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The Approaches of Benchmarking QGDP to
AGDP in China

(provisional translation)

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QGDP, short for quarterly gross domestic product, refers to final products by all resident units in a country during one quarter, and can be obtained on the basis of various quarterly data. Because it is necessary for QGDP to be published timely and the coverage of basic accounts data is not complete, QGDP must be adjusted in terms of AGDP, short for annual gross domestic product, after AGDP is available. In other words, QGDP should be benchmarked to AGDP, and total quarterly number will be consistent with annual number.

In 1992, China began to calculate QGDP, but quarterly data had not been benchmarked to annual data for more than ten years. In 2003, national bureau of statistics of China (NBS) attempted to reconcile QGDP to AGDP systemically for the data from 1992 to 2001, after AGDP had been verified finally.

Condition of Data of QGDP in China

1. Accumulative approach is only used to quarterly accounting

As a result of the limitation of lacking basic data, the approach of accumulative accounting has been utilized for long time, i.e. China calculates GDP for Q1, accumulative GDP from Q1 to Q2, accumulative GDP from Q1 to Q3, and accumulative GDP from Q1 to Q4, rather than accounting for each quarter is developed separately.

2. Coverage of accounts only involves eight industries

Chinese quarterly accounts only includes data of eight industries, i.e. agriculture, industry, construction, transport, storage, post & telecommunication services, wholesale & retail trade and catering services, finance and insurance, real estate, and other services. According to

classification of industries branch, agriculture belongs to the primary industry, which includes agriculture, forestry, animal husbandry and fishery, and excludes the services of these items. Industry includes mining and quarrying, manufacturing, production and supply of water and gas, electricity, and industry and construction consist of the secondary industry. Except of agriculture, industry and construction, the other five industries are classified into the tertiary industry, which includes all services.

Some adjustment for the industry classification was made and the three industries were prescribed newly in the late vision of *The Classification of National Economic Industry* (GB/T4754-2002) in 2002. However, all data involved in this paper are not adjusted according to the new criterion.

3. There is not any adjustment for quarterly data after released

Chinese quarterly accounting was dealt with far late, and because of the limitation of capability and the shortage of experience, QGDP data were not adjusted at all times since these quarterly data were released in the fifteenth day after corresponding quarter. In other words, before quarterly data were reconciled to annual data in 2003, neither were quarterly data verified in the basis of more detailed data and benchmarked to annual data, nor was seasonal adjustment made for quarterly data, so quarterly data were stayed in initial state.

The Choice of the Approaches of Benchmarking

There are many approaches of benchmarking abroad, and common approaches include pro-rata benchmarking technique, pro-rata Denton method and regression model method. Pro-rata technique is to distribute the difference between total number of quarterly data and annual data into corresponding quarterly indicators. This method is the simplest benchmarking technique, so it is easy to comprehend and use. However, this method does not take the

continuity of time series into account, so the “step problem” may be introduced in the benchmarked quarterly time series, and this problem will result in great error of estimates. Pro-rata Denton method can avoid this limitation. The movements in the benchmarked quarterly national accounts is kept as proportional as possible to those in the quarterly indicator series using a least square technique to minimize the difference in relative adjustment to neighboring quarters subject to annual total constraint. Under the constraints of annual total number, relative difference for adjacent quarters is minimized as much as possible, and the step problem is avoided consequently. Model method refers to use regression model to benchmark quarterly data to annual data. NBS chooses the pro-rata technique to benchmark QGDP to AGDP, and the reason of choosing the method is as follows:

1. Accumulative account is used in Chinese QGDP accounts, and therefore, the step problem between Q4 of one year and Q1 of the next year does not appear when the pro-rata technique is chosen to benchmark.

2. Because China attempts to benchmark QGDP to AGDP for the first time, it is not feasible to choose complicated methods. The pro-rata technique is easy to comprehend and accept for the public.

3. Pro-rata Denton method has been selected to try to calculate quarterly data of some industries before the pro-rata technique is selected finally, and then it is found that the difference between results about the two methods is not obvious. Hence, the most feasible method, i.e. the pro-rata technique, is selected to benchmark QGDP to AGDP in China.

The Process of Benchmarking QGDP to AGDP

The basic thought of the pro-rata technique is: at first, added-value at current prices of the above eight industries are benchmarked respectively, and the same to added-value at constant prices, then GDP and added-value of the

three industries are the total added-value of industries after benchmarked. The detailed process is as follows:

1. Transforming accumulative data to discrete quarterly data

Discrete quarterly added-value at current prices and at constant prices for the eight industries can be derived respectively by residual procedures from accumulative data, i.e. that is taking the difference between accumulative quarterly data and corresponding accumulative quarterly data, so two sets of time series can be formed: One series is quarterly time series of data of added-value at current prices for the eight industries, another series is quarterly time series of data of added-value at constant prices for the eight industries.

2. Pre-adjustment

Before formal benchmarking is operated, pre-adjustment should be made for time series of primal QGDP accounts, including time series of added value and time series of growth rate, in order to ensure the reliability of benchmarking results. The detailed process is as follows:

- a. Eliminating the inconsistency between primal time series

By observing primal time series, there may be inconsistency in some time between time series of growth rate over the previous year calculated by added-value and time series of primal growth rate. Some adjustment for primal time series should be made in order to keep consistency between time series. The fundamental of adjustment is to regard quarterly added-value of 2001 as the benchmark level, and then adjustment for data of discrete quarterly added-value of past years is made according to growth rate at the condition of keeping time series of growth rate in immovability.

- b. Ensuring the reasonability of proportion of quarterly added-value for every industry in each year

According to agriculture, industry, construction, transport, storage, post and telecommunication services, wholesale & retail trade and catering services,

finance and insurance, real estate, other services, some indicators related closely to added-value of these industries can be selected. These indicators include gross output value of agriculture, gross output value of industry, investment in construction and installation, turnover of passenger & freight and business volume of post & telecommunications, total retail sale of consumer goods, outstanding of deposits and loans, floor space of sold commercial houses, compensation of employees in other services. The quarterly proportions of these indicators are compared with the quarterly proportion of industries added-value, and it will be found that there is great difference between both proportions in some industries. For this kind of industries, quarterly added-value should be adjusted according to the quarterly proportion of related indicators. The industries, which need to be adjusted, are as follows:

a) Construction ([see chart 1](#))

At first, the quarterly proportions of investment in construction and installation are calculated, and the results are that the proportion of investment of Q1 is 23 percent approximately, the proportion of Q2 is 25 percent approximately, the proportion of Q3 is 24 percent approximately, and the proportion of Q4 is 28 percent approximately. These data accord basically with seasonal characters of construction. Secondly, the proportion of quarterly added-value of construction is calculated, and then by comparing the proportion of quarterly added-value with proportions of investment in construction, it is found that the difference between proportions is great in some quarters from 1992 to 1999. Thirdly, for these quarters, quarterly added-value of construction is adjusted according to quarterly proportion of investment.

b) Transport, storage, post and telecommunication services (see [chart 2](#))

Comparing quarterly proportion of turnover of passenger & freight and business volume of post & telecommunications with quarterly proportion of

quarterly added-value of transport, storage, post and telecommunication services, the difference for 2000 is great. In order to reduce the difference as much as possible, quarterly added-value of this industry for 2000 is adjusted according to quarterly proportion of related indicators. Subsequently, quarterly added-value of this industry for each year is derived by growth rate in terms of adjusted quarterly added-value of 2000, which is regarded as the benchmark level.

3. Using the pro-rata technique to benchmark QGDP to AGDP

After pre-adjustment, time series of quarterly added-value at current prices and at constant prices for the eight industries are benchmarked to annual data by pro-rata technique. The benchmark formula is:

$$X_{q,t} = \left(A_t - \sum_q I_{q,t} \right) \times \left[\frac{I_{q,t}}{\sum_q I_{q,t}} \right] + I_{q,t}$$

In which, $X_{q,t}$ is the data of quarter q of year t after benchmarked, A_t is the benchmark data of t year, $I_{q,t}$ is the data of quarter q of year t before benchmarked.

4. Transforming quarterly benchmarked data into accumulative data

Because accumulative approach is used for quarterly accounting in china, it is necessary to transform quarterly benchmarked data into accumulative data. For example, adding Q1 and Q2 can gain the sum of Q1 and Q2, and adding Q1, Q2 and Q3 can gain the sum of from Q1 to Q3.

5. Calculating GDP and added-value of the three industries

Quarterly added-value at current prices for the primary industry is quarterly benchmarked added-value at current prices for agriculture. Quarterly added-value for the secondary industry is the sum of quarterly benchmarked added-value at current prices for industry and construction. Quarterly added-value for the tertiary industry is the sum of quarterly benchmarked

added-value at current prices for transport, storage, post and telecommunication services, wholesale & retail trade and catering services, finance and insurance, real estate, and other services. Then, benchmarked QGDP at current prices is derived from the sum of added-value for the three industries. GDP and added-value at constant prices for the three industries can be obtained by the same processes.

Data comparison between primal data and benchmarked data

In terms of above processes, two aspects can affect the difference between primal data and benchmarked data: one is the extent of pre-adjustment, and another is the difference between annual data as the benchmark level and accumulative data of corresponding quarters.

1. Comparison for added-value at current prices

a. Comparison for GDP at current prices (see [chart 3](#))

It can be found from table 3 that the biggest difference, 561.2 billion Yuan, between benchmarked data and primal data at current prices appears in from Q1 to Q3 in 1994.

b. Comparison for added-value at current prices of agriculture (see [chart 4](#))

It can be found from table 4 that the biggest difference between benchmarked added-value and primal added-value for this industry is 122.62 billion Yuan, and appears in from Q1 to Q4 in 1994.

c. Comparison for added-value at current prices of industry (see [chart 5](#))

It can be found from table 5 that the biggest difference between benchmarked added-value and primal industry added-value for this industry is 138.39 billion Yuan, and appears in from Q1 to Q3 in 1995.

d. Comparison for added-value at current prices of construction (see [chart 6](#))

It can be found from table 6 that the biggest difference between benchmarked added-value and primal construction added-value for this industry is 103.98 billion Yuan, and appears in from Q1 to Q3 in 1994.

e. Comparison for added-value at current prices of transport, storage, post and telecommunication services (see [chart 7](#))

After pre-adjustment, large adjustment is made for added-value at current prices for this industry. Hence, the difference for almost quarters between benchmarked added-value and primal added-value is comparatively obvious, and the biggest difference is 90.27 billion Yuan, which appears in from Q1 to Q3 in 1999.

f. Comparison for added-value at current prices of wholesale and retail trade & catering services (see [chart 8](#))

It can be found from table 8 that the biggest difference between benchmarked added-value and primal added-value for this industry is 13.47 billion Yuan, and appears in from Q1 to Q3 in 1994.

g. Comparison for added-value at current prices of finance and insurance (see [chart 9](#))

It can be found from table 9 that the biggest difference between benchmarked added-value and primal added-value for this industry is 40.02 billion Yuan, and appears in from Q1 to Q3 in 1995.

h. Comparison for added-value at current prices of real estate (see [chart 10](#))

It can be found from table 10 that the biggest difference between benchmarked added-value and primal added-value for this industry is 21.49 billion Yuan, and appears in from Q1 to Q4 in 1992.

i. Comparison for added-value at current prices of other services (see [chart 11](#))

It can be found from table 11 that the biggest difference between

benchmarked added-value and primal added-value for this industry is 131.19 billion Yuan, and appears in from Q1 to Q3 in 1996.

2. Comparison for growth rate at constant prices

After added-value at constant prices is benchmarked according to annual data as the benchmark level, growth rate for benchmarked added-value over the previous year can also be calculated, so it is found that there is some difference in growth rate when new growth rate is compared with primal growth rate. The difference appears in years before 1996, and also appears in 2001. The biggest difference in growth rate appears in from Q1 to Q4 in 1994, an increase of 0.8 percent (see [chart 12](#)).

It can be found from benchmarked data of the three industries (see [chart from 13 to 20](#)) that adjustment for tertiary industry is made by large margin. It is difficult for basic data used to accounting for tertiary industry to obtain, so the result is not exact and error is large. In annual accounting, annual estimates are more reliable because comprehensive and particular data can be available, but the difference in estimates between quarterly accounts and annual accounts may be large. Hence, adjustment may be made by large margin when benchmarking quarterly data to annual data.

The Publication of Benchmarked data

In 2003, NBS released data of quarterly accounts after benchmarked according to finally verified annual data, and published *Historical Data of China Quarterly GDP Accounts from 1992 to 2001*. For the future, quarterly data will be benchmarked successively after annual data are verified finally, and benchmarked data will be published in publication.