

## Appendix B6

### Adjustment of the Rural CPI

The adjusted rural consumer price index (CPI) adjusts the official rural CPI to take into account self-produced-self-consumed goods, which the official rural CPI appears to not consider. The necessary data to do so are available for 1987-2002.

#### *Justification of the adjustment*

One reason to believe that the official rural CPI only covers monetary living expenditures is the official definition of the rural CPI as measuring the “relative change in the price of consumer goods and services purchased [*goumai*] by rural households” (*Statistical Yearbook 2003*, p. 336, or similar in earlier editions). The Chinese term for “purchased” unambiguously implies a monetary purchase. Liu Chengxiang, Liu Ke, and Jin Yaofeng (2000), p. 108, in their otherwise detailed explanations of the variables covered in official statistics, provide the same definition and very few further details. Given the scope of their explanations on other variables, one would expect them to elaborate on the handling of rural self-produced-self-consumed products if these were covered.

The terms used within the tables of published data in the *Statistical Yearbook* confirm the limitation of the rural CPI coverage to monetary living expenditures. Thus, in the table on rural monetary living expenditures, the two exhaustive categories of consumer goods and services both come with the term “purchase” (*goumai*),<sup>1</sup> while in the table on total living expenditures (covering monetary and self-produced-self-consumed living expenditures), the relevant term is “expenses” (*zhichu*).<sup>2</sup> The term “purchase” rather than the term “expenses” appears in the definition of the CPI.

A second reason to believe that the official rural CPI only covers monetary living expenditures comes from an examination of data for 1997. The year 1997 was chosen from all years between 1990 and 2002 because it had a relatively large discrepancy between the annual change in the rural consumer price category foods and the annual change in the price index for grain (within foods); grain is the main item in self-produced-self-consumed products (the products suspected of not being included in the official rural CPI). The rural CPI was recalculated using the approximately corresponding eight categories in the rural household living expenditure survey to weight the different price indices within the rural CPI. (i) When only monetary rural household living expenditure data are used as weights, with no breakdown of foods available, the reconstructed rural CPI is 101.9 vs. the official rural CPI of 102.5. (ii) When rural household *total* living expenditure data are used as weights, ignoring the available breakdown of foods and using the corresponding eight major categories (of the CPI and total living expenditures), the reconstructed CPI is 101.4, slightly further away from the official rural CPI than in the previous scenario. (iii) In an additional step, the grain

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<sup>1</sup> In detail, the two terms are “purchase of living consumer goods” (*goumai shenghuo xiaofeipin*) and “purchase of non-goods” (*goumai feishangpin*).

<sup>2</sup> In detail, the two terms are “living consumer goods expenses” (*shenghuo xiaofeipin zhichu*) and “non-goods expenses” (*feishangpin zhichu*).

(*liangshi*) price index within the CPI's foods price index is applied to the consumption of staples (*zhushi*) in the living expenditure survey (see the appendix on rural grain prices for the identical coverage of the terms grain and staples). Reconstructing the rural CPI by splitting the category foods within living expenditures into the two groups staples and other foods, and applying the grain price index to staples and the arithmetic mean of all other 16 food price indices to the other foods, while for the other seven price indices within CPI proceeding as above, yields a reconstructed CPI of 96.5, much further away from the official rural CPI. In other words, if self-produced-self-consumed products—mainly staples—are properly weighted, the resulting CPI is far removed from the official CPI. (For CPI and living expenditures data see *Statistical Yearbook 1998*, pp. 303f., 348.)

The relationships between the three reconstructed rural CPIs in 1997 suggests that the weights used in the construction of the official rural CPI reflect only the monetary rural living expenditures. In other words, in the official rural CPI the self-produced-self-consumed living expenditures—which consist almost solely of foods, and within foods, of grain—are not included.

### *Adjustment procedures*

In 1990, nationwide average rural monetary living expenditures of 374.74 yuan per capita contrasted with rural self-produced-self-consumed living expenditures of 209.89 yuan. The official rural CPI, thus, in 1990, covered less than two-thirds of all living expenditures, namely 374.74 yuan out of a total of 584.63 yuan (374.74 + 209.89 yuan). There exists no CPI and no product-specific price indices to cover the rural self-produced-self-consumed living expenditures (209.89 yuan) or products within this category. The adjusted rural CPI constructed here attempts to include the rural self-produced-self-consumed living expenditures in its coverage and, thus, to cover *all* living expenditures (584.63 yuan). (Also see table below.)

Calculation of the adjusted rural CPI involves three steps:

1. The price subindices in the official rural CPI (which is based on monetary expenditures only), as far as relevant for the in-kind living expenditures (for which no price indices are available), need to be identified or, if need be, calculated.
2. To obtain a price index for self-produced-self-consumed (i.e., in-kind) goods and services, these relevant price subindices in the official rural CPI need to be combined following (using) the relative weights of the corresponding *in-kind* living expenditure categories.
3. To obtain the adjusted rural CPI covering *all* rural living expenditures, the official rural CPI (covering monetary living expenditures only) and the constructed price index for rural self-produced-self-consumed goods and services need to be combined in accordance with the relative values of living expenditures in the monetary vs. in-kind categories.

In order to conduct the calculations necessary to obtain an adjusted rural CPI, monetary vs. non-monetary expenditure data on staples, a sub-category of foods, are needed; these data are only available in more recent publications, following the *new* living expenditure classification. For a comparison to the earlier living expenditure classification see the appendix on living expenditure classification schemes and imputation prices.

## Step 1

The in-kind living expenditures (self-produced-self-consumed goods and services) of 209.89 yuan per capita in 1990, on nationwide average, comprised mainly self-produced-self-consumed foods at 187.91 yuan per capita, and, within foods, staples at 117.97 yuan; non-staple foods were 65.80 yuan, and an implicit foods residual was 4.14 yuan. (Also see the table below.) In the following, adjustments are only made to take into account the self-produced-self-consumed foods, worth 187.91 yuan. I.e., the self-produced-self-consumed non-foods valued at 21.98 yuan (209.89 less 187.91) are ignored; this implies the assumption that they experienced a similar rate of inflation as the average product in the adjusted rural CPI.

In order to be able to match CPI categories and living expenditure categories, self-produced-self-consumed foods are considered in two separate categories, staples (in 1990, on nationwide average, 117.97 yuan per capita) and all other self-produced-self-consumed foods, in the following called “non-staples” (69.94 yuan, namely 65.80 yuan official “non-staples” plus the implicit residual of foods of 4.14 yuan). The relevant price indices for self-produced-self-consumed staples and self-produced-self-consumed non-staples need to be obtained from the official rural CPI (compiled to match monetary living expenditures) and its subindices. The relevant price index for the self-produced-self-consumed staples is the staples subindex in the official rural CPI. The relevant price index for the self-produced-self-consumed non-staples is the residual (covering all foods except staples) subindex of foods in the official rural CPI. This residual subindex is not published.<sup>3</sup> However, the implicit price index for non-staples in the official rural CPI can be reverse-engineered through the following equality, which the constructors of the official rural CPI must have used to obtain the foods price index in the official rural CPI in the first place:

$$\begin{aligned} \text{Foods price index in the official rural CPI} = \\ \text{share of staples in monetary foods expenditures} * \text{staples price index} + \\ \text{share of non-staples in monetary foods expenditures} * \text{non-staples price index.}^4 \end{aligned}$$

The here unknown non-staples price index can be (and is) backed out of the above equation.

--- Regarding the hierarchy of price indices, the, for example, staples price index is a subindex of the foods price index, which is a subindex of the CPI; in the equation above, and in the following, for simplicity, the various “sub”s are omitted. ---

Out of the five terms in the equation, four are known. The foods price index in the official rural CPI is available, as is the staples price index in the official rural CPI.<sup>5</sup> The shares of staples and non-staples (including the implicit residual of foods expenditures) in monetary

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<sup>3</sup> What is published are a large number of further subindices within foods which cannot be properly matched with the official “non-staples” and with the implicit residual of foods in the living expenditure data.

<sup>4</sup> The constructors of the official rural CPI presumably have price data and living expenditure data available on a large number of non-staples sub-categories. Using the aggregate of these sub-categories here—in the absence of sufficiently detailed living expenditure data across provinces—makes no difference to the accuracy of the calculation.

<sup>5</sup> The sources of the official rural CPI and its subindices are the *Statistical Yearbook* series, the *Price Statistical Yearbook* series, the *Rural Statistical Yearbook* series, the *Price Yearbook* series, and the *Urban Household Survey Yearbook* series.

foods expenditures are also known—assuming that the NBS uses the corresponding household expenditure shares. (For the raw, nationwide average 1990 data see the table below.) For example, nationwide, monetary living expenditures on foods in 1990 were 155.85 yuan per capita, and, within foods, on staples 17.50 yuan. The share of staples in monetary foods expenditures thus is 0.112287 (17.50/155.85). The share of non-staples (official “non-staples” of 80.29 yuan and an implicit residual of 58.06 yuan) is 0.887713 (unity less 0.112287, or (80.29+58.06)/155.85).

Data on foods price indices, staples price indices, monetary living expenditures on staples, and monetary living expenditures on non-staples are available at the provincial level for the years 1987 through 2002. (For the years prior to 1987 the needed rural price indices are not available and no attempt is made to approximate an adjusted rural CPI; for the years after 2002 the monetary living expenditure data on staples are not available.) For each province, in each year, the equation can be solved for the unknown, implicit non-staples price index.

One may wonder why province-specific weights (expenditure shares) rather than nationwide average weights are used to calculate the provincial non-staples price index (which differs across provinces already because the foods price index and the staples price index vary across provinces). An association could be made between the use of nationwide average weights for all provinces, and the use of fixed (nationwide average) quantities in the construction of the 1990 basket (which is then priced in each province). But the weights used here are “price index weights” rather than quantity weights in the calculation of absolute prices. The objective here, in reverse-engineering the equation, is to obtain an accurate provincial-level price index for a specific good (non-staples); to obtain this price index the best choice of expenditure shares (for staples and non-staples) is the ones which underlie the derivation of the provincial foods price index in the first place, i.e., the provincial shares.<sup>6</sup>

One complication is data availability on the staples price index in the official rural CPI in 1992 and 1994. In these two years, data on the staples price index in the official rural CPI are not available *across provinces*; the two figures for the *nationwide* staples price index in the official rural CPI are available. In both years, 1992 and 1994, the *total* (aggregate rural-urban) retail sales staples price index was used. Up through 1993, the official CPI comprises services and consumer goods, where the consumer goods data are taken from the retail sales price index statistics (in the most recent years, a comparison of relevant price indices in the CPI and the retail sales price index shows an extremely small discrepancy). Thus, the uncertainty introduced by this procedure is that a total (aggregate rural-urban) instead of rural-only staples price index is used. In 1994, the (known) nationwide *rural* CPI staples price index at 150.7 (a 1.507-fold increase over the previous year) was exactly identical to the *total* (aggregate rural-urban) nationwide retail sales staples price index. In 1992, the nationwide *rural* CPI staples price index (i.e., in 1992, retail sales staples price index) at 112.7 compared to the *total* nationwide retail sales staples price index at 124.3; consequently the retail sales staples price index is multiplied, here, across all provinces by 112.7/124.3 (the

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<sup>6</sup> Using fixed, nationwide average weights of 1990 for all provinces in all years, in each of the three steps, yields an outcome very similar to the one using province- and year-specific weights. For example, the correlation coefficient between the price of the rural basket in 2000 based on an adjusted rural CPI using *nationwide average (1990)* weights throughout and the price of the rural basket in 2000 based on an adjusted rural CPI using *province- and year-specific* weights is 0.9544 (after omitting the in the two cases identical values of Beijing, Tianjin, Shanghai, and Chongqing), a value significant well below the 0.1% significance level.

ratio which makes the nationwide value of the total retail sales staples price index equal to the known rural nationwide CPI staples price index). To judge the margin of error inherent in using the *total* retail sales staples price index instead of the *rural* CPI (or, rather, retail sales) staples price index, the two vectors of values (across provinces) were compared in each of the years 1991, 1993, and 1995. The correlation coefficients in the three years were 0.8186, 0.8488, and 0.9015, which all imply a significance level smaller than 0.1%. The substitution procedure used here for the years 1992 and 1994, thus, appears highly justified.

### *Step 2*

At this point in the calculations, for each province in each year (1987-2002) the staples price index (from the official rural CPI) has been identified and a non-staples price index has been backed out of the official rural CPI. In the second step, these two price indices need to be weighted according to the value of the two different in-kind living expenditure categories, staples and non-staples, that make up the total *in-kind* living expenditures considered here (self-produced-self-consumed foods). The weights are year-specific (and province-specific).

The constructed price index for self-produced-self-consumed foods then is the combination of the official rural CPI staples price index and the constructed official rural CPI non-staples price index. For example, at the nationwide level in 1990, the relative weights are given by the 1990 living expenditures on self-produced-self-consumed goods, as reported above, and in the table below, with 117.97 yuan per capita, vs. 69.94 yuan (65.80 yuan official “non-staples” and 4.14 yuan residual foods) out of total self-produced-self-consumed foods of 187.91 yuan, i.e., weights of 0.627801 and 0.372199. The weights for each province in each year are similarly calculated. The result is a constructed price index for self-produced-self-consumed foods for each province in each year (and a nationwide average value in each year).

### *Step 3*

In the third step, this constructed price index for self-produced-self-consumed foods is combined with the official rural CPI (which only covers monetary living expenditures) into the adjusted rural CPI. The relative weights are rural living expenditures on self-produced-self-consumed foods of, in the nationwide case in 1990, 187.91 yuan per capita vs. total rural monetary living expenditures of 374.74 yuan, relative to the sum of the two values of 562.65 yuan, i.e., 0.333973 and 0.666027. The sum of self-produced-self-consumed foods and all monetary living expenditures, 562.65 yuan, plus the non-foods self-produced-self-consumed living expenditures of 21.98 yuan yields 584.63 yuan, the nationwide total (monetary and non-monetary) rural living expenditures, (which, by construction of the nationwide rural basket, is also the value of the nationwide rural basket). This handling of the non-foods self-produced-self-consumed living expenditures implies that these are assumed to be subject to the same price changes as the average item included in monetary living expenditures and self-produced-self-consumed foods.

For the derivation of the province- and year-specific adjusted rural CPI, province- and year-specific data covering rural living expenditures on self-produced-self-consumed foods and total rural monetary living expenditures are used.

### *Province- and year-specific data complications*

For Beijing, Tianjin, Shanghai, and the in 1997 newly elevated to provincial-level rank Chongqing (previously part of Sichuan), no rural consumer price indices are available at all. In these four provincial-level municipalities, the official provincial CPI equals the official urban CPI. In the absence of official rural CPI data, what is labeled “official rural CPI” here is the published official provincial CPI (which in turn is identical to the published official urban CPI). An adjusted rural CPI cannot be calculated and the value of the adjusted rural CPI reported here therefore also equals the official provincial CPI.

Until 1996, Chongqing was part of Sichuan; in 1997 it became an independent provincial-level entity. Thus, the basket cannot be priced in Chongqing in the base-year. It is assumed that the base-year value of the basket in Chongqing is the same as in all rural areas of Sichuan, and that prices prior to 1997 changed over the years at the same rate as in the rural areas of Sichuan. The pre-1997 Chongqing official rural CPI and adjusted rural CPI are copies of the Sichuan official and adjusted rural CPIs. Given the exclusion of Chongqing from Sichuan in 1997, the Sichuan CPI, after 1996, remains meaningful as a time series only if it is assumed that the non-Chongqing areas in Sichuan had the same relevant price characteristics as Chongqing in 1996.

No official rural CPI, rural foods and staples price indices are available for Tibet in the years prior to 1999, but living expenditure data are for all years. For the missing price indices, Qinghai values are substituted. The adjusted rural CPI of Tibet in the years prior to 1999 then is a combination of Qinghai values (in terms of underlying price indices) and Tibet values (in terms of weights calculated from living expenditure data).

The needed, detailed rural household living expenditure data are available only for 1985 (but not for Hainan), 1990, and then the years 1993-2002.<sup>7</sup> Values for the missing years, i.e., for 1987-1989, 1991, and 1992 are obtained through linear interpolation based on the 1985 and 1990 values in the case of the missing values for the years 1987-1989, and based on the 1990 and 1993 values in the case of the missing values for the years 1991 and 1992.<sup>8</sup>

Variation of province-specific weights across years can be considerable. Variations on the order of 10-20% across two years in a particular weight (specific to a particular province) are common. Going back to the raw data, in one case what seemed an obvious typo in the original source was corrected. In all other cases the original data were not altered, even if their time series did not appear credible.

### *Alternative data*

An alternative, less feasible calculation would have been the following. To inflate the self-produced-self-consumed part of living expenditures, which largely represent foods, the

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<sup>7</sup> The sources of the detailed rural household living expenditure data are the *Rural Household Survey Yearbook* and the *Rural Statistical Yearbook* series.

<sup>8</sup> Calculating the correlation coefficient across provinces of the 1985 vs. 1990 values, and, separately, the 1990 vs. 1993 values, individually for each of the three types of living-expenditure-based weights used in the derivation of the adjusted rural CPI, all 6 correlation coefficients are significant at the 0.1% level. Beginning-of-period and end-of-period values, thus, appear sufficiently similar to justify interpolation.

agricultural procurement price index could be used instead of the rural CPI. (It could also be used to value *all* foods, whether self-produced-self-consumed or purchased using money.) The largest item within the self-produced-self-consumed living expenditures, accounting for more than half of the total, is staples (grain); the agricultural procurement price index for grain, at the national level, exhibits a time pattern somewhat different from the rural CPI grain price index. Agricultural procurement price indices would also be available for other foods such as edible oil, livestock, or vegetables. However, there are three reasons not to use the agricultural procurement price index. One is that in 1990, as explained in the appendix on rural grain prices, the agricultural procurement price of grain did not match the implicit price (implicit in the rural living expenditure and income data) very well. Second, provincial-level agricultural procurement price index data are scarce. *50 Years of New China* reports the overall agricultural procurement price at the provincial level until 1998, but for the most recent years, and for the various subindices, individual provincial statistical yearbooks of the individual years would have to be consulted, and it is near-certain that not all provincial statistical yearbooks carry the information. Third, the agricultural procurement price index is unlikely to cover all agricultural products, and unlikely to use the weights implicit in the total rural living expenditures.

### Rural Living Expenditures, 1990, yuan per capita

	Total (monetary & in-kind)	Monetary	In-kind
New classification scheme (at new imputation prices)			—obtained as residual—
Total	584.63	374.74	209.89
1. Foods	343.76	155.85	187.91
a. Staples	135.47	17.50	117.97
b. Non-staples	146.09	80.29	65.80
c. Implicit residual	62.2	58.06	4.14
2. Clothing	45.44	44.03	1.41
3. Residence	101.37	81.15	20.22
4. Consumer durables and services	30.90	30.74	0.16
5. Health	19.02	18.98	0.04
6. Transport and telecommunications	8.42	8.41	0.01
7. Culture, education, entertainment	31.38	31.33	0.05
8. Others	4.34	4.25	0.09

Sources: *Rural Household Survey Yearbook 2003*, pp. 35, 40. In-kind data are not officially available, and calculated as a residual of total living expenditures less monetary living expenditures.

### References relevant for this appendix and not listed in the paper

- 50 Years of New China. Xin zhongguo wushi nian tongji ziliao huibian (Comprehensive Statistical Data and Material on 50 Years of New China)*. Beijing: Zhongguo tongji chubanshe, 1999.
- Price Yearbook. Zhongguo wujia nianjian (China Price Yearbook)*. Beijing: Zhongguo wujia chubanshe. Various years.