimation is given in the text and other previous publications, so only a summary will be given here.

1. The accounts follow the 1968 SNA system as closely as possible.
2. Private consumption and gross capital formation have been estimated by the commodity-flow method.
3. Government consumption has been estimated from budgetary data from the Government General of Taiwan and local governments. Note that expenditures for the Japanese military in Taiwan were borne by the Government of Japan, and thus not included in Taiwan's accounts. Note that military service is not included in the pre-retrocession production accounts; but since the GDE includes the purchase of goods and service in Taiwan by the Japanese military, the GDE includes some upward biases compared to the GDP, although its amounts are not so large as to disturb our analysis.
4. The increase in stocks has not been estimated as an independent item, but included as a part of other expenditure items.
5. Exports and imports in this database include both the commodity and service trades, although the Mizoguchi-Nojima data covers only the commodity trade. The figures for the service trade have been taken from Yamamoto's estimates (1988).

It is important to test the reliability of the data through any statistical discrepancies existing between production and expenditure accounts for the pre-retrocession period. Because our estimates depend on a number of previous studies, it is not surprising that there statistical discrepancies do exist between any two accounts due to differences in estimation methodology. Generally speaking, however, our results seem to have been successful. To begin with, we have confirmed that the discrepancy for 1941 is relatively small between DGBAS production accounts and our preliminary estimate on expenditure accounts. Further discrepancy ratios in our estimates of GDP for the pre-1938 period are shown in Table I-A. For the twenty-seven years from 1912 to 1938, the distribution of ratios is as follows:

From		−10%	−5%	0%	5%	Over 10%
To	Under −10%	−5%	0%	5%	10%	
Number of years	1	2	6	9	9	0

TABLE I

A. National Accounts in Current Prices

(1) Expenditure on the Gross Domestic Product

(Millions of yuan)

	Gross Domestic Expenditure	Private Final Consumption Expenditure	Government Final Consumption Expenditure	Gross Domestic Capital Formation	Exports of Goods & Services	Imports of Goods & Services
1912	0.005621	0.004693	0.000336	0.000694	0.001832	0.001743
1915	0.005329	0.004396	0.000320	0.000430	0.002168	0.001790
1920	0.016887	0.011161	0.000765	0.004616	0.005782	0.004663
1925	0.017485	0.012354	0.000983	0.002265	0.007053	0.005170
1930	0.017445	0.011798	0.001195	0.002737	0.006644	0.004929
1935	0.023383	0.015151	0.001421	0.004355	0.010374	0.007918
1940			0.002890		0.015725	0.011525
1950			1,671		599	975
1955	29,981	21,623	5,655	3,998	2,475	3,770
1960	62,507	42,559	12,032	12,618	7,192	11,894
1965	112,627	71,452	19,002	25,546	21,771	25,144
1970	226,805	127,636	41,397	57,886	68,746	68,860
1980	1,491,059	767,742	237,160	503,911	783,272	801,026
1985	2,473,786	1,261,580	399,364	471,359	1,341,253	999,770
1990	4,222,004	2,302,009	743,773	945,839	2,013,953	1,783,570

(2) Gross Domestic Product

(Millions of yuan)

	Gross Domestic Product	Primary Industry	Secondary Industry	Tertiary Industry	Statistical Discrepancy Ratio (%)	Population (1,000)
1912	0.006179	0.003358	0.000780	0.002041	–9.929	3,435
1915	0.005699	0.002194	0.001202	0.002304	–6.951	3,570
1920	0.016160	0.005818	0.004469	0.005874	4.302	3,758
1925	0.017863	0.007831	0.004019	0.006006	–2.162	4,147
1930	0.017181	0.006274	0.004833	0.006074	1.510	4,679
1935	0.021981	0.008479	0.006012	0.007491	5.996	5,316
1940	0.035425	0.012350	0.010700	0.012375		6,077
1945	0.126800	0.029900	0.027000	0.069900		6,954
1950	8,212	2,869	1,614	3,729		7,934
1955	29,981	8,720	6,966	14,295	0	9,691
1960	62,507	17,838	16,796	27,873	0	11,392
1965	112,627	26,611	34,025	51,991	0	13,178
1970	226,805	35,076	83,530	108,199	0	14,676
1975	589,651	74,875	235,419	279,357	0	16,450
1980	1,491,059	114,556	682,114	694,389	0	17,805
1985	2,473,786	142,999	1,144,824	1,185,963	0	19,258
1990	4,222,004	174,242	1,795,742	2,252,020	0	20,353

Note: Annual figures are available for download in the home page of COE Project, http://www.ier.hit-u.ac.jp/COE/online data/taiwan/index.html. The e-mail address is coe-admi@ier.hit-u.ac.jp.

B. National Accounts in Real Prices (1960 Constant Prices)

(1) Expenditure on the Gross Domestic Product

(Millions of yuan)

	Gross Domestic Expenditure	Private Final Consumption Expenditure	Government Final Consumption Expenditure	Gross Domestic Capital Formation	Exports of Goods & Services	Imports of Goods & Services
1912	9,181	8,697	102	1,701	3,320	4,639
1915	10,185	9,515	90	947	4,228	4,595
1920	13,383	10,425	103	3,145	4,792	5,085
1925	16,827	12,623	150	2,627	7,960	6,533
1930	18,962	14,622	197	3,728	9,848	9,433
1935	25,441	17,987	243	6,796	13,462	13,047
1940			447		11,181	13,159
1950			4,797		2,422	4,035
1955	44,295	32,053	8,593	5,983	3,738	6,072
1960	62,506	42,559	12,032	12,618	7,192	11,895
1965	99,737	63,763	17,949	19,865	20,930	22,770
1970	162,602	88,613	31,561	35,441	59,890	52,903
1975	238,498	131,509	38,852	68,460	113,037	113,360
1980	391,483	203,993	67,004	106,812	251,770	238,096
1985	586,283	271,250	90,540	83,087	404,785	263,379
1990	749,221	439,327	150,655	140,252	554,155	535,168

(2) Gross Domestic Product

(Millions of yuan)

	Gross Domestic Product	Primary Industry	Secondary Industry	Tertiary Industry	Per Capita GDP (Yuan)	Statistical Discrepancy Ratio (%)
1912	10,424	6,393	1,868	2,163	3,035	–13.54
1915	11,296	7,011	1,866	2,419	3,164	–10.91
1920	12,351	7,296	2,612	2,470	3,287	7.11
1925	15,016	8,259	3,546	3,211	3,621	10.76
1930	20,267	11,095	5,049	4,123	4,331	–6.88
1935	23,457	11,971	6,813	4,673	4,413	7.80
1940	26,261	13,592	7,308	5,361	4,321	
1945	12,514	8,193	1,751	2,570	1,800	
1950	27,889	14,198	5,488	8,203	3,515	
1955	44,296	16,225	10,981	17,090	4,571	0
1960	62,507	17,838	16,796	27,873	5,487	0
1965	99,381	23,417	28,722	47,242	7,541	0.36
1970	161,708	26,414	60,111	75,183	11,019	0.55
1975	256,606	27,585	102,848	126,173	15,599	–7.06
1980	434,629	31,415	198,990	204,224	24,411	–9.93
1985	606,961	34,192	282,108	290,661	31,517	–3.41
1990	928,295	35,542	397,570	495,183	45,610	–19.29

Note: The same as Table I-A.

C. National Accounts: Implicit Deflator (1960 = 100)

(1) Expenditure on the Gross Domestic Product

	Gross Domestic Expenditure	Private Final Consumption Expenditure	Government Final Consumption Expenditure	Gross Domestic Capital Formation	Exports of Goods & Services	Imports of Goods & Services
1912	0.0000612	0.0000540	0.0003294	0.0000408	0.0000552	0.0000376
1915	0.0000523	0.0000462	0.0003556	0.0000454	0.0000513	0.0000390
1920	0.0001262	0.0001070	0.0007427	0.0001468	0.0001207	0.0000917
1925	0.0001039	0.0000979	0.0006553	0.0000862	0.0000886	0.0000791
1930	0.0000920	0.0000807	0.0006066	0.0000734	0.0000675	0.0000523
1935	0.0000919	0.0000842	0.0005848	0.0000641	0.0000771	0.0000607
1940			0.0006465		0.0001406	0.0000876
1945			0.0011751		0.0004839	0.0016176
1950			34.83		24.73	24.16
1955	67.68	67.46	65.81	66.82	66.21	62.09
1960	100.00	100.00	100.00	100.00	100.00	100.00
1965	112.92	112.06	105.87	128.60	104.02	110.43
1970	139.48	144.04	131.17	163.33	114.79	130.16
1975	247.24	256.14	239.53	261.54	206.75	223.19
1980	380.87	376.36	353.95	471.77	311.11	336.43
1985	421.94	465.10	441.09	567.31	331.35	379.59
1990	563.52	523.99	493.69	674.39	363.43	333.27

(2) Gross Domestic Product

	Gross Domestic Product	Primary Industry	Secondary Industry	Tertiary Industry
1912	0.0000593	0.0000525	0.0000418	0.0000944
1915	0.0000505	0.0000313	0.0000644	0.0000952
1920	0.0001308	0.0000800	0.0001711	0.0002378
1925	0.0001190	0.0000949	0.0001133	0.0001871
1930	0.0000848	0.0000566	0.0000957	0.0001473
1935	0.0000937	0.0000708	0.0000882	0.0001603
1940	0.0001349	0.0000909	0.0001464	0.0002308
1945	0.0010133	0.0003649	0.0015420	0.0027198
1950	29.45	20.21	29.41	45.59
1955	67.68	53.74	63.44	83.65
1960	100.00	100.00	100.00	100.00
1965	113.33	113.64	118.46	110.05
1970	140.26	132.79	138.96	143.91
1975	229.79	271.43	228.90	221.41
1980	343.06	364.65	342.79	340.01
1985	407.57	418.22	405.81	408.02
1990	454.81	490.24	451.68	454.79

Note: The same as Table I-A.

These ratios suggest that GDP estimated from production accounts slightly exceeds GDP estimated from expenditure accounts, and that the statistical discrepancy ratios are not too large in their absolute values. It is safe to say that our nominal national accounts shown in Table I-A could be used as a long series, although some detailed revisions are expected in the future.

C. *Real Accounts and the Implicit Deflator*

As in the case of nominal accounts, four series are available for real accounts of Taiwan. They are

1. Real accounts in 1986 prices on expenditure estimated by DGBAS from 1951 to 1991, and those on production span 1961 to 1991.
2. The quasi-official estimates of production accounts in 1951 prices estimated by DGBAS for the 1941–51 period.
3. The Mizoguchi-Nojima estimates of expenditure accounts in 1934–36 average prices for the 1912–38 period (preliminary data is also available from 1903 to 1911).
4. Wu's estimates of production accounts in 1951 prices for the 1910–51 period.

Note that official implicit deflators have not been published for the 1951–60 production accounts.

Our task is to unify these series and test their reliability. For the post-retrocession period, the official estimates given by DGBAS were adopted. To make up for the lack of official estimates on 1951–60 real production by industry, we made the following approximation:

1. 1961 real production in the primary industries has been linked by the production index of agriculture compiled by the JCRR.
2. 1961 real production in the secondary industries has been linked by the production index of mining and manufacturing compiled by DGBAS.
3. Real production in the tertiary industries has been estimated by subtracting real production in primary and secondary industries from the real GDP obtained from expenditure accounts.

Item 3 depends on national accounts reports by DGBAS, which define statistical discrepancy as zero not only in the nominal accounts but also in the real accounts. These reports are preliminary in nature and should be replaced if DGBAS publishes the official figures for real production accounts. The COE Project has requested its research members to take 1960 as the reference year for implicit deflators. Because nominal and real accounts generate the system of implicit deflators, it is possible to switch the reference year from 1986 to 1960, as shown in Table I-C. The new real accounts in Table I-B are calculated according to these deflators. Note that the statistical discrepancy is no longer zero, because the reference year of deflators by groups of commodities has been switched.

Pre-retrocession real accounts have been initially calculated in 1934–36 average prices. For the expenditure accounts, the Mizoguchi-Nojima estimates have been used. Real production in primary and secondary industries has been obtained by deflating the nominal values by the deflators for each industry shown in Wu's estimates after switching the reference year. Real production in the tertiary industries has been obtained by adding up the figures for the five sub-industries shown in the nominal accounts, for which the deflators are defined as follows.

- Transportation and communication: Wu's deflator.
- Wholesale and retail: GDP deflator in the expenditure accounts.
- Finance and real estate after the deduction of imputed interest: Deflator for accommodation in the private consumption.
- Government services: Deflator for government consumption.
- Other services: Deflator for services geared to private consumption.

The deflator for the tertiary industries is the ratio of nominal values to real values.

To link these pre-retrocession series to the post-retrocession periods, we will not rely on indirect methods as done in Mizoguchi (1988), but will shift to the direct method, using the Taiwanese government's official statistics on price indicators, which also cover the period of economic chaos (1941–51). Through this approach, the real series are obtained for three industries in the production accounts, and for government consumption and foreign trade in the expenditure accounts. The semi-direct method has been used for determining the linkage for personal consumption and gross capital formation. The nominal data has been adjusted by price indices calculated from already published time series of price surveys. The results are shown in Tables I-B and I-C.

In comparison to the nominal accounts, ratios of statistical discrepancy to GDP are larger in the real accounts. This reflects the "biases" arising from changes in relative prices. Even if the statistical discrepancy were zero in a particular year's price evaluation, it would increase to some extent when the reference year of deflators switches to another year.

III. SOME FINDINGS

Since the purpose of this paper has been to supply data, we leave analysis of our estimates for future study. However, some simple observations may be useful in showing the potential of our estimates. Table II shows the over time changes of composition of GDP and can serve as the basis for any number of analyses. For example, a sharp decline can be found after 1960 for the share of the primary industries, which was the major production sector under the Japanese occupation. The share of government consumption increased in the post-retrocession period, because defense expenditures were mainly financed by the Government of Japan in the pre-retrocession period. While foreign trade enjoyed a surplus before World

TABLE II

NOMINAL GDP AND ITS COMPOSITION

(%)

	1915	1925	1935	1951	1960	1970	1980	1990
Composition in expenditure accounts:								
Private consumption	79.58	70.65	64.79	72.42	67.87	56.28	51.49	54.52
Government consumption	5.79	5.62	6.08	17.85	19.25	18.25	15.91	17.62
Capital formation	7.78	12.95	18.62	14.43	19.96	25.52	33.80	22.40
Export	39.52	40.34	44.37	10.20	14.00	30.31	52.53	53.72
Import	32.40	29.57	33.86	14.89	21.08	30.36	53.27	42.24
Composition in production accounts (excluding discrepancies):								
Primary industry	38.19	43.55	38.25	32.28	28.54	15.47	7.68	4.13
Secondary industry	21.29	22.72	27.60	21.33	26.87	36.83	45.75	42.53
Tertiary industry	40.52	33.73	34.15	46.38	44.59	47.71	46.57	53.34

War II, the trade balance was nearly zero from the 1950s to the 1980s, and reaped surpluses during the 1990s.

Our next example concerns Table III. Let us consider the two following identities among three factors:

$$\text{Nominal GDP} = \text{deflator} \times \text{real GDP},$$
$$\text{Real GDP} = \text{population} \times \text{real per person}.$$

We can then analyze the growth rate of nominal GDP by breaking it down into the real GDP, the GDP deflator, and population growth, and thus find average growth rates for different periods. Taiwan's pre–World War II growth rate was high by international standards, but due to high population growth, there was little improvement in living standards. In contrast, rapid economic growth from 1960 brought a large increase in per capita GDP. In addition, we can infer that the economic chaos of the 1940s slowed real GDP growth and increased the GDP deflator by even greater rates.

It is well known that the constant price system is too rigid to be applied for long-term historical statistics. Our case is no exception. Because relative prices changed remarkably throughout the economic development of Taiwan, the growth rate varies depending on the selection of the reference year. It is a good idea to apply yearly linkage-type indices for the implicit deflator as a proxy of a Divisia-type index suggested in the 1993 SNA; however, time-consuming research is necessary to perfect such an idea. To overcome such a dilemma, we propose a simplified form of link index method. Suppose an aggregated value (for example, GDP) is composed of a number of subgroups (for example, three industrial groups). To save work, just adjust the effects of relative price changes between subgroups, supposing the effects within groups are relatively small. This assumption would be ac-

TABLE III

A SUMMARY OF HISTORICAL ANNUAL GROWTH RATES OF GDP

Period	Nominal	Deflator	Real	Population	Per Capita
1912–20	12.76	10.74	1.82	1.13	0.69
1920–30	0.61	–4.63	5.50	2.22	3.21
1930–40	6.72	3.93	2.68	2.64	0.34
1940–45	28.39	69.36	–24.19	2.73	–26.21
1945–50	831.40	610.16	31.15	2.67	27.74
1950–60	22.85	11.70	10.00	3.68	6.08
1960–70	13.76	3.44	10.00	2.57	7.22
1970–80	20.72	9.36	10.39	2.01	8.21
1980–90	10.97	2.85	7.88	1.29	6.51

TABLE IV

COMPARISON OF CONSTANT PRICE METHOD WITH SEMI-DIVISIA METHOD IN THE CALCULATION OF REAL GDP

(Millions of yuan)

	1912	1920	1930	1940	1951	1960	1970	1980	1990
Series A	9,655	12,779	19,056	24,835	30,920	62,507	161,708	434,620	928,295
Series B	8,517	8,181	14,768	20,699	27,922	62,507	172,291	466,411	995,772
Series C	6,918	9,497	13,945	—	30,413	62,507	161,612	383,009	716,235

cepted under normal economic conditions. Based on this assumption, it would be possible to change base years of deflators every ten years and calculate the aggregated values. Long real data can be obtained by the linkage of these series. Table IV shows our preliminary results. GDPs in 1960 constant prices (Series A) are compared with those obtained by adjusting the effects of relative price changes between three industrial groups (Series B) and those adjusted for such changes between five expenditure groups (Series C)—private consumption, government consumption, gross capital formation, exports, and imports. Because data is not available from 1938 to 1950 for Series C, we interpolated them using the deflators for Series B.

CONCLUDING REMARK

As is noted in Section III, the purpose of this paper was to publish our estimates on long-term Taiwanese GDP. While we tried to obtain as reliable a series as possible, we admit that our work is far from complete. Finally, we call upon readers, especially users of the national accounts of Taiwan, to help us via comment and criticism to improve these preliminary estimates.

REFERENCES

China, Republic of (ROC), Directorate-General of Budget, Accounting and Statistics (DGBAS). 1992. *National Income in Taiwan Area of the Republic of China, 1992: National Accounts for 1951–1991 and Preliminary Estimates for 1992.* Taipei.

———. Various years. *Statistical Yearbook of the Republic of China.* Taipei.

China, Republic of (ROC), DGBAS, Evaluation Committee of National Income Statistics (ECNIS). 1995. "Minguo 30 nian zhi 39 nian guonei shengchan maoer" [Data for examinations on estimates of gross domestic product, 1941–50]. Taipei.

Government General of Taiwan. Various years from 1899 to 1942. *Taiwan sōtokufu tōkeisho* [Statistical annual of the Government General of Taiwan]. Taipei.

Ho, Samuel P. S. 1978. *Economic Development of Taiwan, 1860–1970.* New Haven, Conn.: Yale University Press.

Hsing, Mo-huan. 1963. "An Apraisal of the Growth Rates of the Taiwan Economy as Revealed in Official National Income Statistics." Mimeographed. Presented to the Eighth General Conference of the International Association for Research in Income and Wealth, Curfu, Greece, June 24–30. Quoted in Samuel P. S. Ho, *Economic Development of Taiwan, 1860–1970* (New Haven, Conn.: Yale University Press, 1978).

Kuo, Fang-Yao; Zho-Ying Cui; Ming-Zi Lin; and Jung-Yi Dong. 1997. "Minguo 26 nian zhi 39 nian Taiwan diqu guonei shengchan maoer zhi tuigu" [Estimates of gross domestic product in Taiwan Area, 1937–50]. Paper presented for the seminar on Economic Conditions of the 1940s Taiwan, held in the National Taiwan University in March.

Lee, Teng-hue. 1966. "Intersectoral Flows in the Economic Development of Taiwan, 1895–1960." Ph.D. diss., Cornell University. Quoted in Samuel P. S. Ho, *Economic Development of Taiwan, 1860–1970* (New Haven, Conn.: Yale University Press, 1978).

Mizoguchi, Toshiyuki. 1975. *Taiwan Chōsen no keizai seichō* [Economic growth in Taiwan and Korea]. Tokyo: Iwanami Shoten.

———. 1988. "Taiwan Kankoku no kokumin keizai chōki keiretsu no suikei" [Long-term national accounts of Taiwan and Korea]. In *Nihon Taiwan Kankoku no chōki hatten (senzen sengo o fukumu) no bunseki* [Analysis of the long-term (including prewar and postwar) development of Japan, Taiwan, and Korea], ed. Toshiyuki Mizoguchi. Kunitachi, Japan: Hitotsubashi University, Institute of Economic Research.

Mizoguchi, Toshiyuki, and Noriyuki Nojima. 1988. "Kokumin keizai keisan" [National accounting ststistics]. In *Kyū Nihon shokuminchi keizai tōkei: Suikei to bunseki* [Basic economic statistics of former Japanese colonies, 1895–1938: Estimates and findings], ed. Mataji Umemura and Toshiyuki Mizoguchi. Tokyo: Tōyō Keizai Shimpōsha.

Shinohara, Miyohei. 1971. "Kōgyōka to bōeki: Senzen o chūshin to shite" [Industrialization and trade: With special reference to pre–World War II]. In *Taiwan no keizai seichō* [Taiwan's economic growth], ed. Miyohei Shinohara and Shigeru Ishikawa. Tokyo: Institute of Developing Economies.

Shinohara, Miyohei, and Shigeru Ishikawa, eds. 1971. *Taiwan no keizai seichō* [Taiwan's economic growth]. Tokyo: Institute of Developing Economies.

Umemura, Mataji, and Toshiyuki Mizoguchi, eds. 1988. *Kyū Nihon shokuminchi keizai tōkei: Suikei to bunseki* [Basic economic statistics of former Japanese colonies, 1895–1938: Estimates and findings]. Tokyo: Tōyō Keizai Shimpōsha.

Wu, Tsong-Min. 1991. "1910 nian zhi 1950 nian Taiwan diqu guonei shengchan maoer zhi guji" [An estimation of Taiwan's gross domestic product: 1910–50]. *Jingji cong-kan* 19, no. 2: 127–76.

Yamamoto, Yūzō. 1988. "Taiwan Chōsen no bōeki to kokusai shūshi" [Foreign trade and balance of payments of Taiwan and Korea]. In *Kyū Nihon shokuminchi keizai tōkei: Suikei to bunseki* [Basic economic statistics of former Japanese colonies, 1895–1938: Estimates and findings], ed. Mataji Umemura and Toshiyuki Mizo-guchi. Tokyo: Tōyō Keizai Shimpōsha.