CHAPTER 9

Validation of ICP Regional Prices and Basic Heading PPPs

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The national coordinating agencies (NCAs) of countries participating in regional comparisons of the International Comparison Program (ICP) provide the regional coordinating agency (RCA) with a set of national annual purchasers' prices for a selection of items chosen from a common list of precisely defined products. The prices refer to the year of the comparison and cover the whole range of final goods and services included in the gross domestic product (GDP). They are used to calculate purchasing power parities (PPPs) for basic headings, and the basic heading PPPs are used to derive intraregional measures of price and volume relatives for the countries participating in the comparison. The measures are subsequently published by the RCA, thereby reaching a variety of users, including policy makers, economic analysts, researchers, politicians, and journalists, as well as the general public. If the measures are to contribute accurately to informed debate, it is essential that the prices on which the PPPs are based are rigorously checked and corrected for error—that is, validated—before the PPPs are calculated. The validation of price data is thus a priority for ICP regional comparisons. This chapter describes how the ICP validates regional price data. The same procedures are employed to validate price data collected across regions in order to combine them in a global comparison.

Two types of error are considered here: sampling error and nonsampling error. Sampling error occurs because the prices on which the PPPs are based are collected from a sample of outlets rather than from all outlets. Nonsampling error occurs for reasons such as pricing the wrong product or incorrectly recording the product's price or unit of measure. An important distinction between the two types of error is that sampling error would disappear if prices were collected by an enumeration of all outlets, but nonsampling error would not; it would continue to occur. Sampling error is controlled before price collection through sample design; nonsampling error is handled both before and during price collection through good survey design and management and after price collection through validation. ICP validation is directed at nonsampling error and not sampling error. The objective is to minimize, if not eliminate, the incidence of nonsampling error

among regional price data after collection. This goal is achieved by editing and verification. Editing consists of checking prices for possible errors. Verification consists of either confirming that the prices identified as possible errors are correct or correcting them if they are not.

Validation is an iterative process requiring a number of rounds of editing and verification. Possible errors are found by identifying prices that have a measure of divergence that is greater than a given critical value or a value that falls outside a given range of acceptable values. The divergence measures are generally defined by the parameters of the series being edited—parameters such as the average and the standard deviation. Hence if some of the possible errors identified in the initial edit are found to be actual errors and are corrected, the parameters of the price series will change and so will the divergence measures of each price remaining in the series. A second edit will find new possible errors that must be verified. Again, when the actual errors are corrected, the parameters of the price series will change, which may lead to more possible errors being detected if a third edit is made. Usually the number of new possible errors falls as the validation progresses, until the return on further rounds is considered marginal and not worth pursuing. Time is also a consideration: first, because of the need to release data on a timely basis and, second, because the longer the delay between price collection and verification, the more difficult it becomes to correct the prices that are wrong.

ICP validation comprises two separate processes: one to edit and verify the prices collected by a single country, referred to as *intra*country validation; the other to edit and verify the prices collected by all countries participating in the regional comparison, referred to as *inter*country validation. Intracountry validation is directed at a country's individual price observations and the average prices to which they give rise. The objective is to verify that price collectors *within a country* have priced comparable products and have priced them correctly. It is carried out by the country's NCA, with or without input from the RCA, depending on the region. Intercountry validation is directed at the average prices reported by participating countries and the price ratios that the average prices generate between the countries. The objective is to verify that price collectors *in different countries* have priced products that are comparable across the countries and have priced them correctly. Intercountry validation takes place after intracountry validation and is carried out jointly by the RCA and the NCAs. Both processes are explained in this chapter.

Before considering the validation processes, it is important to emphasize that prevention is preferable to correction. The incidence of nonsampling error can be significantly reduced through good survey design and management. Price collections should be carefully planned, efficiently carried out, and properly supervised; product specifications should be sufficiently detailed to enable price collectors to identify products unambiguously in the outlets they visit; price collectors should be well trained, given clear instructions, and provided with price reporting forms that are user-friendly; fieldwork should be closely monitored to ensure that price collectors record the prices, quantities, and other data required; and the staff engaged in processing and validating the prices should be properly trained and supervised. Validation complements good survey practice. Failure to observe good survey practice will not be rectified through editing and verification, however thorough.

Possible Errors, Errors, and Outliers

For a price comparison to be valid, the products whose prices are being compared must be comparable—that is, the same or equivalent—and the prices themselves have to be free from error and bias. Failure to meet either one of these requirements negates the comparison. To avoid this

happening, the editing and verification procedures employed for the ICP regional comparisons focus on the main types of nonsampling error: product error and price error.

A *product error* occurs when price collectors price products that do not match the product specification and then neglect to report having done so. Perhaps they are not aware of the mismatch, such as when the product specification is too loose,[1] or perhaps they price a substitute product as required by the pricing guidelines but do not mention this on the price reporting form. Price collectors are usually instructed to collect the price of a substitute product if they are unable to find the product specified. They are further instructed to flag the substitution and to note the differences between the substitute product and the specified product. Flagging brings the substitution to the attention of the NCA, which, together with the RCA, can then decide what to do with the price collected. It may be possible to adjust the price for quality differences between the product priced and the product specified. Or, if other countries report prices for the same substitute product,[2] price comparisons can be made for the substitute product, as well as for the product originally specified. If neither of these options is available, the price will have to be discarded. Substitution does not in itself introduce error. It is the failure of price collectors to flag and document the substitution that gives rise to a product error.[3]

A *price error* occurs when price collectors price products that do match the product specification but record the price incorrectly, or they record the price correctly and error is introduced afterward in the process of reporting and transmitting the price. Associated with each price is a quantity: the specified quantity (the quantity to be priced) and the reference quantity (the quantity to which the price collected is to be adjusted). Price error can also arise because, even though the price is correctly recorded, the quantity priced is recorded incorrectly (or it is recorded correctly and error is introduced later during processing), so that the adjusted price for the reference quantity, which is the price that is validated, will be wrong as well.[4]

Editing for product errors and price errors involves identifying prices that have extreme values—that is, prices whose values are determined to be either too high or too low vis-à-vis the average according to the criteria used. The price may score a value for a given test that exceeds a predetermined critical value, or its value may fall outside some prespecified range of acceptable values. Both are standard ways of detecting errors in survey data, and both are employed by the ICP. Prices with extreme values are not necessarily wrong. But the fact that their values are considered extreme suggests that they could be wrong—that is, they are possible errors and need to be investigated. It is not ICP practice to reject prices with extreme values outright; rather, the ICP first establishes whether they are genuine observations. Then it can decide how to deal with them. Prices with extreme values that are found to be wrong are errors and should be corrected or dropped. Prices with extreme values that are shown to be accurate observations are "outliers"[5] and should be retained if they are part of the population defined by the rest of the price observations. In practice, it is not unusual for outliers that meet this criterion to be "corrected"—that is, discarded or replaced by an imputed value—in order to remove the "noise" they introduce into the data set.

Inliers and Bias

Just as all prices that have a test score above a critical value or a value that falls outside a range of acceptable values are not necessarily errors, all prices that have a test score below the critical value or within the range of acceptable values are not necessarily free from product error or price error. These prices—sometimes referred to as "inliers"—are not picked up during the editing for extreme values, at least not initially. However, because validation is an iterative process, they may

be detected at a later stage. Another and perhaps surer way of finding inliers during intracountry validation is, in addition to editing all the prices together, to group them by type of outlet and location and to edit each group separately. In this way, extreme values, and possible inliers, which were not considered extreme when all the prices were being edited together, will emerge.

Editing by type of outlet and location is not an option for intercountry validation because there are no internationally agreed definitions of outlet types or of urban and rural. Moreover, not all countries collect prices in rural areas; instead, they use spatial coefficients to adjust urban prices to national prices. Even so, editing prices by type of outlet and location during intracountry validation can aid intercountry validation by allowing the mix of outlets and locations at which individual products were priced to be analyzed. This analysis is of particular relevance to those products found to have extreme average prices during intercountry validation. These average prices may be extreme not because of outliers or undetected inliers in the underlying price observations, but because they are biased—a bias caused by their prices being observed at a selection of outlets and locations that do not fit their distribution profile.[6]

The selection of outlets for a price survey is supposed to mirror consumer purchasing patterns at various outlet types for the products being priced. For example, if consumers purchase 60 percent of their clothing and footwear from supermarkets, 20 percent from department stores, and 20 percent from specialty shops, a sample of 10 outlets for the clothing and footwear survey would include six supermarkets, two department stores, and two specialty shops. And if 70 percent of these purchases were made in urban areas and 30 percent in rural areas, seven of the selected outlets would be in urban areas and three in rural areas. Selecting outlets in this way introduces implicit weights to accommodate the varying service elements of outlets and their impacts on price.[7] Unbiased average prices are the result.[8]

In general, the NCAs try to select outlets in line with the distribution profiles of the products being surveyed as far as they are known. The selection will not be specific to each type of product being surveyed, but to the group of products overall. Hence, although the selection will be representative of the distribution profile of the group, it will not necessarily be representative of the distribution profiles of all products within the group, and the average price of those products for which the outlet location mix is wrong will be either too high or too low. For example, if the distribution of underwear purchases is 80 percent supermarkets, 10 percent department stores, and 10 percent specialty shops, the 60/20/20 selection described earlier for clothing and footwear would systematically overstate the average prices for underwear because the service element of department stores and specialty shops is normally greater than that of supermarkets, and their prices are correspondingly higher.

This problem is insoluble because the resources for price collection are limited. An outlet selection that is appropriate for a broad group of products will inevitably be unsuitable for some of the types of products included in the broad group. It is simply not feasible to design a sample of outlets that is appropriate for each and every item to be priced. The problem has to be addressed after price collection. Intracountry validation of average prices by outlet type and location can help to identify products for which the output location mix is not representative. In particular, it can be used to identify products whose average prices are biased by the dominance of one specific outlet type. The average prices of such products can be corrected by suppressing price observations from outlet types that are overrepresented or by duplicating the price observations from outlet types that are underrepresented.

The selection of outlets, whether randomized or purposive, can result in choosing outlets that are themselves outliers and not representative of the purchasing patterns of the average consumer. If the selection of outlets has been randomized, the outlier outlets must be retained because

dropping them would undermine the theoretical justification for random selection. But if the selection was purposive, the answer is not so clear. The objective behind purposive sampling is to select a set of outlets that are representative of those used by households most of the time. If the prices at a selected outlet do not conform to the price levels of other outlets of the same type, being consistently higher or consistently lower, the outlet is an outlier and should be replaced by one whose prices are closer to the average. Intracountry validation of average prices by outlet type and location helps to identify outlier outlets.

Validation Process

Validation consists of two distinct processes: intracountry validation and intercountry validation. Intracountry validation precedes intercountry validation. It is designed to establish that price collectors within the same country have priced products that match the product specifications and that the prices they have reported are correct. Those conducting intracountry editing search for extreme values first among the individual prices that a country has collected for each product it has chosen to survey and then among the average prices for these products. The editing and subsequent verification are the responsibility of the country's NCA. It is carried out without reference to the price data of other countries.[9] When the NCA has completed intracountry validation, it provides the RCA with validated average prices for the products it priced plus the coefficient of variation, the maximum-minimum ratio, and the number of price observations for each of the average prices reported. These are reviewed by the RCA before starting intercountry validation.

Intercountry validation is designed to establish that price collectors in different countries have priced products that are comparable between countries—in other words, that they have all interpreted the product specifications in the same way—and that the prices they have reported are correct. Those conducting intercountry editing look for extreme values among the average prices that the region's NCAs have reported to the RCA for the same products within a basic heading. In undertaking this task, they convert the average prices, which are expressed in national currencies, to a common currency. Both exchange rates and PPPs are used to carry out this process, as explained later. After being converted, the average prices of each NCA are checked against the average prices of the other NCAs in the region. This task cannot be carried out effectively without the lead and active participation of the RCA and the NCAs agreeing to share their average prices with each other.

Intracountry editing usually consists of two rounds of editing and verification and takes about two or more months to complete. Intercountry validation requires on average four rounds of editing and verification and some four months to complete. Intercountry validation takes longer because of the interactions that arise during validation between the data sets of different countries. Revisions introduced by one NCA can alter the outcome of the edits made on the prices of other NCAs. Dealing with such revisions can be time-consuming because not all countries participating in the comparison are covered in the early rounds of validation; they are introduced in later rounds as their average prices become available. For this reason, intercountry validation can take longer than four months.[10] The process is not complete until all countries in the region have been included in the intercountry diagnostic tables and their NCAs have signed off on the validation and formally approved their revised price data.

An important feature of intercountry validation is the iterative nature of the process, with the intercountry diagnostic tables going back and forth between the RCA and the region's NCAs. The process begins with the NCAs sending their average prices to the RCA. The RCA then compiles the diagnostic tables, examines them, identifies prices that seem implausible, and sends the tables

with its queries to the NCAs. Once the NCAs have investigated the RCA's queries, the NCAs revise the incorrect prices and send them back to the RCA. After entering the corrections into the database, the RCA recalculates the diagnostic tables, reviews them, and sends them to the NCAs with further questions about the reliability of specific prices. The process continues until both the RCA and the NCAs consider the revised price data to be final.

The intercountry diagnostic tables referred to are called Quaranta tables and Dikhanov tables in the rest of this chapter. They are explained and compared in the annex.

Intracountry Validation

Central to intracountry validation is the validation and averaging module. The module generates two diagnostic tables for use by the NCAs as they edit the individual prices they have observed and the average prices to which the individual prices give rise. These diagnostic tables are the price observation table and the average price table (see tables 9.1a and 9.2a). A price observation table is created for each product priced within a basic heading. The columns list the individual prices observed, other characteristics of the product, and the results of diagnostic tests designed to identify possible errors. The average price table contains the prices and diagnostics for every product in the basic heading. Although the NCA reviews both tables, the RCA sees only the average price table. The price observation table identifies extreme values among the *individual prices* collected for a specific product, whereas the average price table flags extreme values among the *average prices* of the products priced. Common to both tables are fields 01–04, which identify the product and specify the reference quantity (the quantity to which the price observations are to be adjusted when a product specification gives a range for the quantity to be priced). It is the individual prices and the average price for the reference quantity that are validated.[11]

The first step in the validation process is to enter the individual prices and related information into the module (fields 05–15 of table 9.1a). Data entry should be done as soon as possible after price collection, so that price collectors and outlet personnel still have a clear recollection of the circumstances prevailing when the prices were collected. Ideally, the individual prices would be entered and screened the day after they are collected, which will allow field supervisors to catch and correct the mistakes of price collectors from the outset of the process.

The second step, after the details of each price observation have been entered, is to check the entries to ensure that the product codes are correct and that the codes and the corresponding price observations have been entered in sequence. There should be numeric entries only for reference quantity, quantity observed, and price observed. The quantity observed should be in the same unit as the reference quantity. The importance indicator[12] should be entered for all price observations of products that are important.

Intracountry editing has two stages. The first involves identifying extreme values among the individual prices listed in the price observation table. The second involves identifying extreme values among the average prices of the products listed in the average price table. An extreme value is defined as an individual price or average price that for a given test scores a value that falls outside a predetermined critical value.

The diagnostic tests, which are based on statistical theory, all involve measures of variability. If prices are normally distributed, they are centered on the mean, and the standard deviation provides a measure of the average departure from it. Ninety-five percent of the observations will be in the range of the mean plus or minus two standard deviations, and 99 percent plus or minus three standard deviations. In many cases, however, the prices will follow a distribution shaped like a right triangle (mostly low prices with a declining number of higher prices). The mean and

standard deviation are both functions of the minimum and maximum values. The diagnostics used to validate prices take into account both kinds of distributions:

- Extreme values among price observations in the price observation table are identified by means of two tests: the ratio to average price test and the T-value test.

  Ratio to average price test. The ratio to average price is the ratio of the reference quantity price for a price observation to the average reference quantity price for the product. To pass the test, the ratio has to be within the range of 0.5–1.5. In other words, an individual price is expected to be no less than half of the mean or no more than double the mean price. A price observation with a ratio that falls outside this range fails the test and will be flagged in the price observation table as having an extreme value that needs to be checked. This is a simple first test because it does not rely on the standard deviation, which is also affected by an extreme value.

  The choice of the range 0.5–1.5 as the critical value is based on statistical theory and practical experience from previous data collections. Product specifications, which are as precise as possible, are expected to provide price observations that are less than plus or minus half the average price if the product specification has been priced correctly.

  T-value test. The T-value is the ratio of the deviation of the reference quantity price for a price observation from the average reference quantity price for the product to the standard deviation of the product. To pass the test, the ratio must be 2.0 or less (any value greater than 2.0 is suspect because it falls outside the 95 percent confidence interval). A price observation with a ratio greater than 2.0 fails the test and will be flagged in the price observation table as having an extreme value requiring investigation.
- Extreme values among average prices shown in the average price table are also identified by two tests: the max-min ratio test and the coefficient of variation test.

  Max-min ratio test. The max-min ratio is the ratio of the maximum reference quantity price observed for the product to the minimum reference quantity price observed for the product. An average price with a ratio greater than 2.0 fails the test and will be flagged in the average price table as having an extreme value that needs to be verified. The ratio of 2.0 implies a coefficient of variation (standard deviation/mean) of 10–15 percent or a 95 percent confidence interval of 20–30 percent.

  Coefficient of variation test. The coefficient of variation is the standard deviation for the product expressed as a percentage of the average price for the product. To pass the test, the coefficient of variation should be 20 percent or below. An average price with a coefficient of variation greater than 20 percent fails the test and will be flagged in the average price table as having an extreme value that requires verification.

  As with the ratio to average price test, the critical values are based on expectations arising from the precision of the product specifications. These two tests produce similar results. The max-min ratio test is most useful when a price observation differs considerably from the rest of the observations. When the coefficient of variation test shows a large value, it may indicate that the product was too loosely specified.

The validation and averaging module is programmed to flag price observations and average prices that have test values that fall outside the critical values. It is the reliability of the individual prices of the flagged price observations and of the flagged average prices that has to be established. Or, more precisely, it is the reliability of the flagged price observations and of the price observations underlying the flagged average prices that the NCA must investigate.[13]

The NCA should first check that flagged price observations have been entered correctly into the module. In other words, it should verify that the prices in the price observation table are the same as those on the price reporting forms. If they are not the same, the price in the table should be corrected and the modification noted in field 20. If they are the same, the prices have been entered correctly. The NCA will have to revisit the outlets where the prices were collected to ascertain whether the products priced match the product specifications and whether the prices reported are correct. If the product matches the product specification and the correct price has been reported, verification is complete. The extreme value is established as an accurate observation and an outlier—a finding that should be noted in field 19 of the table. If the product priced does not match the product specification or if the price has been reported incorrectly, the situation must be rectified by finding a product in the outlet that does match the product specification and pricing it or establishing the correct price for the product originally priced if it is still available.

The following courses of action are open to the NCA:

- Price observations that are flagged and found to be incorrect are either suppressed or replaced by the correct observation.
- Price observations that are flagged as failing the ratio to average price test—but not the T-value test—and found to be correct are outliers. An outlier should be retained if it is a valid observation and part of the population as defined by the rest of the price observations. This can be established by recalculating the average price and the standard deviation without including the outlier and using them to derive a T-value for the outlier. If the T-value is now greater than 2.0, the outlier, though accurate, is not valid and should be suppressed. If the T-value still does not fall outside the critical value, then the observation is valid and should be retained at least initially. Later, during intercountry validation, it can be decided whether it should be suppressed or replaced by an imputation.
- Price observations that are flagged as failing the T-value test and found to be correct are also outliers. Even so, they should be suppressed because they clearly are not part of the same population as the other price observations, even when included in the calculation of the average price and standard deviation.

In all cases, the suppression or correction of a price observation should be noted in field 20 of the price observation table.

Table 9.1a illustrates how the price observation table looks when first generated and after the first review by the NCA: extreme values are in boldface, the NCA comments are in field 19. All the price observations for rice A are shown as having failed the ratio to average price test, though only one, in field 16, column 8, is flagged as having failed the T-value test. All the observations for rice A appear to need verification, but do they? A closer examination reveals that only one observation needs investigating initially, and that is the 499.00 price with the high T-value. It is 10 times larger than the other observations and dominates the average price and the standard deviation, all of which explain the poor showing of the other observations in the ratio to average price test.

Table 9.1b shows the price observation table after verification. On investigation, the 499.00 was found to be a price error. The price had been recorded incorrectly during data entry. It has been replaced by the correct price as noted in field 20. As a result, the observation no longer fails the T-value test, and all the remaining observations pass the ratio to average price test.

In Table 9.1b, the two observations with shaded columns did not match the product specification. In the corner shop (outlet 19), the rice priced was sold loose and not in a packet as

TABLE 9.1a Validation Process: Price Observation Table after First Review by National Coordinating Agency and before Verification

Field		After first review and before verification								
01	Product code	1101111.0111								
02	Abbreviated product description	rice A, packet 400–600 grams								
03	Reference quantity	500								
04	Unit of reference quantity	grams								
05	Date of observation	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy
06	Price collector identifier	A	A	B	B	C	C	C	D	D
07	Outlet identifier	001	009	015	019	025	036	037	048	051
08	Location of outlet	rural	rural	rural	rural	urban	urban	urban	urban	urban
09	Type of outlet	market	market	market	corner shop	supermarket	market	corner shop	kiosk	supermarket
10	Quantity observed	400	400	400	500	1,000	400	600	450	400
11	Unit of observed quantity	grams	grams	grams	grams	grams	grams	grams	grams	grams
12	Price observed	28.72	31.92	31.92	50.00	80.00	34.32	59.88	449.10	44.00
13	Importance indicator	*	*	*	*				*	*
14	Price type	bargained	bargained	bargained	regular	discounted	bargained	regular	regular	regular
15	Additional information				sold loose	only packet size available				
16	Reference quantity price	35.90	39.90	39.90	50.00	40.00	42.90	49.90	499.00	55.00
17	Ratio to average price	**0.38**	**0.42**	**0.42**	**0.53**	**0.42**	**0.45**	**0.53**	**5.27**	**0.58**
18	T-value	–0.39	–0.36	–0.36	–0.29	–0.36	–0.34	–0.30	**2.66**	–0.26
19	NCA comments				mismatch	mismatch			verify	
20.	Status of price observation	original	original	original	original	original	original	original	original	original
Column number		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*

Note: A product is important if it is a volume seller. Important products are identified by an asterisk (*) and are often referred to as "asterisk products."

TABLE 9.1b Validation Process: Price Observation Table after Verification

Field		After verification								
01	Product code	1101111.0111								
02	Abbreviated product description	rice A, packet 400–600 grams								
03	Reference quantity	500								
04	Unit of reference quantity	grams								
05	Date of observation	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy	dd/mm/yy
06	Price collector identifier	A	A	B	B	C	C	C	D	D
07	Outlet identifier	001	009	015	019	025	036	037	048	051
08	Location of outlet	rural	rural	rural	rural	urban	urban	urban	urban	urban
09	Type of outlet	market	market	market	corner shop	supermarket	market	corner shop	kiosk	supermarket
10	Quantity observed	400	400	400	500	1000	400	600	450	400
11	Unit of observed quantity	grams	grams	grams	grams	grams	grams	grams	grams	grams
12	Price observed	28.72	31.92	31.92	50.00	80.00	34.32	59.88	44.91	44.00
13	Importance indicator	*	*	*	*		*	*	*	*
14	Price type	regular	regular	regular	bargained	discounted	regular	regular	regular	regular
15	Additional information				sold loose	only packet size available	asterisk added	asterisk added		
16	Reference quantity price	35.90	39.90	39.90	50.00	40.00	42.90	49.90	49.90	55.00
17	Ratio to average price	0.82	0.91	0.91			0.98	1.14	1.14	1.25
18	T-value	−1.12	−0.56	−0.56			−0.14	0.84	0.84	1.55
19	NCA comments				mismatch	mismatch			price error	
20	Status of price observation	original	original	original	suppressed	suppressed	original	original	corrected 49.90	original
Column number		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*

specified, while in the supermarket (outlet 25) the size of the packet priced was well outside the size range specified. The price collectors had priced these substitute products because rice A was not sold in packets in the corner shop or in smaller packets in the supermarket. Because the prices of the substitute products could not be used, they have been suppressed as recorded in field 20. Note that these observations are mismatches and not product errors, because the price collectors flagged the substitutions (see field 15). They would have been product errors if they had not been flagged. They would have been inliers as well because their values would not have been detected as extreme. This demonstrates the importance of reviewing the additional information provided by price collectors, as well as the individual prices themselves, and not just relying on the mechanical identification of extreme values.

As seen in the example that follows, the suppression or correction of extreme values among price observations will introduce changes that will affect the possible error status of the average price, especially those with high max-min ratios. A high coefficient of variation, on the other hand, can be due to reasons other than a straightforward product error or price error. The price of the product may vary greatly among different types of outlets, or the product may not have been priced consistently across outlets because either the product specification was too broad or it was interpreted differently by different price collectors.

Providing the price observations are correct and a comparable product has been priced across outlets, price variation arising from different outlet types is an economic fact of life. The average price should be kept and the reason for the variation explained to the RCA. It is possible that the mix of outlet types selected for the survey does not reflect the distribution profile of the product in question. If so, it should be investigated and, if necessary, the mix adjusted as appropriate by suppressing prices from those types of outlets that are overrepresented or by duplicating the prices from those types of outlets that are underrepresented.

Products with average prices whose variation is caused by too broad a specification or inconsistent pricing across outlets should be deleted unless they are important *and* the basic heading does not have a sufficient number of products. In this case, they and their average prices should be retained provisionally, and this should be noted in field 30 of the average price table. Later, it can be decided with the RCA whether the products should be dropped, retained, or split on the basis of what other NCAs in the region have reported.

Table 9.2a illustrates how the average price table looks when first generated before any corrections are made to the underlying price observation table (table 9.1a). The average price for rice A is shown as failing both the max-min ratio test and the coefficient of variation test. To find the reason, it is necessary to return to the price observation table and the price error in column 8. Table 9.2b shows the average price table after verification or, more correctly, after verification of its price observation table and correction of column 8. As a result of this correction, the average price passes both the max-min ratio test and the coefficient of variation test.

The validation of individual prices and average prices proceeds product by product across the basic headings. After the second round of validation, most if not all extreme values identified will have been investigated. There may still be extreme values among the price observations and the average prices, but these will have been documented and they can be removed later, during the intercountry validation, if necessary. On completion of the intracountry validation, the NCA sends the average price table to the RCA, which reviews it before entering the average prices into the average price diagnostic module for intercountry validation. The review may give the RCA cause to send the table back to the NCA after it highlights the anomalies among the average prices that need further explanation. The NCA then returns the table to the RCA after it addresses the questions posed by the RCA and corrects the average prices as required.

TABLE 9.2a Average Price Table after First Edit by National Coordinating Agency (NCA) and before Verification

Field		After first edit and before verification		
01	Product code	1101111.0111	1101111.0112	1101111.0113
02	Abbreviated product description	rice A, packet 400–600 grams	rice B, packet 250–500 grams	rice C, sold loose
03	Reference quantity	500	500	1000
04	Unit of reference quantity	grams	grams	grams
21	Reference period	mm/yy	mm/yy	mm/yy
22	Number of observations	9	5	10
23	No. with importance indicator	5	5	10
24	Average price of product	94.72	46.75	45.46
25	Maximum price for product	499.00	69.00	59.90
26	Minimum price for product	35.90	39.90	32.90
27	Max-min ratio	**13.9**	1.7	1.8
28	Standard deviation	151.7	12.63	8.8
29	Coefficient of variation	**160.2**	**27.0**	19.4
30	NCA comments	verify	verify	accept
31	Status of average price	original	original	original

TABLE 9.2b Average Price Table after Verification

Field		After verification		
01	Product code	1101111.0111	1101111.0112	1101111.0113
02	Abbreviated product description	rice A, packet 400–600 grams	rice B, packet 250–500 grams	rice C, sold loose
03	Reference quantity	500	500	1,000
04	Unit of reference quantity	grams	grams	grams
21	Reference period	mm/yy	mm/yy	mm/yy
22	Number of observations	7	4	10
23	No. with importance indicator	7	4	10
24	Average price of product	43.92	41.19	45.46
25	Maximum price for product	55.00	45.00	59.90
26	Minimum price for product	35.90	39.90	32.90
27	Max-min ratio	1.5	1.1	1.8
28	Standard deviation	7.2	2.5	8.8
29	Coefficient of variation	16.3	6.2	19.4
30	NCA comments	verified	verified	accept
31	Status of average price	corrected	corrected	original

Intercountry Validation

Intercountry validation is designed to screen the average prices reported by the region's NCAs for possible errors and to assess the reliability of the PPPs they provide. The objective is to verify that the average prices are for comparable products across countries and that the products have been correctly priced—in other words, to ascertain that the NCAs have interpreted the product specifications in the same way and that they have also priced them accurately. This is done by comparing the average prices for the same product across countries and by analyzing the dispersion of the price ratios that the average prices generate between countries across products and across countries. In short, intercountry editing involves detecting extreme values among the average prices through the corresponding price ratios. It is during this process that the final selection of products to be included in the final computation is made.

Because the NCAs report prices in national currencies, the average prices can be compared only if they are expressed in a common currency. Once converted to a common currency, the average prices of different countries for the same product can be compared with each other and the extreme values identified according to predetermined criteria. But prices, even when expressed in the same currency, cannot be compared across products directly. On the other hand, the price ratios of countries pricing a product can be compared with the equivalent price ratios for other products, providing that they have first been "standardized." Standardized price ratios for a product are the ratios between the individual average prices of the countries pricing the product and the geometric mean of the average prices of all the countries pricing the product when the average prices are expressed in a common currency.[14] Together, tables 9.3a and 9.3b provide a numerical example how these ratios are computed and interpreted. The annex to this chapter shows these data as they are examined using Quaranta and Dikhanov tables. The data in these tables reflect the outcome of several data validations; the purpose is to explain the data validation concepts.

Both exchange rates and PPPs are used in intercountry validation to convert the average prices to a common currency, and both the exchange rate–converted average prices and the PPP-converted average prices are used to derive standardized price ratios. The standardized price ratios based on

TABLE 9.3a Example of Data Validation Using Exchange Rates for Four Countries and Three Products

		Rice basic heading, country details—exchange rate review				
		Country A	Country B	Country C	Country D	Geometric mean
1	NC-price 1	5,770	2.11	1.82	1.98	
2	NC-price 2	21,757	7.87	4.66	7.60	
3	NC-price 3	7,075	3.10	2.59	3.09	
4	XR	3,830	1.84	0.759	1.00	
5	XR P 1	1.51	1.15	2.40	1.98	1.69
6	XR P 2	5.68	4.27	6.14	7.60	5.80
7	XR P 3	1.85	1.68	3.40	3.09	2.39
8	XR-ratio 1	89	68	142	117	
9	XR-ratio 2	98	74	106	131	
10	XR-ratio 3	77	70	142	129	

Note: NC = national currency; XR = exchange rate.

TABLE 9.3b Example of Data Validation Using PPPs for Four Countries and Three Products

		Rice basic heading, country details					
		Country A	Country B	Country C	Country D	Geometric mean	Variation coefficient
1	NC-rice 1	5,770	2.11	1.82	1.98		
2	NC-rice 2	21,757	7.87	4.66	7.60		
3	NC-rice 3	7,075	3.10	2.59	3.09		
4	PPP-rice 1	2,914	1.07	0.92	1.00		
5	PPP-rice 2	2,662	1.04	0.61	1.00		
6	PPP-rice 3	2,230	1.00	0.84	1.00		
7	PPP-rice	2,673	1.04	0.779	1.00		
8	PPP-price 1	2.16	2.04	2.34	1.98	2.13	
9	PPP-price 2	8.14	7.60	5.98	7.60	7.28	
10	PPP-price 3	2.65	3.00	3.32	3.09	3.00	
11	PPP-ratio 1	102	96	110	93		7.5
12	PPP-ratio 2	112	104	82	104		12.7
13	PPP-ratio 3	88	100	111	103		9.3
14							
15	Variation coefficient	11.8	4.2	16.1	6.1		9.75

Note: NC = national currency.

exchange rate–converted prices are called XR-ratios, and the standardized price ratios based on PPP-converted prices are called PPP-ratios.[15] Both XR-ratios and PPP-ratios are edited and verified. But only PPP-ratios are used to generate the measures of dispersion referred to shortly.

The PPPs used to convert the average prices to a common currency are calculated from the average prices being validated across countries. This means that editing starts with PPPs based on prices that still have to be verified. These opening PPPs are likely to be unreliable, and the flagging of extreme values among the PPP-ratios is likely to be unreliable as well. Exchange rates, on the other hand, are not determined by the average prices and remain unaffected by them. For this reason, XR-ratios are used in the initial stages of validation. It may appear paradoxical to use XR-ratios to edit the prices from which PPPs are to be derived in view of the fact that PPPs are calculated because exchange rate–converted prices do not reflect the price levels of countries. But experience shows that XR-ratios provide a better "feel" for the reliability of the average prices reported at the beginning of the validation process. Experience also shows that many of the ratios initially identified as extreme values among the XR-ratios are found to be incorrect.

Table 9.3a provides an example of using exchange rates to validate prices across countries. The example is for the rice basic heading with four countries and three products. Rows 1–3 show the national annual average price in the currency of each country for each product, and row 4 each country's exchange rate to country D, whose exchange rate is 1.00 because it is the base. The questions are, did each country price the same or a similar product, and are the prices recorded in the same units? Should the product have been included? Therefore, the next step is to convert each product price to the currency of country D, using the respective exchange rates, to obtain an

average product price across countries. These product prices—exchange rate prices or XR-prices—and the respective geometric means are shown in rows 5–7. Even though the prices are now in a common currency, it is readily seen that the price levels differ by product and across countries. Product 2 is several times more expensive than the other products, and all product prices in country B are relatively cheap. In order to examine the country-product relationship in more detail, the standardized exchange rate ratios or XR-ratios are shown in rows 8–10. These are simply each country's XR-price for a product divided by the geometric mean of the product price. Country C shows the most variability, suggesting a review of its average prices for products 1 and 3. Product 3 is the most variable, suggesting that the specifications used to define its characteristics be reviewed across all countries.

The next data validation step is to repeat the steps just shown but using PPPs to convert the national product prices to a common currency. The first step is to compute the product PPPs and aggregate them to country PPPs as shown in table 9.3b. For simplicity purposes, the prices in national currency are repeated in rows 1–3. Rows 4–6 show the product PPPs, which are simply each country's price in its currency divided by country D's price in its currency. The result is a product PPP with country D as the base. As discussed in previous chapters, any country could be chosen as the base. Row 7 shows the aggregated or average PPP for rice for each country—this can be determined using any of the methods described in previous chapters. When the average product prices for each country are divided by the respective PPPs, they are converted to each product's PPP price and its mean as shown in rows 4–6. Because PPPs remove price level differences between countries, one would expect the PPP product prices for each product to be similar, with little variation from the geometric mean.

The PPP ratios in rows 11–13 (PPP price divided by the mean product price) show the variability between countries and between products. The variation coefficients in row 15 are a measure of the variability of the product PPPs for each country (country variation coefficient). Again, country C shows the most variability—twice that of countries B and D. In practice, this may indicate that country C did not price enough items, or that there may be a problem with the price for product 2, which is at a different level than the other products in that country.

The product variation coefficients shown in rows 11–13 measure dispersion among the PPP ratios for each product. In theory, these standardized PPP prices should be the same. Product 2 in country C should be examined again. The variation coefficient representing variability across products and across countries is shown in row 15. This coefficient is most useful when comparing PPPs across basic headings and will be discussed in more detail shortly.

Intercountry validation is an iterative process that can involve several iterations or rounds before being completed. After each round, as incorrect prices are removed or corrected, the PPPs will become more reliable, and so, too, will the flagging of extreme values among the PPP-ratios. Hence as validation progresses, the focus on extreme values shifts from those among the XR-ratios to those among the PPP-ratios. The aim of the exercise is to remove, or at least reduce, the extreme values among the PPP-ratios. If this is achieved, the extreme values remaining among the XR-ratios can be ignored. XR-ratios and PPP-ratios that fall outside the 80–125 range are flagged as having an extreme value requiring verification.

Variation coefficients with values above 33 percent are extreme, requiring the NCAs to investigate the PPP-ratios that are flagged among the PPP-ratios covered by the coefficient. Besides being editing tools, the coefficients provide the means to monitor progress during validation and, at its conclusion, to assess how effective the whole process of editing and verification has been in reducing the incidence of nonsampling error among the price data. Coefficients should be significantly smaller at the end of validation than they were at the beginning.

Outliers

Editing a basic heading with a Quaranta table or an aggregate with a Dikhanov table entails identifying average prices with extreme values or, more precisely, the PPP-ratios with extreme values. The average prices underlying the PPP-ratios flagged as extreme values are the only possible errors. They are not errors by definition, no matter how well established are the criteria used to identify them. They cannot be removed automatically. They have to be referred back to the NCAs reporting them for verification. The NCAs are required to investigate the average prices returned to them as possible errors and to confirm whether they are correct or incorrect. When prices are found to be incorrect, the NCAs are expected to correct them; otherwise, they are suppressed. But if they are found to be correct, they are outliers, and the decision has to be made whether to keep them, to replace them with an imputed value, or to drop them—not necessarily an easy decision. One compromise would be to review the importance classification to ensure important products are classified correctly. Some of the deviations, even larger ones, can be legitimate. Individual economies may have particular pricing policies, such as low fuel prices in some of the oil-producing countries. Such prices may be flagged as extreme values, but they would not be incorrect, and it would be wrong to remove them despite the "noise" they may introduce into the data set.

If, however, there are no extenuating circumstances, the disturbance created by an outlier can have an impact, not only on the PPP for the country reporting the outlier but also on the PPPs for other countries in the regional comparison. In such cases, replacing the outlier with an imputed value or suppressing it are options to be considered. If, within the context of a basic heading, the outlying average price refers to a product that is particularly important for the reporting country, deleting it may not be justified, though imputing a value may be. But if the average price refers to a product that is less important or not important, removing it is probably warranted. Whatever action is taken, it has to be decided jointly by the country's NCA and the RCA on a case-by-case basis.

The annex to this chapter provides a more detailed review of the validation process through use of the Quaranta and Dikhanov tables, which are designed specifically for data validation. The next section is an overview of the process to review PPPs across basic headings. Those readers not familiar with Quaranta and Dikhanov tables may want to review the annex before continuing to the next section.

Validation of Basic Heading PPPs

Dikhanov tables are generally compiled for a group of basic headings constituting an aggregate. Validation at the aggregate level puts the editing and verification of average prices into a broader context. In other words, are the average prices consistent not just within the basic heading, but also within a larger set of products in different basic headings? Editing at the aggregate level enables inconsistencies to be identified that would not be found by editing solely at the basic heading level. For example, suppose that for alcoholic beverages a country priced all the products in quarts instead of liters as specified. The price ratios would be consistent within the basic heading, but they would not be consistent with the country's price ratios in other basic headings. Such errors are identified by editing across basic headings. In this respect, it is useful to compile Dikhanov tables at different levels of aggregation. For example, basic headings covering food items could first be checked in a Dikhanov table covering food and nonalcoholic beverages and subsequently in a Dikhanov table covering all household final consumption expenditure (HFCE).

An example of a Dikhanov table for an aggregate, in this case household final consumption expenditure, is given in Table 9.4a. A modified version—with CPD residuals converted to PPP-ratios and standard deviations shown as variation coefficients—appears in table 9.4b. Neither table is complete. CPD residuals (PPP-ratios) are shown for only 22 of the 864 products priced and for only 9 of the 18 countries included in the comparison. Note also that the PPPs for the aggregate, HFCE, are not weighted. They have been calculated by a CPD that uses the whole set of products and their prices without taking basic heading expenditures into account.

Table 9.4a has two parts. The first part provides summary information (PPPs, standard deviations, and price levels) by country for the aggregate. The second part covers the basic headings constituting the aggregate. For each basic heading there are two sections: one with the same summary information by country but for the basic heading; the other with CPD residuals and product variation coefficients for the products priced for the basic heading. Table 9.4a shows the residuals in log form. To assist in the identification of extreme values among the CPD residuals, the residuals are coded as follows:

CPD residuals with values	Font	PPP-ratio equivalence
Between −0.25 and 0.25	No emphasis	Between 78 and 128
Between −0.75 and −0.25 or 0.25 and 0.75	Italics	Between 47 and 78 or 128 and 212
Between −2.0 and −0.75 or 0.75 and 2.0	Boldface	Between 14 and 47 or 212 and 739
Less than −2.0 or greater than 2.0	Boldface italics	Less than 14 or greater than 739

All residuals distinguished by font should be investigated. All should be checked rigorously, but those in boldface and boldface italics particularly so. Table 9.4b shows the residuals in percentage terms, making it easier to interpret directly.

The first part of table 9.4a facilitates the comparison of PPPs (or price level indexes) across the basic headings. It is to be expected that PPPs will vary from basic heading to basic heading, even in homogeneous regions. And yet it is important that the variability between basic heading PPPs be reviewed and validated to ensure that the PPPs are plausible. For example, the PPPs for fruit for countries D, G, and I are about 40 percent higher than their PPPs for vegetables, while for the other countries the two sets of PPPs are of a similar order of magnitude. This situation may reflect reality, or it may be that the fruit selected for the product list are not representative for these countries, but that possibility needs to be verified. In the case of country I, the average prices of green sweet bell pepper and eggplant would seem to be the problem. If the average prices are verified as correct, a case could be made for dropping the two of them because both the product standard deviation for the pepper and the country standard deviation for the basic heading are over the 0.30 critical value. A similar argument could be developed for garlic in country F if the average price reported is shown to be accurate.

It can also be seen from the tables that the distinguishing fonts help to identify those products having average prices that need verification. But, more important, they make identification of possible problem countries easier—see, for example, countries A, C, and D in the table.

It is at this stage that the classification of importance should be validated. In other words, one would not expect the price for an important product to be an outlier. This could also indicate a possible product selection error.

TABLE 9.4a Dikhanov Table for an Aggregate (Household Final Consumption Expenditure, HFCE), Countries A–I

Item code	Item name	A	B	C	D	E	F	G	H	I	STD 1 STD 3	Items/countries
		2005	2005	2005	2005	2005	2005	2005	2005	2005		
1100000	**HFCE**											
	PPP	4.052	16.02	0.739	75.69	43.7	7.879	96.76	1.000	5,227		
	STD 2	0.291	0.221	0.297	0.258	0.240	0.279	0.249	0.271	0.276	0.510	
	No. of items priced	567	608	450	566	525	420	481	611	457		864
	XR (LCU/US$)	5.779	13.01	0.709	75.55	51.88	6.359	102.3	0.571	4,464		
	Rebased XR	10.12	22.78	1.242	132.3	90.87	11.14	179.2	1.000	7,817		
	PLI	0.400	0.703	0.595	0.572	0.481	0.707	0.540	1.000	0.669		
1101161	**Fresh or chilled fruit**											
	PPP	1.900	15.65	0.423	57.09	48.31	6.580	99.68	1.000	6,074		
	STD	0.326	0.189	0.353	0.395	0.260	0.164	0.364	0.204	0.126		
	PLI	0.188	0.687	0.341	0.431	0.532	0.591	0.556	1.000	0.777		
1101161.01	Apple: golden delicious		−0.080	0.177		−0.050	0.002	0.105	*−0.290*	0.092	0.145	12
1101161.02	Apple: red delicious		−0.140	0.189		−0.180	0.039	*0.273*	*−0.300*	0.079	0.194	13
1101161.03	Apple: local variety	−0.050	*−0.320*	*0.258*			*0.271*		−0.030		0.248	9
1101161.04	Banana	*0.285*	*0.457*	*0.581*	*−0.330*	*−0.390*	0.050	−0.150	0.184	0.223	0.287	18
1101161.05	Red grapes	*−0.510*	−0.010	*−0.250*	*0.482*	0.174	0.055		0.038	−0.140	0.265	15
1101161.06	Green grapes	*−0.610*	−0.120	*−0.300*	*0.414*	*0.292*	−0.100	*0.484*	−0.130	−0.070	0.285	16
1101161.07	Grapefruit	0.184	0.099	*−0.550*	*0.501*		−0.120	−0.160	−0.020		0.246	14
1101161.08	Lemon	*0.363*	0.030	−0.120	*−0.420*		0.027	*−0.640*	*0.447*		0.361	14
1101161.09	Mandarin		0.157	*−0.380*	−0.200	*0.345*	−0.000	−0.090	0.234		0.243	13
1101161.10	Orange	0.024	−0.060	*0.397*	*−0.510*	0.187	−0.110	*0.451*	−0.050	−0.040	0.234	16
1101161.11	Pear	*0.260*	−0.010			*−0.390*	*−0.380*	0.245	−0.120	−0.190	0.268	14
1101161.12	Watermelon	0.051			0.072	0.012	*0.258*	*−0.530*	0.036	0.040	0.228	13

1101171	**Fresh or chilled vegetables**											
	PPP	1.557	14.29	0.370	32.00	44.66	5.708	63.49	1.000	3,425		
	STD	0.292	0.503	0.321	0.254	0.239	0.383	0.255	0.337	0.608		
	PLI	0.154	0.627	0.298	0.242	0.492	0.513	0.354	1.000	0.438		
1101171.01	Cucumber	0.066		0.124	–0.170	–0.230	0.009	*–0.290*		0.220	0.272	13
1101171.02	Garlic	0.227	*0.354*	–0.090	*0.290*	*–0.300*	**–0.930**	0.137	0.027		0.448	17
1101171.03	Round tomato	*–0.390*	*0.391*	*–0.400*	–0.120	0.045	*0.408*	–0.130	0.221	0.145	0.250	16
1101171.04	Green sweet bell pepper	*–0.410*	*0.479*	*0.256*	–0.000	–0.140	0.226		*0.587*	**–1.100**	0.400	16
1101171.05	Green cabbage	*0.444*	*–0.480*	*0.475*	*–0.310*	*0.515*	*0.256*	0.105		–0.700	0.325	17
1101171.06	Carrots	–0.030	*–0.640*	*0.367*	–0.000	–0.140	0.138	*0.525*	*–0.440*		0.295	17
1101171.07	Cauliflower	*0.286*	*0.503*	*–0.440*	*0.351*	–0.060	–0.070		–0.110		0.272	16
1101171.08	Onion	0.118	*–0.610*	0.059	*0.394*	*0.302*	–0.030	0.049	*–0.280*	*0.266*	0.295	18
1101171.09	Maize			*–0.340*	–0.050	0.122		–0.070		*0.424*	0.203	10
1101171.10	Eggplant	*–0.300*			*–0.370*	–0.120		*–0.320*		*0.748*	0.317	13

TABLE 9.4b Modified Dikhanov Table for an Aggregate (Household Final Consumption Expenditure, HFCE), Countries A–I

Item code	Item name	A	B	C	D	E	F	G	H	I	Var. co. 1 Var. co. 3	Items/countries
		2005	2005	2005	2005	2005	2005	2005	2005	2005		
1100000	**HFCE**											
	PPP	4.052	16.02	0.739	75.69	43.7	7.879	96.76	1.000	5,227		
	Var. co. 2	29.1	22.1	29.7	25.8	24.0	27.9	24.9	27.1	27.6	51.0	
	No. of items priced	567	608	450	566	525	420	481	611	457		864
	XR (LCU/US$)	5.779	13.01	0.709	75.55	51.88	6.359	102.3	0.571	4,464		
	Rebased XR	10.12	22.78	1.242	132.3	90.87	11.14	179.2	1.000	7,817		
	PLI	40.0	70.3	59.5	57.2	48.1	70.7	54.0	100.0	66.9		
1101161	**Fresh or chilled fruit**											
	PPP	1.900	15.65	0.423	57.09	48.31	6.580	99.68	1.000	6,074		
	Var. co. 2	32.6	18.9	35.3	39.5	26.0	16.4	36.4	20.4	12.6		
	PLI	18.8	68.7	34.1	43.1	53.2	59.1	55.6	100.0	77.7		
1101161.01	Apple: golden delicious		92.3	119.4		95.1	100.2	111.1	*74.8*	109.6	14.5	12
1101161.02	Apple: red delicious		86.9	120.8		83.5	104.0	*131.4*	*74.1*	108.2	19.4	13
1101161.03	Apple: local variety	95.1	*72.6*	*129.4*			*131.1*		97.0		24.8	9
1101161.04	Banana	*133.0*	*157.9*	*178.8*	*71.9*	*67.7*	105.1	86.1	120.2	125.0	28.7	18
1101161.05	Red grapes	*60.0*	99.0	*77.9*	*161.9*	119.0	105.7		103.9	86.9	26.5	15
1101161.06	Green grapes	*54.3*	88.7	*74.1*	*151.3*	*133.9*	90.5	*162.3*	87.8	93.2	28.5	16
1101161.07	Grapefruit	120.2	110.4	*57.7*	*165.0*		88.7	85.2	98.0		24.6	14
1101161.08	Lemon	*143.8*	103.0	88.7	*65.7*		102.7	*52.7*	*156.4*		36.1	14
1101161.09	Mandarin		117.0	*68.4*	81.9	*141.2*	100.0	91.4	126.4		24.3	13
1101161.10	Orange	102.4	94.2	*148.7*	*60.0*	120.6	89.6	*157.0*	95.1	96.1	23.4	16
1101161.11	Pear	*126.7*	99.0			*67.7*	*68.4*	127.8	88.7	82.7	26.8	14
1101161.12	Watermelon	105.2			107.5	101.2	*129.4*	*58.9*	103.7	104.1	22.8	13

1101171	Fresh or chilled vegetables											
	PPP	1.557	14.29	0.370	32.00	44.66	5.708	63.49	1.000	3,425		
	Var. co. 2	29.2	50.3	32.1	25.4	23.9	38.3	25.5	33.7	60.8		
	PLI	15.4	62.7	29.8	24.2	49.2	51.3	35.4	100.0	43.8		
1101171.01	Cucumber	106.8		113.2	84.4	79.5	100.9	*74.8*		124.6	27.2	13
1101171.02	Garlic	125.5	*142.5*	91.4	*133.6*	*74.1*	**39.5**	114.7	102.7		44.8	17
1101171.03	Round tomato	*67.7*	*147.8*	*67.0*	88.7	104.6	*150.4*	87.8	124.7	115.6	25.0	16
1101171.04	Green sweet bell pepper	*66.4*	*161.4*	*129.2*	100.0	86.9	125.4		*179.9*	**33.3**	40.0	16
1101171.05	Green cabbage	*155.9*	*61.9*	*160.8*	*73.3*	*167.4*	*129.2*	111.1		49.7	32.5	17
1101171.06	Carrots	97.0	*52.7*	*144.3*	100.0	86.9	114.8	*169.0*	*64.4*		29.5	17
1101171.07	Cauliflower	*133.1*	*165.4*	*64.4*	*142.0*	94.2	93.2		89.6		27.2	16
1101171.08	Onion	112.5	*54.3*	106.1	*148.3*	*135.3*	97.0	105.0	*75.6*	*130.5*	29 5	18
1101171.09	Maize			*71.2*	95.1	113.0		93.2		*153.8*	20.3	10
1101171.10	Eggplant	*74.1*			*69.1*	88.7		*72.6*		*211.3*	31.7	13

Source (both tables): 2005 ICP.
Note: STD = standard deviation; XR = exchange rate; LCU = local currency unit; PLI = price level index; var. co. = variation coefficient.

Conclusion

Intercountry validation is an iterative process. It can commence before all countries participating in the regional comparison have supplied their average prices. After each iteration or verification round, the RCA will change the region's price database in line with the findings reported by the NCAs of countries covered in the round, add the prices of countries joining the validation process to the database, and rerun the average price diagnostic module to produce new Quaranta and Dikhanov tables. These tables will identify new extreme values as a result of the changes introduced by the RCA, and these will need to be investigated by the NCAs. Gradually, after a number of rounds of verification and after the prices of all countries participating in the comparison have been included in the database, there will be convergence, and the return on further rounds of verification will be deemed marginal by the NCAs and the RCA and not worth pursuing. The intercountry validation is now complete. *In signing off from the validation process, NCAs are accepting responsibility for their average prices*. The process is concluded when the NCAs formally approve the validated price data.

ANNEX

Quaranta and Dikhanov Tables

Both the Quaranta and Dikhanov tables provide similar measures of price variation for products and countries employing either basic heading PPPs for editing basic headings individually or PPPs for an aggregate[16] for editing across the basic headings constituting the aggregate. The Dikhanov table is specific to the Country Product Dummy (CPD) or Country Product Representative Dummy (CPRD) method of calculating PPPs, whereas the Quaranta table has a broader application that includes the Gini-Éltetö-Köves-Szulc (GEKS) and GEKS* methods as well as the CPD and CPRD methods.[17] ICP regions used the CPD method in the 2005 comparison.

Quaranta tables are employed to edit prices within basic headings, and Dikhanov tables are used to edit prices within aggregates of several basic headings. Editing prices within a basic heading is the purpose for which the Quaranta table was originally intended. It provides a large amount of information about product prices, but the presentation is outdated, which makes it cumbersome when applied to a large number of products such as that priced for an aggregate.[18] A Dikhanov table contains much of the same information as a Quaranta table,[19] but it is programmed to hide certain items, which can be called up if required so that only key series are displayed. The more compact format of the Dikhanov table plus the color scheme used to identify different levels of extreme values make it better-suited to editing prices across the basic headings and products comprising an aggregate.

The average price diagnostic module produces a multiple of Quaranta tables, one for each basic heading being validated, and one Dikhanov table for the corresponding aggregate. The RCA makes the Quaranta tables and the Dikhanov table available to the NCAs at the same time. This leaves open the question of whether intercountry validation should begin with the Quaranta tables or with the Dikhanov table. Some analysts prefer to start with Quaranta tables and consult the Dikhanov table after there have been a number of rounds of verification in which the PPPs are more reliable. Others prefer to begin with the Dikhanov table, using it to identify countries and products that need investigating and subsequently organizing the investigation around the Quaranta tables. One argument in favor of the first approach is that most, if not all, operations relating to a comparison are organized around the basic headings. In particular, PPPs are first calculated and averaged at the level of the basic heading, and it is basic heading PPPs that are weighted during aggregation. It therefore seems logical and consistent to start validation at the basic heading level with the Quaranta tables. Another argument is that the Dikhanov table does not give the same prominence as Quaranta tables to the XR-ratios, which are required in the early stages of intercountry validation. In the Dikhanov table, they are a pull-up item, and extreme values are not flagged. Quaranta tables give equal weight to the XR-ratios and the PPP-ratios, and extreme values among both are flagged.

Table 9A.1 is an example of a Quaranta table. The numbers in italics have been added for ease of reference, and the explanatory notes follow the table. The table has three sections. The first section gives general details about the table of which the more important are the calculation method *[6],* the range of acceptable values for XR-ratios and PPP-ratios *[7],* and the numeraire *[8].* The second section gives summary information for the basic heading that relates either

TABLE 9A.1 A Quaranta Table

QUARANTA TABLE DETAILS

[1] **Region:** Asia *[2]* **Survey:** Food and beverages *[3]* **Time period:** 1st quarter 2011 *[4]* **Version:** Final *[5]* **Date:** 30.06.11

[6] **Calculation method:** CPD *[7]* **Limits of XR- and PPP-ratios:** 80%, 125% *[8]* **Numeraire:** LCU of country D *[9]* **Page:** 1

BASIC HEADING AND COUNTRY DETAILS

[10] **1101111 Rice** *[11]* **Av. weight:** 45.1 *[12]* **No. of items:** 3 *[13]* **Var. co. 1:** 9.5

[14] Country	*[15]* XR	*[16]* PPP	*[17]* PLI (%)	*[18]* Weight	*[19]* No. of items	*[20]* Var. co. 2
A	3,830.9492	2,673.8500	69.8	23.8	3: *1	11.8
B	1.8439	1.0353	56.1	34.6	3: *3	4.2
C	0.7594	0.7791	102.6	58.3	3: *1	16.1
D	1.0000	1.0000	100.0	63.9	3: *2	6.1

PRODUCT DETAILS BY COUNTRY

1 *[21]* **1101111.0111 Rice, long grain, 500–1,000 g packet** *[22]* **Var. co. 3:** 7.5

[23] Country	*[24]* NC-price	*[25]* Asterisks	*[26]* Quotations	*[27]* Var. co. 4	*[28]* XR-price	*[30]* XR-ratio	*[31]* PPP-price	*[33]* PPP-ratio
A	5,770.58	*	15	5.1	1.51	89	2.16	102
B	2.11	*	13	4.4	1.15	68	2.04	96
C	1.82		9	21.2	2.40	142	2.34	110
D	1.98		5	16.8	1.98	117	1.98	93
				[29] **GM** = 1.69		*[32]* **GM** = 2.13		

2 *[21]* **1101111.0112 Rice, short grain, 500–1,000 g packet** *[22]* **Var. co. 3:** 12.7

[23] Country	*[24]* NC-price	*[25]* Asterisks	*[26]* Quotations	*[27]* Var. co. 4	*[28]* XR-price	*[30]* XR-ratio	*[31]* PPP-price	*[33]* PPP-ratio
A	21,757.60		9	14.2	5.68	98	8.14	112
B	7.87	*	10	7.7	4.27	74	7.60	104
C	4.66	*	15	9.1	6.14	106	5.98	82
D	7.60	*	8	8.9	7.60	131	7.60	104
				[29] **GM** = 5.80		*[32]* **GM** = 7.28		

3 *[21]* **1101111.0113 Rice, basmati, 500–1,000 g packet** *[22]* **Var. co. 3:** 9.3

[23] Country	*[24]* NC-price	*[25]* Asterisks	*[26]* Quotations	*[27]* Var. co. 4	*[28]* XR-price	*[30]* XR-ratio	*[31]* PPP-price	*[33]* PPP-ratio
A	7,075.88		6	15.3	1.85	77	2.65	88
B	3.10	*	14	10.4	1.68	70	3.00	100
C	2.59		7	24.7	3.40	142	3.32	111
D	3.09	*	10	10.2	3.09	129	3.09	103
				[29] **GM** = 2.39		*[32]* **GM** = 3.00		

Notes to table 9A.1

	QUARANTA TABLE DETAILS	
[1]	**Region**	Region covered by the table.
[2]	**Survey**	Type of product covered by the table.
[3]	**Time period**	Period during which the prices for the products covered by the table were collected.
[4]	**Version**	Version of the table: first, second, third, . . . , final.
[5]	**Date**	Date the table was computed.
[6]	**Calculation method**	Method used to calculate the basic heading PPPs in column *[16]*. Currently, the CPD, but it could also be the CPRD, the GEKS, or the GEKS*.
[7]	**Limits of XR- and PPP-ratios**	The range in which the XR-ratios in column *[30]* and the PPP-ratios in column *[33]* should lie if they are not to be flagged as extreme values. Currently, 80–125, but 65–155 is also used. The intervals of the ranges are not equal because it is the relative deviations from a geometric mean that are being measured.
[8]	**Numeraire**	Currency selected as numeraire. RCAs may choose the currency of any of their countries as numeraire.
[9]	**Page**	Page number. Depending on the number of products priced and the number of countries pricing them, a Quaranta table for a basic heading can cover a large number of pages.
	BASIC HEADING AND COUNTRY DETAILS	
[10]		Code and name of the basic heading covered by the table.
[11]	**Av. weight**	Average expenditure weight for the group of countries covered by the basic heading. The unweighted arithmetic mean of the national weights in column *[18]*. Like the national weights, it is scaled to 100,000.
[12]	**No. of items**	Number of products specified and priced for the basic heading.
[13]	**Var. co. 1**	Overall variation coefficient or, more precisely, the average product variation coefficient for the products priced for the basic heading. It is calculated as the unweighted arithmetic mean of the product variation coefficients at *[22]*. It measures the average variation of the PPP-ratios in column *[33]* of all products priced for the basic heading. It is flagged when greater than 33 percent.
[14]	**Country**	Abbreviated names of countries covered by the table.
[15]	**XR**	Market exchange rates of the countries expressed as the number of units of national currency per unit of the numeraire currency specified in *[8]*.
[16]	**PPP**	Purchasing power parities for the basic heading calculated as specified in *[6]* and expressed as the number of units of national currency per unit of the selected numeraire currency specified in *[8]*. The prices used to calculate the PPPs are the average prices in national currencies that countries report for the products they priced for the basic heading—that is, the NC-prices in column *[24]*.
[17]	**PLI**	Price level indexes. The PPPs in column *[16]* expressed as a percentage of the corresponding exchange rate in column *[15]*.
[18]	**Weight**	National expenditure weights scaled to 100,000. That part of a country's GDP that is spent on the basic heading when both expenditures are expressed in national currency and valued at national price levels.
[19]	**No. of items**	Number of products priced by each country for the basis heading and the number of products priced by each country that are important—that is, the number of products assigned an asterisk (*).
[20]	**Var. co. 2**	Country variation coefficient. The standard deviation of the country's PPP-ratios in column *[33]* for all products priced by the country for the basic heading expressed as a percentage of the arithmetic mean of the country's PPP-ratios in column *[33]* for all products priced by the country for the basic heading. It is flagged when greater than 33 percent.
	PRODUCT DETAILS BY COUNTRY	
[21]		Code, name, and summary definition of the product covered in the subsequent product section.
[22]	**Var. co. 3**	Product variation coefficient. The standard deviation of the product's PPP-ratios in column *[33]* expressed as a percentage of the arithmetic mean of the product's PPP-ratios in column *[33]*. It is flagged when greater than 33 percent.

(*continued*)

Notes to table 9A.1 (*continued*)

		PRODUCT DETAILS BY COUNTRY
[23]	**Country**	Abbreviated names of countries covered by the table.
[24]	**NC-price**	Average price in national currency (NC).
[25]	**Asterisks**	Importance indicator. Generally, important products are indicated by an asterisk (*).
[26]	**Quotations**	Number of price observations on which the average prices in national currency in column *[24]* are based.
[27]	**Var. co. 4**	Price observation variation coefficient. The standard deviation of the price observations underlying the product's average price in column *[24]* expressed as a percentage of the arithmetic mean of the price observations underlying the product's average price in column *[24]*. It is flagged when greater than 20 percent.
[28]	**XR-price**	The average prices in national currency in column *[24]* converted to the numeraire currency with the exchange rates in column *[15]*.
[29]	**GM**	Geometric mean of the exchange rate–converted prices in column *[28]*. The use of a geometric mean here and in *[32]* ensures invariance with respect to choice of numeraire.
[30]	**XR-ratio**	Standardized price ratios based on the exchange rate–converted prices in column *[28]*. The XR-prices expressed as a percentage of their geometric mean at *[29]*.
[31]	**PPP-price**	The average prices in national currency in column *[24]* converted to the numeraire currency with the PPPs in column *[16]*.
[32]	**GM**	Geometric mean of the PPP-converted prices in column *[31]*.
[33]	**PPP-ratio**	Standardized price ratios based on the PPP-converted prices in column *[31]*. The PPP-prices expressed as a percentage of their geometric mean at *[32]*.

to the basic heading as a whole or to each country covered by the basic heading. It is this section that contains the overall variation coefficient *[13],* the PPPs *[16],* the expenditure weights *[18],* and the country variation coefficients *[20]* for the basic heading. The third section covers the products priced for the basic heading. Each product has its own subsection that shows the product variation coefficient *[22];* the average prices reported by countries in national currencies *[24]*—these are the prices being validated and the prices with which the PPPs shown in the table are calculated; the average prices converted to a common currency with exchange rates *[28],* their geometric mean *[29],* and their XR-ratios *[30];* and the average prices converted to a common currency with the PPPs for the basic heading *[31],* their geometric mean *[32],* and their PPP-ratios *[33].*

Examples of a Dikhanov table appear in tables 9A.2, 9A.3, and 9A.4. Reference numbers in italics have been added, and explanations are given in the notes that follow the tables. For illustrative purposes, the tables cover the same basic heading as the Quaranta table, even though Dikhanov tables are usually produced for aggregates. Comparing a Quaranta table with a Dikhanov table for the same basic heading is good way of understanding their similarities and differences, providing the PPPs for both tables are calculated with a CPD. Table 9A.2 is the extended version of a Dikhanov table with the pull-up series (the series that is usually hidden) exposed. This series is the average price in national currency *[16],* the number of price observations on which the average price is based *[17],* the price observation variation coefficient *[18],* and the XR-ratio *[19].* Table 9A.3 shows what the Dikhanov table looks like when the pull-up items are hidden, which is how the Dikhanov table is usually presented. The table has two sections. One gives summary information on the basic heading and countries, including the PPPs *[4],* the country standard deviations *[5],* and the overall standard deviation *[6].* The other

TABLE 9A.2 A Dikhanov Table for a Basic Heading (Extended Version)

		[1] A	*[1]* B	*[1]* C	*[1]* D	STD 1 STD 3	Items/ countries
Code	Name	*[2]* Q1 2011	*[2]* Q1 2011	*[2]* Q1 2011	*[2]* Q1 2011		
[3] 1101111	*[3]* Rice						
	[4] PPP	2,673.85	1.0353	0.7791	1.0000		
	[5] STD 2	0.0974	0.0341	0.1391	0.0505	*[6]* 0.0902	
	[7] No. of items priced	3	3	3	3		*[8]* 3
	[9] XR (LCU/US$)	1,473	0.709	0.292	0.3845		
	[10] Rebased XR	3,830.94	1.8439	0.7594	1.000		
	[11] PLI	0.698	0.561	1.026	1.000		
[12] 1101111.0111	*[12]* Rice, long grain	*[13]* 0.01505	*[13]* −0.04068	*[13]* 0.09660	*[13]* −0.07097	*[14]* 0.0637	*[15]* 4
	[16] *Average price*	*5,770.58*	*2.11*	*1.82*	*1.98*		
	[17] *No. of observations*	*15*	*13*	*9*	*5*		
	[18] *Variation coefficient*	*5.1*	*4.4*	*21.2*	*16.8*		
	[19] *XR-ratio*	*89.0*	*67.7*	*141.9*	*117.0*		
[12] 1101111.0112	*[12]* Rice, short grain	*[13]* 0.11105	*[13]* 0.04284	*[13]* −0.19665	*[13]* 0.04277	*[14]* 0.1169	*[15]* 4
	[16] *Average price*	*21,757.60*	*7.87*	*4.66*	*7.60*		
	[17] *No. of observations*	*9*	*10*	*15*	*8*		
	[18] *Variation coefficient*	*14.2*	*7.7*	*9.1*	*8.9*		
	[19] *XR-ratio*	*97.9*	*73.6*	*105.8*	*131.1*		
[12] 1101111.0113	*[12]* Rice, basmati	*[13]* −0.12610	*[13]* −0.00216	*[13]* 0.10005	*[13]* 0.02820	*[14]* 0.0817	*[15]* 4
	[16] *Average price*	*7,075.88*	*3.10*	*2.59*	*3.09*		
	[17] *No. of observations*	*6*	*14*	*7*	*10*		
	[18] *Variation coefficient*	*15.3*	*10.4*	*24.7*	*10.2*		
	[19] *XR-ratio*	*77.3*	*70.4*	*142.4*	*129.2*		

contains the CPD residuals *[13]* and their standard deviations *[14]* for the products priced by countries. CPD residuals and their derivation are explained in the notes to tables 9A.2, 9A.3, and 9A.4. An examination of the Quaranta and Dikhanov tables shows that the CPD residuals in the Dikhanov table are equal to the logarithms of the PPP-ratios in the Quaranta table. The CPD residual of 0.01505 for long grain rice for country A in tables 9A.2 and 9A.3 is equal to the log of 1.015, where 101.5 is the corresponding PPP-ratio in table 9A.1. Note that this identity holds only if the PPPs in both tables are calculated with a CPD and if the products are included in the calculation as a single group—that is, either as a basic heading or as an aggregate. It will not hold if the CPD is used for the Dikhanov table and the GEKS for the Quaranta table.

TABLE 9A.3 A Dikhanov Table for a Basic Heading (Collapsed Version)

		[1] A	*[1]* B	*[1]* C	*[1]* D	STD 1 STD 2	Items/ countries
Code	Name	*[2]* Q1 2011	*[2]* Q1 2011	*[2]* Q1 2011	*[2]* Q1 2011		
[3] 1101111	*[3]* Rice						
	[4] PPP	2,673.85	1.0353	0.7791	1.0000		
	[5] STD 2	0.0974	0.0341	0.1391	0.0505	*[6]* 0.0902	
	[7] No. of items priced	3	3	3	3		*[8]* 3
	[9] XR (LCU/US$)	1,473	0.709	0.292	0.3845		
	[10] Rebased XR	3,830.94	1.8439	0.7594	1.000		
	[11] PLI	0.698	0.561	1.026	1.000		
[12] 1101111.0111	*[12]* Rice, long grain	*[13]* 0.01505	*[13]* –0.04068	*[13]* 0.09660	*[13]* –0.07097	*[14]* 0.0637	*[15]* 4
[12] 1101111.0112	*[12]* Rice, short grain	*[13]* 0.11105	*[13]* 0.04284	*[13]* –0.19665	*[13]* 0.04277	*[14]* 0.1169	*[15]* 4
[12] 1101111.0113	*[12]* Rice, basmati	*[13]* –0.12610	*[13]* –0.00216	*[13]* 0.10005	*[13]* 0.02820	*[14]* 0.0817	*[15]* 4

Nor will it hold if the CPD residuals for products in the basic heading in the Dikhanov table are based on PPPs for an aggregate and the PPP-ratios in the Quaranta table are derived with PPPs for the basic heading. Table 9A.4 shows the CPD residuals of tables 9A.2 and 9A.3 expressed as PPP-ratios.

The standard deviations for the CPD residuals in the Dikhanov table are actually variation coefficients because the mean of the residuals is 1. They have been expressed as variation coefficients (i.e., multiplied by100) in table 9A.4 to facilitate comparison with the variation coefficients in the Quaranta table in table 9A.1. The two sets of coefficients are not the same because of differences in

TABLE 9A.4 A Modified Dikhanov Table for a Basic Heading (Collapsed Version)

		A	B	C	D	Var. co. 1 Var. co. 3	Items/ countries
Code	Name	2011	2011	2011	2011		
1101111	Rice						
	PPP	2,673.85	1.0353	0.7791	1.0000		
	Var. co. 2	9.7	3.4	13.9	5.1	9.0	
	No. of items priced	3	3	3	3		3
	XR (LCU/US$)	1,473	0.709	0.292	0.3845		
	Rebased XR	3,830.94	1.8439	0.7594	1.000		
	PLI	69.8	56.1	102.6	100.0		
1101111.0111	Rice, long grain	101.5	96.0	110.1	93.1	6.4	4
1101111.0112	Rice, short grain	111.7	104.4	82.1	104.4	11.7	4
1101111.0113	Rice, basmati	88.2	99.8	110.6	102.9	8.2	4

Source (all tables): 2005 ICP.

Notes to tables 9A.2, 9A.3, and 9A.4

[1]	Abbreviated names of countries covered by the table.
[2]	Period during which the prices for the products covered by the table were collected.
[3]	Code and name of the basic heading or aggregate covered by the table.
[4]	Purchasing power parities for the basic heading or aggregate covered by the table. They are expressed as the number of local currency units per unit of the selected numeraire currency. The prices used to calculate the PPPs are the average prices in local currencies that countries report for the products they priced for the basic heading or aggregate—that is, the average prices in row *[16]*.
[5]	STD 2: standard deviation of each country's CPD or CPRD residuals for the basic heading or aggregate. It can be converted to a country variation coefficient by multiplying by 100. The mean of each country's residuals is 1.
[6]	STD 1: standard deviation of the CPD or CPRD residuals of all products priced for the basic heading or aggregate. It can be converted to an overall variation coefficient for products by multiplying by 100. The mean of all product residuals is 1.
[7]	Number of products priced by each country.
[8]	Number of products specified for the basic heading or aggregate.
[9]	Market exchange rates of countries expressed as the number of local currency units per U.S. dollar.
[10]	Exchange rates *[9]* rebased to the numeraire currency. Number of local currency units per unit of numeraire currency.
[11]	Price level indexes. The PPPs in row *[4]* expressed as a ratio of the corresponding rebased exchange rates in row *[10]*.
[12]	Code and name of the product covered.
[13]	CPD or CPRD residuals by product and country.
[14]	STD 3: standard deviation of the product's CPD or CPRD residuals. It can be converted to a product variation coefficient by multiplying by 100. The mean of a product's residuals is 1.
[15]	Number of countries pricing the product.
[16]	Average price in local currency units.
[17]	Number of price observations on which the average prices at *[16]* are based.
[18]	Price observation variation coefficient.
[19]	Price ratios based on exchange rate–converted prices. The converted prices expressed as a percentage of their geometric mean.

computation. The overall variation coefficient in the Quaranta table is an average of the variations coefficients of the products priced for the basic heading, whereas the overall variation coefficient in the Dikhanov table is computed with all the CPD residuals in the table's product section, thereby ensuring consistency between the overall variation coefficient, the product variation coefficients, and the country variation coefficients. In addition, the product variation coefficients in the Quaranta table should in theory be calculated using logarithms because the PPP-ratios are based on the geometric mean of the PPP-prices, but for practical reasons they are calculated using the arithmetic mean and standard deviation of the PPP-ratios. This is not the case with the product variation coefficients in the Dikhanov table. These are based on CPD residuals that, as just mentioned, are logarithms of the PPP-ratios. Despite the computation differences, the two sets of variation coefficients are of similar orders of magnitude and reliability in terms of identifying extreme values.

The version of the Dikhanov table presented in table 9A.4 is more user-friendly than the version in table 9A.3 because it uses the same terminology and concepts in the Quaranta table. It is therefore easier to move back and forth between the two tables during validation. The option of having a Dikhanov table showing CPD residuals expressed as PPP-ratios and their standard deviations as variation coefficients still has to be added to the average price diagnostic module.

A comparison of the Quaranta table and its Dikhanov counterpart shows that they have the following indicators of extreme values in common:

- The *overall variation coefficient* measures dispersion among all the PPP-ratios for a basic heading. In doing so, it measures the homogeneity of the price structures of the countries covered by the basic heading and the reliability of the PPPs calculated for the basic heading. The higher the value of the coefficient, the less homogeneous are the price structures and the less reliable are the PPPs. A value that exceeds 33 percent is extreme.

  During verification of extreme values, priority should be given to basic headings with a coefficient value greater than 33 percent, particularly if they have a large expenditure weight. Basic headings with large expenditure weights will have greater influence on the overall PPPs than basic headings with small expenditure weights. Only Quaranta tables give expenditure weights.

  The value of the coefficient should fall as validation progresses, thereby providing a means of assessing the overall effectiveness of the validation process.
- The *country variation coefficient* measures dispersion among a country's PPP-ratios for a basic heading. In other words, it measures the variation in a country's price levels among the products it priced for the basic heading and the reliability of its PPP for the basic heading. The higher the value of the coefficient, the less uniform are the country's price levels and the less reliable are its PPPs. A value that exceeds 33 percent is extreme.

  During verification, NCAs should give priority to basic headings for which the value of the country variation coefficient is greater than 33 percent, particularly if the expenditure weight for the basic heading is large.

  The coefficient should decline in value as validation progresses. This allows NCAs to assess the effectiveness of their validation.

  The country variation coefficient complements the product variation coefficient (next item) by bringing a different perspective to the same set of data. Focusing on countries rather than products can help to detect countries that have suspect data. In this respect, it is better to use the Dikhanov table with its wider coverage of products to detect errant countries.
- The *product variation coefficient*, the most important of the variation coefficients for validation purposes, measures dispersion among the PPP-ratios for a product. It is an indicator of comparability and accuracy and addresses the questions of whether the NCAs pricing the product priced the same product or an equivalent product and whether they priced it correctly. The higher the value of the coefficient, the less uniform are the product's price levels and the more suspect are the product's comparability and the accuracy of its pricing across countries. Such products are candidates for splitting or deletion, and the RCA should ensure that they are thoroughly investigated by the NCAs. During validation, priority should be given to products with a variation coefficient greater than 33 percent.
- *XR-ratios* are standardized price ratios based on exchange rate–converted average prices. This proxy measure allows the average prices for a product to be compared across countries. It facilitates the identification of extreme values among price ratios for a product at the beginning of the intercountry validation when PPPs and PPP-ratios are likely to be unreliable because they are based on the average prices that are being validated. Initially, XR-ratios outside the range of 80–125 should be investigated during the first and second round of validation. In later rounds, when the PPP-ratios become more reliable, extreme

values among the XR-ratios can be ignored. For this indicator, it is better to consult the Quaranta table because the series is clearly displayed with extreme values flagged.

- *PPP-ratios* are standardized price ratios based on PPP-converted average prices. It is the correct measure with which to compare the average prices for a product across countries and the average prices of a country across products. It is the extreme values among these price ratios for a product that intercountry validation seeks to identify and verify. Ratios outside the range of 80–125 should be investigated.
- The *price observation variation coefficient* measures variation in the price observations on which the average price reported for a product by a country is based. It is taken straight from the average price table. It is used to identify extreme values among average prices during intracountry validation when average prices with a variation coefficient over 20 percent are considered extreme. Should the variation coefficient remain over 20 percent after intracountry validation, the NCA may need to reedit the underlying price observations if there are extreme values among the product's PPP-ratios or if the product variation coefficient is over 33 percent.
- *Price level indexes* measure the differences in price levels between countries for the basic heading. They are useful for comparing the consistency of relative price levels across basic headings.

NOTES

1. When a product specification is too loose, the problem is not so much that the product priced does not match the product specified (because it probably does), but that it is not comparable with the products that other price collectors, both within the country and in other countries, have matched and priced for the same specification. Within a country, the problem can be ameliorated by the NCA and price collectors agreeing on how generic specifications are to be interpreted and what products are to be priced before starting price collection. This will not avoid differences in interpretation between countries that will only become apparent during validation.
2. This can happen when the product specification refers to a specific model that is in the process of being replaced in some countries by a later model—not an infrequent occurrence in the case of household durables.
3. This situation amplifies the earlier observation that price collectors should be well trained and given clear instructions, as well as price reporting forms that are user-friendly. Also, fieldwork should be closely monitored to ensure that price collectors record the prices, quantities, and other data required. Training and field supervision do not eliminate product errors, but they do reduce the incidence.
4. Even if the price and specified quantity are recorded correctly, a price error can be introduced if the price is not adjusted correctly to the reference quantity.
5. The terms *extreme value* and *outlier* are often used synonymously. In this text, *outlier* is reserved for extreme values that have been verified as being correct. On identification, an *extreme value* is a possible error; after verification it is either an error or an outlier.
6. Different products have different distribution profiles. Some products are sold mostly in supermarkets; other products are sold mainly in specialty shops.
7. Prices for the same product can vary from one outlet type to another because it is being sold under varying conditions or circumstances. The conditions or circumstances of sale constitute a service element. If the service element changes from one outlet type to another, the

product being purchased is not the same at both outlets even if it is identical physically. What is actually being bought is a composite product—that is, the product itself plus the service element. The difference in the service element is a quality difference and contributes to the price difference. When those averaging the prices collected for the product take no account of the different service elements of the outlets at which they were observed, the average price is likely to be too high or too low

8. Whether these average prices lead to unbiased price relatives depends on whether the products surveyed have similar distribution profiles in the other countries participating in the comparison and on whether the outlets selected have equivalent service elements in all countries.
9. Originally, it was intended that the RCA would participate in intracountry validation to ensure that a common standard of rigor was maintained across the region. In some regions, the RCA is involved, but in others it is not because of the strict interpretation of confidentiality by countries in the region. In regions in which the RCA is involved in intracountry validation, a country's price observations are reviewed only by its NCA and the RCA; they are not made available to anyone else either inside or outside the region. Experience suggests that RCA participation in intracountry validation may be counterproductive. When the RCA is involved, the NCAs have a tendency to halt being proactive, as required; instead, they become reactive, expecting the RCA to take the initiative.
10. The importance of completing validation on time cannot be overstated. Prices for consumer products are usually collected monthly, with editing and verification carried out quarterly. Thus large numbers of price observations must be processed. Every effort should be made to avoid a backlog, which could delay the regional comparison (and possibly the global comparison). It could also be detrimental to quality. The longer it takes to validate the price data, the harder it becomes to rectify the errors identified during validation. Moreover, to reduce the backlog and catch up on lost time, the RCA and the NCAs may be tempted to cut corners by editing and verifying the prices less rigorously.
11. For example, in table 9.1a the reference quantity is 500 grams (fields 03 and 04), but price collectors may price any quantity in the range of 400–600 grams (field 02). The prices of the quantities priced (fields 10, 11, and 12) are subsequently adjusted to price per 500 grams (field 16). It is the adjusted prices in field 16 that are validated and averaged to give the average price (field 24) in table 9.3a.
12. A distinction is made between products that are important and products that are not when calculating PPPs for a basic heading. Countries are therefore required to indicate which of the products they have priced for a basic heading are important for them. A product is important if it is a volume seller. Important products are identified by an asterisk (*) and are often referred to as "asterisk products."
13. The price observation table and the average price table are linked. The average prices in the average price table are derived from the individual prices in the price observation table. Modifying an individual price will automatically change the corresponding average price. Each average price can be "opened up" to display the individual prices on which it is based. Thus if an average price is flagged as an extreme value, the underlying price observations can be called up to see whether any of them are flagged as extreme values and the cause of the average price being flagged. It follows from this that the two stages of intracountry validation can be done in reverse—that is, starting with average prices rather than price observations. The disadvantage of the approach is that there is a danger that the additional information provided by price collectors will be overlooked.

14. A standardized price ratio equals $\left(\frac{\text{CC-Price}_{1A}}{[\text{CC-Price}_{1A} * \text{CC-Price}_{1B} * \ldots \text{CC-Price}_{1N}]^{\frac{1}{N}}} \right) 100$, where CC-Price_{1A} is the average price for product 1 in country A in the common currency. CC-Price_{1A} is itself equal to $\frac{\text{NC-Price}_{1A}}{\text{CC}_{1A}}$, where NC-Price_{1A} is the average price for product 1 in country A in national currency, and CC_{1A} is the currency conversion rate between the national currency of country A and the common currency. The currency conversion rate is either the exchange rate or the PPP: $\text{CC}_{1A} = \text{XR}_{1A}$ or PPP_{1A}.
15. Also known as CUP-ratios. CUP stands for conventional unit for expressing parities. It is usually an artificial currency unit such as the purchasing power standard (PPS) employed by Eurostat.
16. That is, an aggregate from the aggregation hierarchy of the expenditure classification such as food and beverages, clothing and footwear, household final consumption, or GDP.
17. The CPRD should be employed to calculate PPPs for Quaranta and Dikhanov tables only if the information on the importance of products is reliable. Experience suggests that this is not usually the case. For this reason, it is recommended that Quaranta and Dikhanov tables be first derived with the CPD, and that the CPRD be reserved for the final iterations and the validation of product importance. Large differences between CPD and CPRD residuals and standard deviations would indicate data problems, particularly with the selection of important products. The same holds for the EKS*. PPPs should not be calculated for Quaranta tables with this method if the allocation of importance indicators is suspect. Instead, the GEKS method should be employed, at least during the early stages of validation.
18. The format of the Quaranta table, which dates from the early 1990s, was designed so that the table could be printed on A4 paper.
19. This was not always so. For example, earlier versions of the Dikhanov tables did not contain the XR-ratios on which intercountry validation focuses at the beginning.