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Price Statistics Compilation in 196 Economies: The Relevance for Policy Analysis

by Francien Berry, Brian Graf, Michael Stanger, and Mari Ylä-Jarkko

IMF Working Papers describe research in progress by the author(s) and are published to elicit comments and to encourage debate. The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

I N T E R N A T I O N A L M O N E T A R Y F U N D

IMF Working Paper

Statistics Department

Price Statistics Compilation in 196 Economies: The Relevance for Policy Analysis

Prepared by Francien Berry, Brian Graf, Michael Stanger, and Mari Ylä-Jarkko

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Abstract

The consumer price index (CPI) is a key economic indicator used to gauge inflation, adjust wages, pensions, and social benefits. The producer prices index (PPI) is used for forecasting and deflating GDP estimates. Both indexes are used by the Fund, policymakers, and researchers for global, regional, and domestic surveillance. In this context, the paper evaluates the soundness of the indexes by assessing four major criteria: frequency of updating the weights, the index coverage, timeliness, and the use of international classifications. We discuss online and scanner data as frontier issues. The study shows that the CPI is universally and frequently compiled, timely, and fairly-well aligned with international standards. However, the weights used to compile the index are updated in only 45 percent of economies and have national coverage in 76 percent. PPIs, compiled by only 126 economies are timely, but there is scope for continued improvement as only 36 percent of economies have updated PPI weights and approximately 67 percent maintain the recommended coverage. Outdated weights impact the reliability of the indexes for policy analysis. Frequently updated weights and well-represented coverage mitigate against biases and ensure that the indexes properly measure the price evolution in the economy.

JEL Classification Numbers: C3, E3, E6

Keywords: Price Index, CPI, PPI, Scanner data, Big data, Macroeconomic Statistics

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I. INTRODUCTION¹

Reliable and accurate price indexes are essential inputs for effective policymaking and measuring economic performance. With the globalization of production and trade, and the liberalization of markets, national governments, central banks, international organizations, and data users more generally place emphasis on the quality and accuracy of price indexes, and their international comparability.

A price index is a measure of the proportionate, or percentage, changes in a set of prices over time. Because the prices of different goods and services do not all change at the same rate, a price index reflects their average movement. The four principal price indexes that serve as closely watched indicators of macroeconomic performance are the consumer price index (CPI), producer price index (PPI), export price index (XPI), and import price index (MPI). Each of these are direct indicators of the purchasing power of money in various types of transactions. These indexes are often important tools in the design and operationalization of monetary and fiscal policies, and they are also inputs into private sector's decision making. Another important price index is the residential property price index (RPPI), a critical input used by policymakers to detect potential asset bubbles. This paper compares compilation practices in price statistics focusing on consumer and producer price indexes.

The CPI measures changes over time in the general price levels of goods and services acquired by households for consumption. In many countries, CPIs were originally introduced to provide a measure of the changes in the living costs faced by workers so that wage increases could be related to changing levels of prices. However, over the years, the scope of the CPI has been widened, and it is now widely used as a macroeconomic indicator of inflation, a tool for effecting monetary and fiscal policy, and as deflator in the national accounts to better estimate changes in real economic growth. The CPI is now considered to be one of the most important economic indicators produced by national statistical offices (NSOs).

PPIs measure the average change in the prices received by domestic producers of goods and services for their output over time. PPIs provide detailed product and industry data that allow users to monitor short-term price inflation for different types of production activities. PPIs had their beginnings in the development of wholesale price indexes (WPI). However, over time the WPI has been replaced by the PPI which has broader coverage of products and industries and better conceptual alignment with the system of national accounts.

¹ The authors would like to thank Thomas Alexander, Andrew Baer, Rob Dippelsman, Louis Marc Ducharme, Claudia Dziobek, Weicheng Lian, Margarida Martins, Niall O'Hanlon, Gabriel Quiros, Lisbeth Rivas, Patrizia Tumbarello, Louis Venter, and Yingbin Xiao for comments on an earlier draft and during the STA Brown Bag presentation in April 2018. The authors are also grateful to Zia Abbasi, Issam Alsammak, Pamela Audi, Elirjeta Pepaj, Hubert Gbossa, Donna Grcman, Gregory Legoff, Sebastien Manzi, Achille Pegoue, Brooks Robinson, Roger Sceviour, Todor Todorov, Martha Tovar, and Richard Wild for their contributions to put the dataset together.

Although important economic indicators in their own right, a vital use of PPIs is to deflate the national accounts. Additionally, PPIs are used to adjust the prices of inputs in long-term purchase and sales contracts. The varied uses of PPIs have resulted in increased demand for these statistics. While many countries initially develop a PPI to cover goods produced in mining and manufacturing industries, the PPI should be extended to cover all economic activities.

Because of their widespread uses, movements in the CPI and PPI can have financial implications for all players in an economy, and, may impact the international perception of an economy's performance and stability. Unlike other macroeconomic statistics, CPIs and many PPIs are not subject to revision. It is therefore critical to review the compilation practice of these statistics – the methodological soundness, timeliness, coverage, and the frequency of compilation.

This analysis is based on the recommendations and best practices defined in the *Consumer Price Index Manual: Theory and Practice (CPI Manual, 2004)*, its upcoming update the *CPI Manual: Concepts and Methods (2019)*, and the *Producer Price Index Manual: Theory and Practice (PPI Manual, 2004)*. The economies are grouped into 37 advanced economies and 159 emerging and developing economies. The emerging and developing economies are then grouped into 50 inflation-targeting and 109 non-inflation targeting economies.² We assess the performance of inflation versus non-inflation-targeting economies because a relevant feature of an inflation targeting policy regime is that it assumes a high degree of discipline on the monetary authorities to maintain their commitment to a pre-specified and pre-announced target. Likewise, statistical agencies are required to ensure that the underlying statistics are timely, methodologically sound, and internationally consistent. This suggests that intensive use of the data for policy provides an incentive for NSOs to improve the coverage and methodology of the index.³

This paper focuses on current practices with regard to the (1) frequency of updating the weights; (2) coverage of the CPI and PPI; (3) timeliness of CPI and PPI; and (4) classification systems used in CPI and PPI compilation. These practices, reviewed by IMF staff when providing technical assistance (TA), can be used as benchmarks to assess improvement over time. Other key criteria to assess the soundness of compilation practices include the use of proper index calculation formulae, sampling methods, the treatment of missing prices, and adjusting for changes in quality to name a few. However, discussing these additional criteria would require more detailed data and assessments of country

² The advanced economies are classified using the IMF's World Economic Outlook (WEO) classification. The term "economy," as used in this paper, does not in all cases refer to a territorial entity that is a state as understood by international law and practice. The term also covers some non-sovereign territorial economies, for which statistical data are maintained and provided internationally on a separate and independent basis. We use the term "economy" interchangeable with the term "country."

³ Carson, Carol S., Enoch, Charles, and Dziobek, Claudia, IMF 2002, *Statistical Implications of Inflation Targeting: Getting the Right Numbers and Getting the Numbers Right* (Washington, D.C.).

practices which are not available at this time. The paper provides some observations on the need for future development and improvement of compilation methods to better measure new products and services arising from digitalization and using online and scanner data in price statistics compilation.

This paper relies on the experience gained from the Fund’s delivery of TA over the years. Since 2000, IMF staff have conducted about 60 technical assistance missions and training activities per year to develop and improve price indexes. Targeted projects on price indexes have been supported by external donors.⁴ The IMF’s Regional Capacity Development Centers (RCDCs) support the development of prices statistics in 108 economies. This paper draws on publicly available data including the IMF’s [Dissemination Standards Bulletin Board \(DSBB\)](#), and information provided by the real sector advisors located in the Fund’s 10 RCDCs. The overview of new products and services and scanner data are based on a 2017 joint IMF-OECD questionnaire on the treatment of digitalization in CPI and PPI compilation. Forty-three countries responded to the survey on CPIs and 36 countries responded to the survey on PPIs.

II. THE STATUS OF CONSUMER PRICE INDEX (CPI) COMPILATION

The CPI is an important indicator of underlying economic performance and is used for a variety of purposes. The most common uses are: indexation of wages, rents, contracts, and social benefits payments; deflation in the national accounts; and a tool for monetary and fiscal policy. CPIs are compiled by all economies in the sample. Nineteen percent these (37 economies) are advanced economies and the remaining 81 percent are emerging and developing economies.

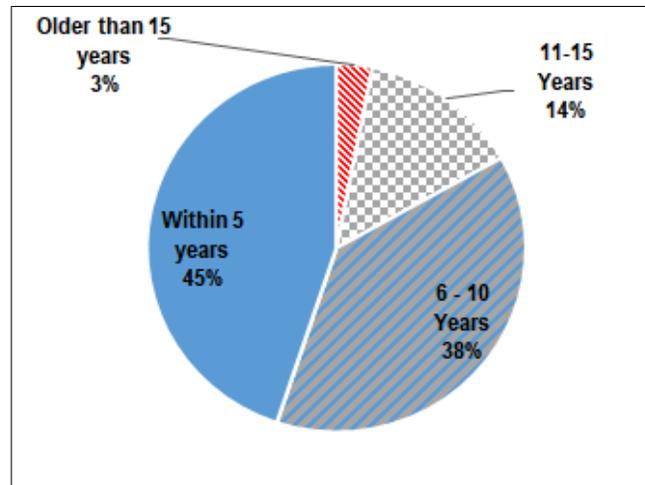
A. Frequency of Updating the CPI Weights

The CPI weights reference period is one indicator of the reliability and accuracy of the data. The weight reference period represents the year for which the expenditure data used to derive CPI weights were collected. The time elapsed between weight updates is important to assess the quality of the statistics used to measure and monitor the evolution of price changes in the economy. The *CPI Manual 2004* and its forthcoming update recommend that the CPI weights be no more than five years old. Maintaining updated CPI weights ensures that the basket of goods and services remains relevant and that the index is representative of the current expenditure patterns of households. Where there are significant structural changes or rapidly changing consumption patterns, it is recommended that CPI weights be updated even more frequently. The further away the CPI’s weights are from the current period, the less reliable and representative the estimates become. Outdated expenditure patterns lead to mismeasurement of price changes and can introduce bias into the index. Less reliable estimates of price changes can result in misleading signals for policy making. Figure 1

⁴ IMF global partners provide funding through a variety of mechanisms to support capacity development activities.

provides an overview of the current status of the weight reference periods in all compiling economies.

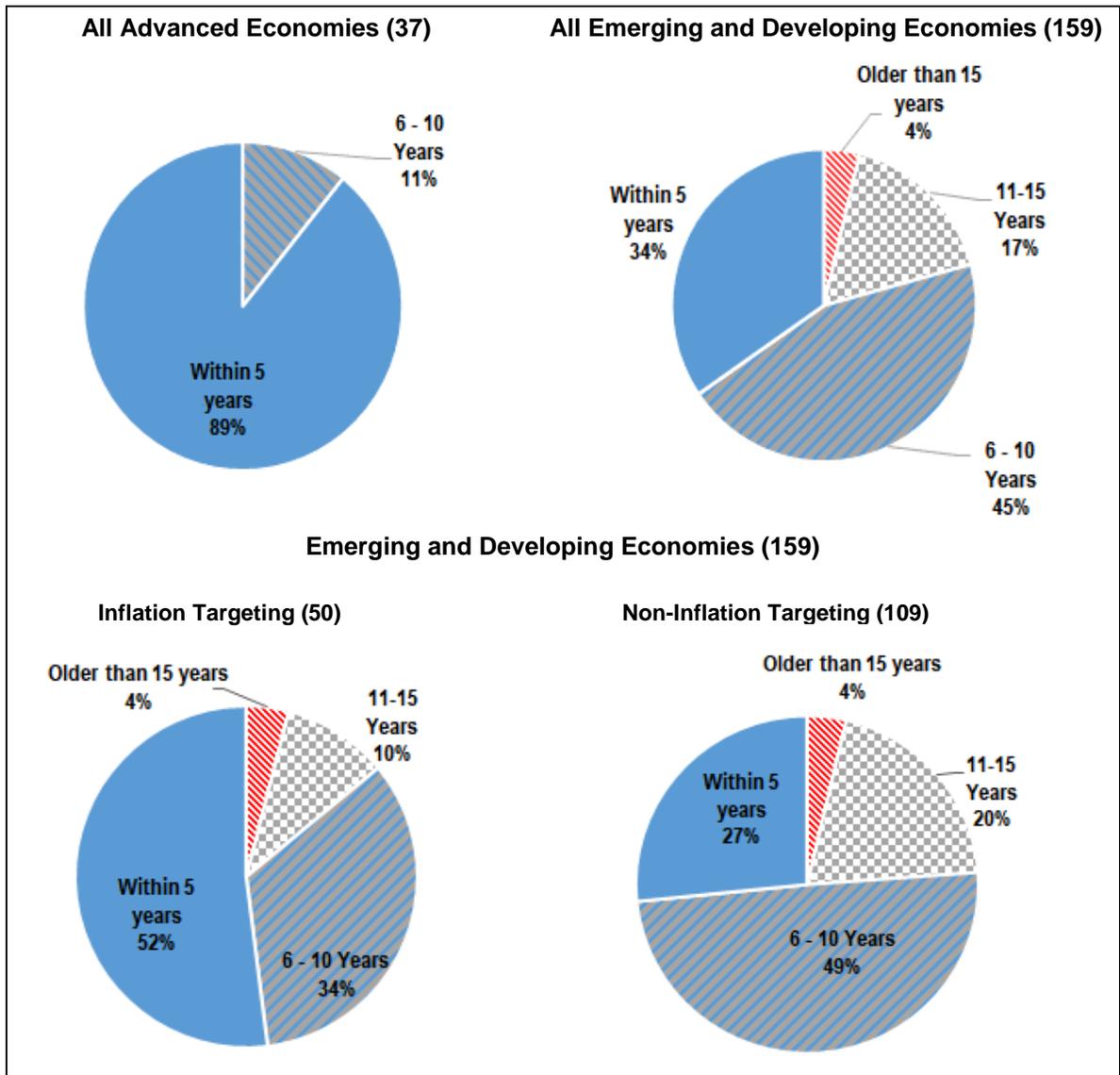
Figure 1. CPI Weight Reference Period - All Economies



Source: IMF staff estimates as of July 2019.

Approximately 45 percent of all economies have CPI weights that have been updated within five years (Figure 1). Advanced and inflation targeting economies revise CPI weights more frequently (Figure 2). Eighty-nine percent (33 economies) of all advanced economies and 52 percent (26 economies) of inflation targeting emerging and developing economies have revised the weights in the last five years. The remaining four advanced economies and 17 of the remaining inflation targeting emerging and developing economies (34 percent) have weight reference period between 6 and 10 years old. One reason may be that advanced and inflation targeting economies have more formal data quality requirements of the CPI for domestic policy needs – to assess current economic performance and to forecast inflation in order to set the specific targets. As a result, resources have been made available to collect the expenditure data needed to update CPI weights on a more frequent basis. Furthermore, the CPI, and other price indexes for these economies are used by authorities as inputs to more sophisticated policy designs, such as adjusting the monetary policy rate, pricing treasuries, and/or indexing salary and wage contracts.

Figure 2. CPI Weight Reference Period by Economic Classification



Source: IMF Staff Estimates as of July 2019.

B. Geographical Coverage of CPI

Geographical coverage of the CPI is another key component in assessing the methodological soundness. The geographical coverage refers to either the coverage of expenditure or the coverage of price collection. Ideally, these two should coincide whether the CPI is compiled and disseminated as a national or regional index. In general, the index should include expenditure made by all households - urban and rural - throughout the country. The most important element of geographic coverage refers to the expenditure data used to compile the weights and to select a representative basket of goods and services.

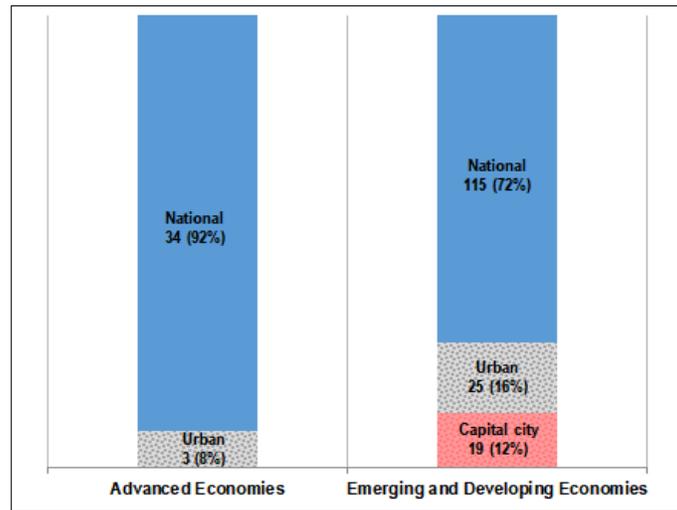
A national CPI should cover expenditure and prices throughout the country. If regional CPIs are disseminated, expenditure weights should be used to aggregate the regional indexes into the national ‘all-items’ index. If regional indexes are not disseminated, a representative sample of geographic areas can be selected for price collection, but the index weights should be based on the expenditure of all households in the country. The question often arises as to whether a CPI can be limited to urban areas, or if rural areas should also be covered given that in many countries a significant part of the population resides in rural areas. Rural CPIs are important for poverty analysis, but many countries do not publish these rural indexes. For the index weights, expenditure collected from all households (urban and rural) should be used.

In terms of price collection, many countries restrict price collection to urban areas only.

This can be justified on the basis that rural households travel to the nearest urban (or town) center to purchase goods and services and that the price movement in rural and urban areas is similar. The definition for “urban area” may vary, in some countries, it is defined to include population centers with a population of 1,000 or more inhabitants. Another justification for collecting prices only in urban areas is that there are relatively few goods and services available for pricing in rural areas and the collection of these few prices tends to be cost prohibitive.

According to the *CPI Manual*, an index with weights based on the expenditure of all households (urban and rural) but with price collection only in urban areas (including towns located in rural areas) can be considered a national index. The key is that the weights represent the expenditure of all households regardless of size, income, or location. In the past, it was common for the CPI coverage to be restricted to the capital city. However, coverage has expanded over time in many countries to include all households in the country. Increasing the geographic coverage (in terms of expenditure) results in a more representative and reliable measure of price change for an economy.

Figure 3. Geographical Coverage of CPI Expenditure Weights
(number of countries and percent)



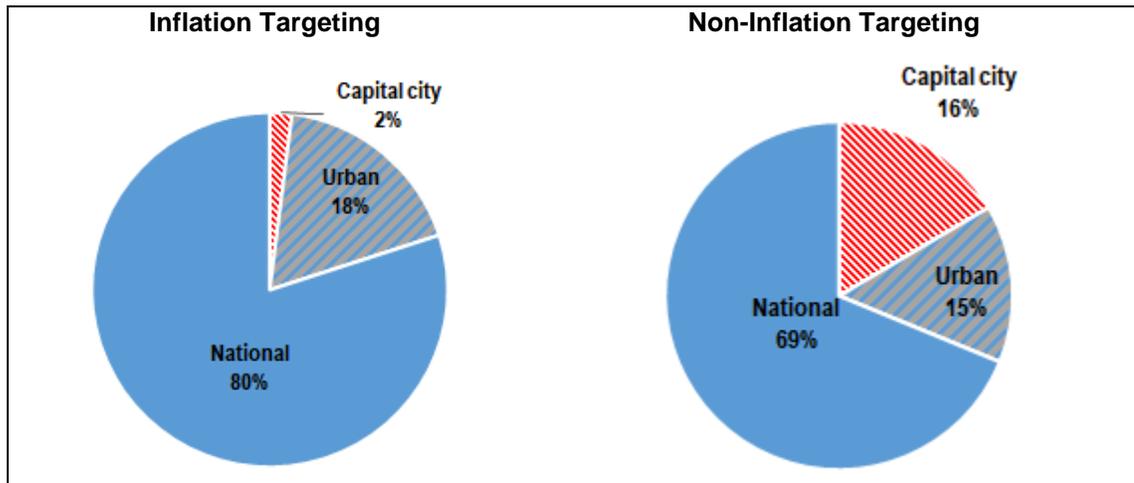
Source: IMF Staff estimates as of July 2019.

Overall, in 149 economies (76 percent) the CPI weights are based on the expenditure of all households - in both urban and rural areas. National coverage is represented in 92 percent of advanced economies (34 economies) and 72 percent (115 economies) of emerging and developing economies (Figure 3). In 25 emerging and developing economies (16 percent), the weights reflect expenditure in urban areas, while in 19 economies (12 percent), they cover only expenditure in the capital city. These economies are primarily low and lower middle-income countries with significant resource constraints.⁵

As shown in Figure 4, the CPI covers national expenditure in 80 percent of inflation targeting and 69 percent of non-inflation targeting emerging and developing economies. For 18 percent of inflation targeting economies and 15 percent of non-inflation targeting economies, weights reflect expenditure in only urban areas. The outperformance of inflation targeting economies suggests that the demand for and policy use of this information may provide an incentive for statistical agencies to improve the coverage.

⁵ Data collected from country websites and World Bank Open Data Portal <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>.

Figure 4. Geographical Coverage of CPI in Emerging and Developing Economies



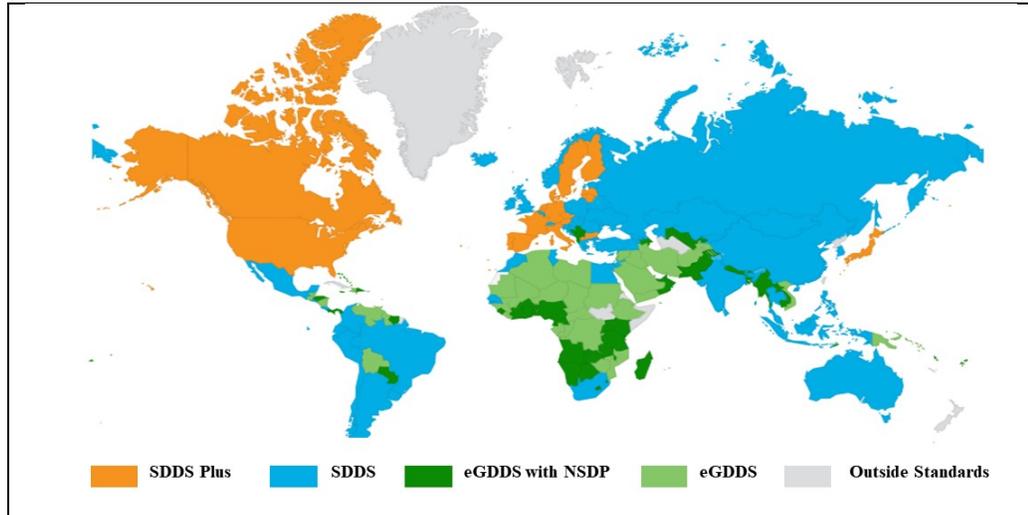
Source: IMF Staff Estimates as of July 2019.

C. Timeliness of CPIs

The IMF established voluntary standards for the dissemination of economic and financial data, including the CPI. The Special Data Dissemination Standards (SDDS) prescribes monthly dissemination of the CPI, while the enhanced General Data Dissemination System (e-GDDS) suggests dissemination within eight weeks of the reference period. The Dissemination Standards Bulletin Board ([DSBB](http://dsbb.imf.org/)) gives the public access to the National Data Summary Pages (NSDPs) of member countries and the standards of publication of each data series.⁶ The e-GDDS, SDDS, and SDDS Plus are the three broad data standards to which Fund member countries are encouraged to participate, subscribe, or adhere. To date 75 economies (41 percent) are SDDS Plus or SDDS subscribers and 108 economies (59 percent) countries report data according to the requirements of e-GDDS (Figure 5). Of the SDDS and SDDS plus subscribers, 34 are advanced economies while 41 are emerging and developing economies.

⁶ <http://dsbb.imf.org/>.

Figure 5. Economies and IMF’s Data Dissemination Standards

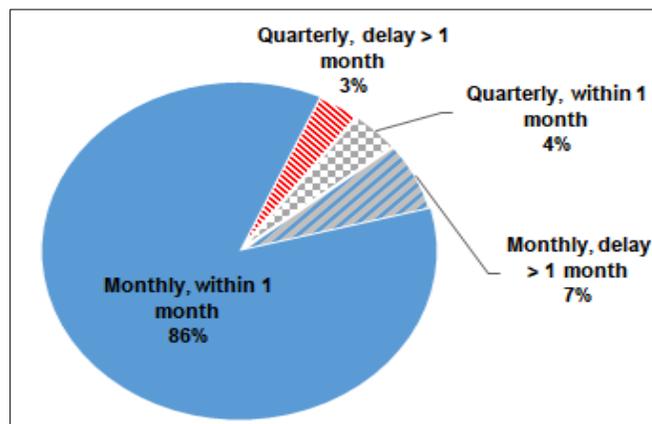


Source: IMF Dissemination Standards Bulletin Board as of July 2019.

As is the case with all statistics, timely dissemination of the CPI is key to the usefulness and relevance of the data. Over the years, countries have reduced the lag between dissemination and the reference month. Often the increased frequency of dissemination coincides with methodological improvements. Increased frequency signals that statistical agencies make a concerted effort to meet data user needs through the availability of timely data. Timeliness of the data provides an indication of improving quality and relevance.

Approximately 86 percent of countries compile and disseminate a monthly CPI and publish within four weeks after the reference period (Figure 6). In 13 economies, the CPI is compiled monthly, but published more than one month after the reference period. In these countries, the delays span from 6 to 12 weeks after the reference month. For 15 economies (7 percent), the CPI is compiled quarterly and is published within 1 and 3 months after the reference quarter.

Figure 6. Frequency and Timeliness of CPI Publication



Source: IMF Dissemination Standards Bulletin Board and country websites – April 2018.

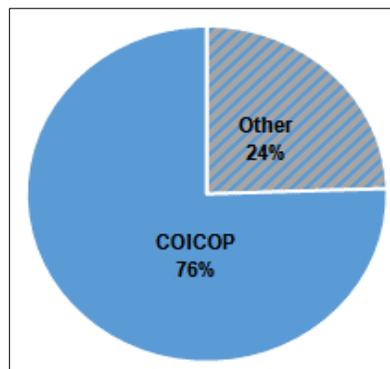
D. Classification System for CPI Compilation

To enhance international comparability of CPI data, it is recommended that countries use the internationally agreed *Classification of Individual Consumption According to Purpose (COICOP)*. COICOP was adopted by countries under the auspices of the United Nations. At the highest level (two-digit level) of categorization according to purpose, COICOP 2018 has 13 divisions. These are then divided into 63 groups of products, which are in turn divided into 186 classes and 338 subclasses.^{7, 8} COICOP provides the scheme for stratifying products in CPI sample frames and provides the weighting and index aggregation structure. Household budget surveys, national accounts, and purchasing power parities also use the COICOP classification.

Approximately 76 percent of economies (148 economies) use the COICOP classification system (Figure 7). Ninety-five percent of advanced economies and 81 percent of inflation-targeting economies use COICOP. In most cases, countries develop a national adaptation of COICOP for their CPI, in which expenditure is broken down by creating more detailed lower-level micro-classes by adding digits to meet individual country circumstances. These classifications are aligned with international standards to the greatest extent possible and adapted to national standards where necessary. For those relatively few countries that continue to use a country-specific classification system, many produce an alternative aggregation of their CPI using COICOP for purposes of international comparability.

The use of COICOP enhances comparability between countries and the implementation of COICOP reflects a country's commitment to applying international standards and comparability.

Figure 7. CPI Classification Systems



Source: IMF staff estimates as of April 2018.

⁷ https://unstats.un.org/unsd/class/revisions/coicop_revision.asp.

⁸ CPI metadata by country, including the use of COICOP classification, are currently maintained by the IMF and formerly by the International Labour Organization (ILO) at http://laborsta.ilo.org/applv8/data/SSM1_NEW/E/SSM1.html and <http://data.imf.org/regular.aspx?key=61016024>.

III. STATUS OF PRODUCER PRICE INDEX (PPI) COMPILATION

PPIs measure changes in the prices received by domestic producers of goods and services. A main use of PPIs is to deflate national accounts to produce more accurate estimates of changes in volume estimates. The main scope is the total output produced in the country for domestic use and export. Along with CPIs, PPIs are used as short-term indicators of inflationary trends and in macroeconomic forecasting. In some economies, the PPI or its sub-series are used in indexation of legal contracts and as analytic indicators for businesses and researchers. For purposes of inflation targeting and policymaking, the PPI provides information on the development of producer costs and is often used as a leading indicator of potential consumer price inflation.

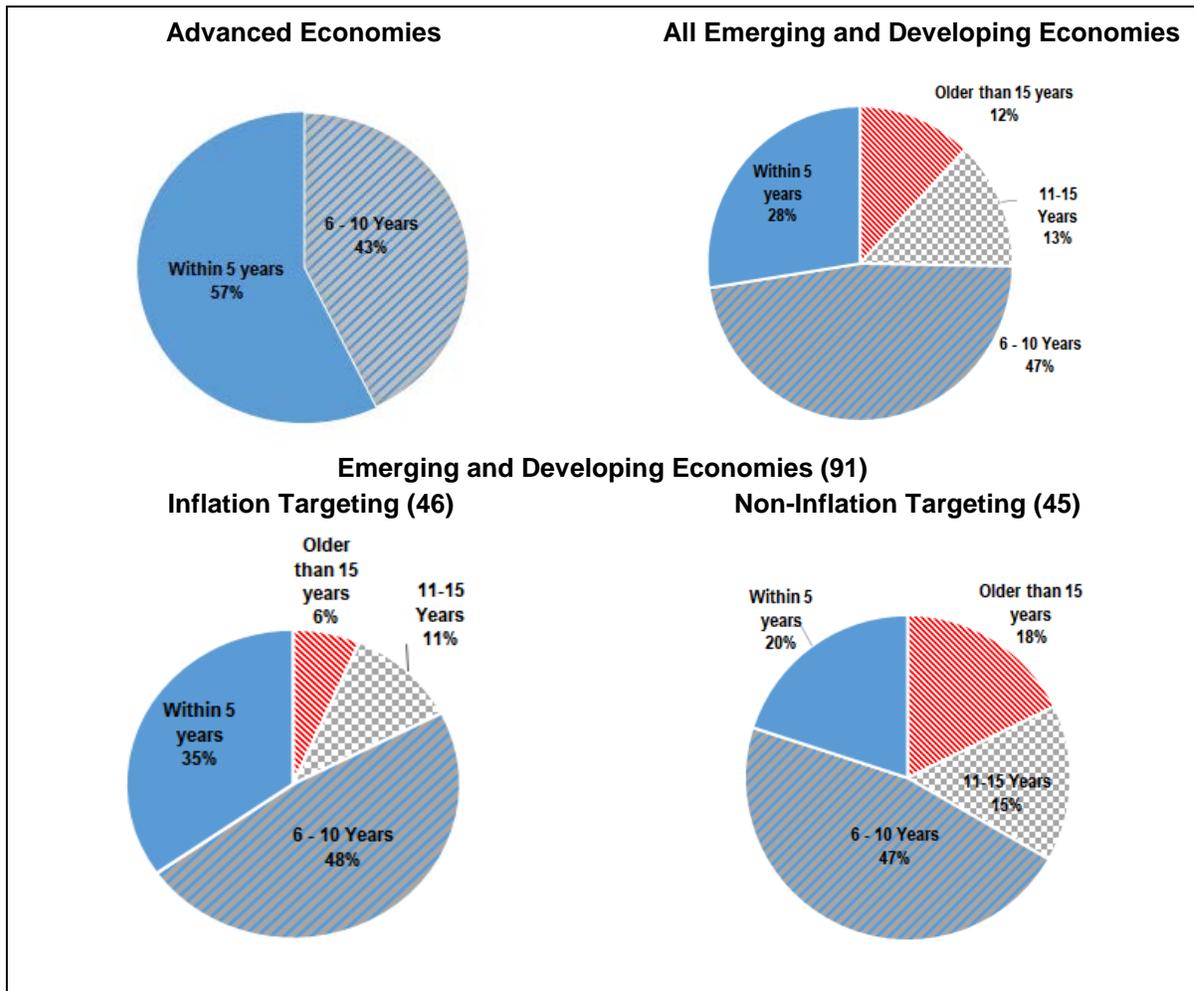
PPIs are compiled by significantly fewer economies than CPIs. While all 196 economies in the sample compile CPIs, only 126 economies (64 percent) produce PPIs. Twenty-eight percent (35 economies) of these are advanced economies and the remaining 91 are emerging and developing economies. Sixty-four percent (81 economies) of PPI compilers are inflation targeting economies while 45 are non-inflation targeting economies. Some countries produce a total output PPI that can be disaggregated by different activities, while other produce separate PPIs for each of the individual activities (services, agriculture, or manufacturing). This paper does not distinguish between these two approaches.

A. Frequency of Updating the Weights of the PPIs

PPI weights are derived using data from economic censuses, establishment surveys, or by using national accounts data such as those compiled from supply and use tables (SUTs). The ideal sources of weight data are total values of production as reported during an economic census; however, alternative sources are used if the census data are out of date or unavailable. Data used to develop detailed weights at the product level are often collected directly from sampled establishments. Best practice recommends that PPI weights are updated at least every five years.

Updating the weights on a routine and regular basis ensures that the index remains representative of current economic activity. Outdated weights can introduce a bias into the index, which adversely affects the accuracy of the data produced. Reliable estimates of economic growth require accurate PPIs. IMF surveillance activities as well as policymaking depend upon accurate PPI compilation. The timing of PPI weight updates serves as an indicator of quality for the PPI.

Figure 8. PPI Weight Reference Period by Economic Classification



Source: IMF staff estimates as of April 2018.

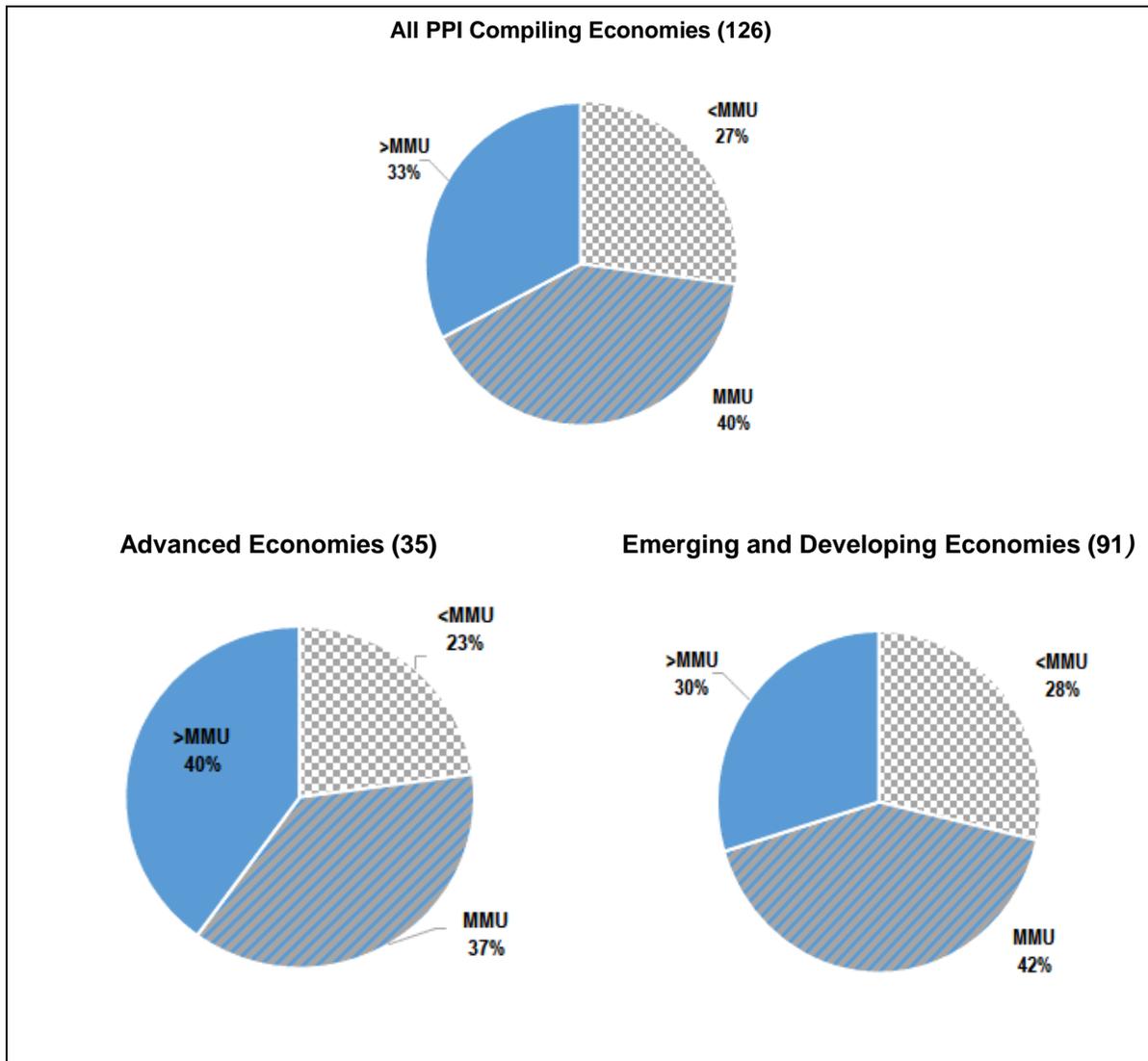
Approximately 36 percent of all countries update the weights within the recommended time frame. Figure 8 shows that 57 percent of advanced economies (20 economies) have updated weights. The remaining 43 percent have weights between 6 and 10 years old. From the emerging and developing economies, 28 percent (25 economies) have updated PPI weights, 47 percent (43 economies) have weights between 6 and 10 years old, and 25 percent (23 economies) have weights older than 10 years. In inflation targeting emerging and developing economies, 35 percent maintain weights 5 years old and less. These countries update weights more frequently than non-inflation targeting economies, in which only 20 percent have weights less than 5 years old. Of the non-inflation targeting economies, 33 percent have weights older than 10 years relative to the 17 percent of inflation targeting economies with weights older than 10 years.

B. PPI Coverage

PPI coverage is generally defined in close collaboration with data users, especially national accounts compilers. When first developing a PPI, it is recommended to start with mining, manufacturing and utilities (MMU) sectors. Coverage is expanded over time to include other more complex activities such as construction and services. Thirty-three percent of economies compile a PPI with more comprehensive coverage, most commonly covering agriculture and/or construction industries. Forty percent of economies (51 economies) cover only MMU, and 27 percent (34 economies) cover less than the recommended MMU, covering only manufacturing in most of these cases. Restricting coverage to include MMU is not representative. In many countries, MMU is relatively unimportant in terms of contribution to total GDP as compared to other economic activities such as agriculture, construction, and services. For example, in many cases MMU contributes as little as 10–15 percent (or even less) of total GDP. The percentages differ only slightly between advanced, and emerging and developing economies, in advanced economies the coverage is wider on average (Figure 9). In cases where other sectors are a major source of production, the PPIs should be extended to cover those activities. For example, in 2017, services contributed more than 65 percent of global GDP; and in approximately 80 percent of all economies, the service sector accounts for more than 40 percent of total GDP. This indicates that services PPIs are necessary for adequate coverage of domestic production in these economies.

Broader coverage results in a more representative index that provides policymakers and other data users with a more reliable measure of price change. Expanding PPI coverage provides a good indicator of improving quality. For some countries the term PPI, by definition, includes only the MMU sectors. These countries then produce separate PPIs for other individual economic activities such as services, agriculture, or construction. When disseminating PPI data, these countries include only the data for mining, manufacturing, and utilities. Additional collection is needed to identify the individual PPIs for different economic activities. A future update of this paper could provide a broader picture of PPI coverage that would include the individual PPIs for sectors. This would be useful information for analysis and surveillance purposes.

Figure 9. Industrial Coverage of PPIs



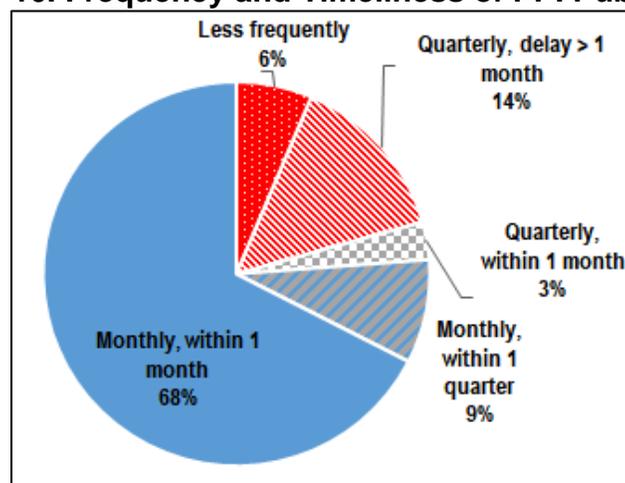
Source: IMF staff estimates as of April 2018; Note: MMU refers to Mining, Manufacturing and Utilities.

C. Timeliness of PPIs

The IMF's SDDS requires that PPIs be compiled and disseminated monthly with a one-month lag. For e-GDDS participants, the PPI is encouraged, not required, and should be disseminated within eight weeks of the reference period. Of the 126 economies that compile PPIs, monthly dissemination is practiced by 77 percent (96 economies). Eighty-six of these economies publish the indexes within one month after the end of the reference month and 11 economies publish within 3 months after the reference month (Figure 10). Twenty-two economies (17 percent) compile a quarterly PPI, 4 publish the index within one month after reference quarter and 18 with longer delay, usually within 3 months after the reference quarter. Eight economies compile a semiannual or an annual PPI.

As with the CPI, the timely dissemination of PPI data is key to the usefulness and relevance of the data. In many cases, countries initially disseminate a monthly PPI on a quarterly basis, with the on-going goal of increasing the frequency of dissemination. The timeliness of data provides an indication of improving quality and relevance.

Figure 10. Frequency and Timeliness of PPI Publication



Source: IMF DSBB and national websites – April 2018.

D. Classification in the PPI Compilation

The classification structure used for PPIs serves as the weighting and aggregation structure. A classification system provides an organizing structure and is the first step in compiling the index. In addition to benefiting the compilers, using an internationally recommended classification system facilitates cross-country comparison at a reasonably detailed level of aggregation.

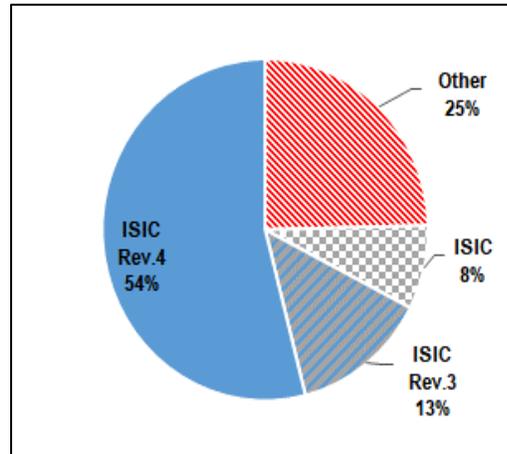
PPIs should be compiled by economic activity and by products. The international classification for activities is *ISIC Rev.4*. European Union countries use the General Industrial Classification of Economic Activities within the European Communities (*NACE Rev.2*) which is based on *ISIC Rev.4* but contains more detail. Some countries also have their own versions, that are generally derived from either the *ISIC Rev.4* or *NACE Rev.2*. Some countries or regions, such as North America, have developed classifications (*North American Industrial Classification System – NAICS*) which compares with *ISIC* at the upper levels.

For products, the Central Product Classification Version 2.1 (CPC) is the relevant international standard. The CPC was developed using the *Harmonized Commodity Description and Coding System (HS)* as the basic building blocks. The European community developed its own extension of the CPC called *Classification of Products by Activity (CPA)*. There are other regional or national product classifications.

Most economies use ISIC, or a national classification system derived from and comparable to ISIC. *ISIC Rev.4* or comparable classification is used by 68 economies

(54 percent), 27 economies (21 percent) use older versions of ISIC and 20 economies (25 percent) use other classifications (Figure 11).

Figure 11. PPI Classification System



Source: IMF Staff estimates – April 2018.

IV. FRONTIER ISSUES IN PRICE STATISTICS

Frontier issues refer to emerging topics in price statistics that will transform traditional concepts and methods used to compile price indexes. Examples of these issues include the use of scanner data, web scraping, expanding coverage to include the digital economy, and quality adjustment challenges from the use of the new data sources and incorporation of new items. Over time, these frontier issues may become indicators of the quality of the statistics. They already play an important role in the research to improve the measure of price statistics. The section below provides an overview of each of these frontier issues and their impact on compiling price indexes.

A. Big Data and Price Indexes

Traditional methods of compiling price indexes rely on surveys and sampling. In recent years, new data sources have emerged, that provide the opportunity to enhance and improve data collection methods. Two main ‘big data’ sources are scanner data and data from the internet. Scanner data are high volume data gathered at the point of purchase on individual transactions, dates, quantities, descriptions, and values of products sold. Alternatively, online data refer to unstructured data collected from online vendor websites using methods such as web scraping. These data sources provide an opportunity for more frequent and timely price indicators. However, due to current limitations, they can only partially replace or supplement the manually collected data.

Scanner data can be used to supplement the household budget survey (HBS) to develop more detailed weights by outlet type or by item. The data are formed from point of sale (POS) terminals or checkout points when products purchased by customers are scanned for

pricing. At this point, the purchase is also registered to a database, such that both the price of the product and the volume or quantity sold to the individual customer are collected.

The availability of scanner data provides opportunities to improve the CPI. Scanner data sets typically contain complete coverage of items sold by a retailer at all their locations with both quantities sold, and revenue received by the retailer for these items. This information has the potential to improve the accuracy of the prices used to compile the CPI; increase the samples of items priced; and provide quantity or revenue information to weight items according to their economic importance. Scanner data typically does not cover the entire universe of expenditure that is in scope of the CPI. For example, these data may only be available for large retail chains and not for small independent stores or other types of outlets.

While scanner data sets present opportunities to improve the accuracy of the CPI, there are also challenges that need to be addressed before scanner data can be used to compile the CPI. First, the data must be obtained. For some countries, scanner data must be purchased, while in other countries the data are provided free of charge for statistical purposes. Data can be obtained directly from retailers or from third-party market research firms. Once the data have been obtained, several challenges must be addressed. These include developing an information technology infrastructure to process the volume of data; classifying scanner data so that it can be effectively used for CPI compilation; implementing rigorous checks to ensure data quality; developing an appropriate index calculation formula; and effective treatment of quality changes.

Internet shopping continues to grow in importance in all countries. More and more consumers purchase goods and services from online outlets. These online outlets can be web-based outlets, that is they exist only online, or the online extension of a traditional outlet. These online outlets provide greater opportunities not only for consumers, but also for compilers. National statistics offices have begun to collect prices from these online outlets using technique known as web scraping. Web scraping refers to the collection of price data directly from websites. Advances in technology and automated scraping software facilitate large scale data collection from the internet. In addition to increasing the volume of products priced, web scraping allows products to be priced more frequently than would be possible using traditional data collection methods. Web scraping provides an opportunity to significantly enhance the sample of products and prices collected by expanding product coverage. However, web scraping has some disadvantages and is not likely to replace traditional survey methods. One drawback of web-scraped data is that item coverage can be limited. In some countries, internet shopping does not include the wide range of goods and services included in the CPI. Another challenge with web scraping is that the website will often block web scraping tools, or robots. In addition to web scraping for the CPI, many countries use web scraping to collect the data used to compile residential property price indexes (RPPIs).

Big data provide huge potential for the compilation of more reliable, representative, and timely price indexes with less resources; however, further research is needed on how these sources can be fully used in the CPI. When developing these big data sources, compilers can benefit from the experiences of countries already developing methodologies for the use of scanner and web scraped data.

B. Digitalization and Quality Adjustments in CPI

One fundamental goal of a price index is to measure the change in prices while maintaining constant quality. This is the core principle of a fixed basket index and facilitates the measurement of price change over time. In reality, the goods and services consumed change and evolve overtime. The index should reflect pure price change and not changes due to differences in quality. Quality adjustment has always been important in the compilation of price statistics. The challenge to compilers has always been how to estimate the value of the quality change so that it can be removed from the index. Different methods exist for the treatment of quality changes; however, there is need for additional work to further improve and refine the techniques used. For the CPI, the emergence of scanner data has presented unique problems for the treatment of quality changes that the traditional methods do not adequately address, and work continues to develop better quality adjustment methods that can deal with big data sets.

Compilers have traditionally struggled with the treatment of quality changes when totally new goods and services enter the market. Two different types of new goods and services can be considered. First, evolutionary new goods and services. Evolutionary new goods refer to the more advanced development or extension of an existing good or service. For example, mobile phones have evolved over time from devices used only to make phone calls to smart phones that have more computing power than traditional desktop computers. Second, revolutionary new goods and services refer to those goods and services that did not exist previously and represent totally new goods or services, such as tablets. For services, the measurement of quality change becomes even more challenging. For example, the growing importance of internet shopping and the introduction of new platforms built to facilitate the exchange of privately-owned products and to provide services, such as Uber and Airbnb. Quality changes must be taken into account in order to compile an accurate estimate of price change.

The results of a joint IMF-OECD survey conducted in August 2017 give a view of how e-commerce is treated in price indexes. In total, 43 countries responded to the questionnaire on e-commerce in CPIs, 63 percent of which are advanced economies. On the treatment of e-commerce in PPIs, 36 countries responded to the survey, 69 percent of which are advanced economies. The results of the survey indicate that e-commerce is more widely included in CPIs than in PPIs.

E-commerce can be considered as domestic or cross-border depending on the location of the outlet. Domestic e-commerce refers to online shopping from domestic outlets while cross-border e-commerce refers to online shopping from outlets outside the borders of the country. Approximately 77 percent of respondents (33 countries) include e-commerce in the CPI. Domestic e-commerce is more widely covered in the index than cross-border activities. In general, the results suggest limited coverage of online activities by emerging and developing economies (Table 1). Of the 16 emerging and developing economies sampled, only 37.5 percent (6 countries) include e-commerce in either the prices or weights, compared with 100 percent of advanced economies surveyed. However, while 97 percent of the advanced economies sampled (26 countries) include domestic e-commerce in the CPI, only 37 percent (10 countries) include cross-border e-commerce in their CPIs.

The inclusion of domestic versus cross-border online activities in the CPI can also be reflected in price collection patterns. The divisions from which prices are most commonly collected are Recreation and culture (09), Furnishing, household equipment and routine household maintenance (05), and Transport (07). For products or services commonly purchased from cross-border retailers such as Clothing and footwear (03) and Restaurants and hotels (11), prices are only collected in 13 countries.

Countries introduce newly significant products to the index either on an annual basis or when rebasing the index.⁹ This applies also to new phenomena, like the sharing economy. Only 3 of the 43 economies surveyed include sharing economy services in the CPI. The reason for exclusion is that the sharing economy as a percentage of overall consumption is not yet considered to be relevant or some services are not legal in the economies.

Table 1. Countries Including E-Commerce in CPI (43 economies)

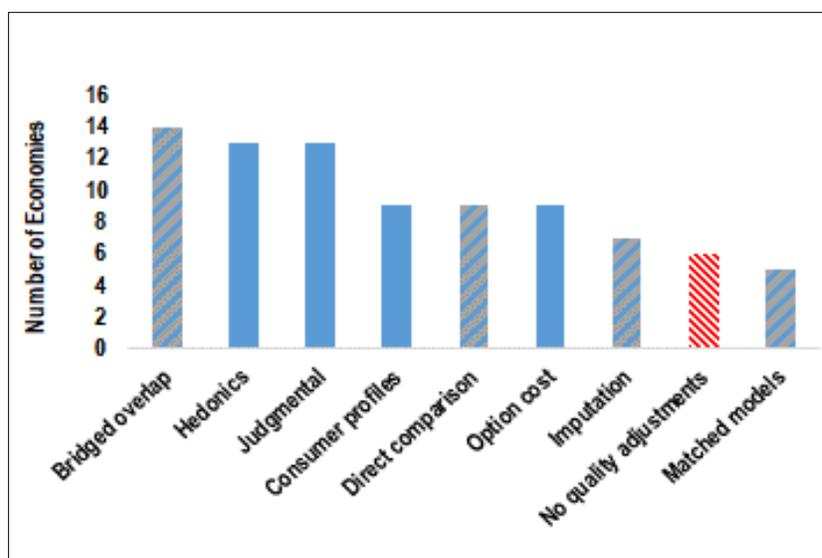
		Domestic E-commerce		Cross-border E-commerce	
		Prices	Weights	Prices	Weights
Included in CPI	Advanced Economies	26	27	10	19
	Emerging and Developing Economies	4	6	2	3
	Total	30	33	12	22
Not Included in CPI	Advanced Economies	1	0	17	8
	Emerging and Developing Economies	12	10	14	13
	Total	13	10	31	21

Source: Joint IMF-OECD Survey conducted in August 2017; Sample size 43 economies.

⁹ Products that are not necessarily new on the market, but become popular over time, for example tablet computers or personal monitoring devices. The term is different from replacement product, when a new model of the product arrives to the market.

The survey also sought to ascertain how adjustments are made for changes in quality.¹⁰ From 43 countries only 6 do not use any quality adjustment method in the CPI. Sixty-three percent of economies (27 economies) use several methods depending on the product group, eight countries use one quality adjustment method for all products. The main methods used are overlap (14 economies), hedonic regression (13 economies), and judgmental (13 economies) methods (Figure 12).

Figure 12. Quality Adjustment Methods in the CPI



Source: Joint IMF-OECD Survey conducted in August 2017; Sample size 43 economies.

C. Digitalization and Quality Adjustments in PPI Compilation

As with the CPI, the goal of the PPI is to measure pure price changes and not changes due to differences in quality. The methods used to treat quality changes in the PPI are the same as those used in the CPI. The *PPI Manual* explains different methods for quality adjustment. Thirty-six economies responded to the joint IMF-OECD questionnaire survey on how digitalization and quality change are measured in the PPI.

The results highlight the limited coverage of e-commerce activities in PPIs. Fifty-three percent (19 countries) of respondents include e-commerce activities in their PPIs, 89 percent of which are advanced economies (Table 2). Similar to the CPIs, domestic e-commerce activities are covered in all countries that include online activities in the PPI – either in both weights and prices (12 countries), weights only (19 countries), or prices only (1 country). Five economies include domestic e-commerce in the PPI but not cross-border (for export). Only two Emerging and Developing Economies include e-commerce in the PPIs. The PPI, by definition, should include both domestic and export sales. One obvious area for improvement is the need to expand coverage of e-commerce activities to include exports.

¹⁰ Reinsdorf, Marshall; Quiros, Gabriel; STA Group. (2018). Measuring the Digital Economy. IMF Staff Discussion Note 02/18.

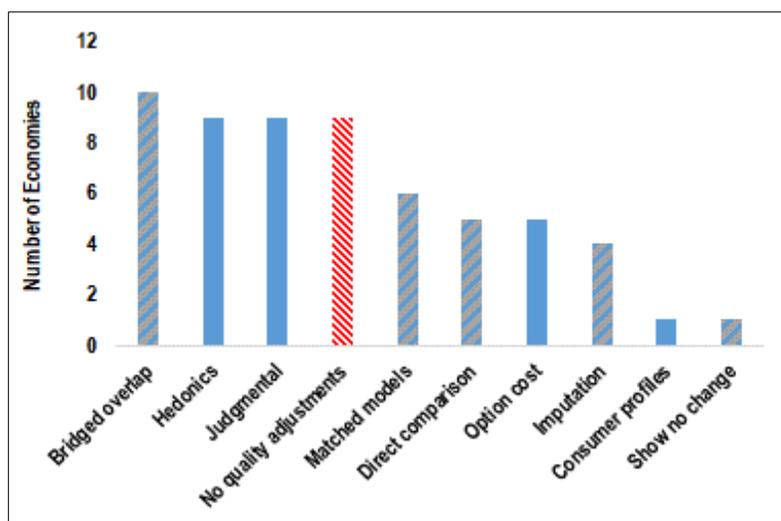
Despite the importance of quality adjustment, according to the joint IMF-OECD questionnaire, 9 economies out of 36 (25 percent) do not quality adjust when making replacements (Figure 13). About 15 economies use various methods depending on the product and 12 economies use one quality adjustment method in all cases. The most commonly used methods are the same used for the CPI: overlap, hedonic regression, and judgmental quality adjustment.

Table 2. Countries Including E-Commerce in PPI (36 economies)

		Domestic E-commerce		Cross-border E-commerce	
		Prices	Weights	Prices	Weights
Included in PPI	Advanced Economies	13	16	7	10
	Emerging & Developing Economies	0	2	0	1
	Total	13	18	7	11
Not Included in PPI	Advanced Economies	12	9	18	15
	Emerging & Developing Economies	11	9	11	10
	Total	23	18	29	25

Source: Joint IMF-OECD Survey conducted in August 2017; Sample size – 36 economies.

Figure 13. Quality Adjustment Methods in PPI



Source: Joint IMF-OECD Survey conducted in August 2017; Sample size – 36 economies.

Countries introduce newly significant goods and services to the index either on an annual basis or when rebasing the index. This includes newly emerging shared economy services. In the survey only two countries out of 36 include sharing economy services into the PPI. The reasons for exclusion depend on the economy: the scope of the PPI is restricted to business to business, the share from production is not yet considered to be relevant, or some services are not legal in the country.

V. SUMMARY AND CONCLUSIONS

Reliable price statistics are essential for informed economic policy-making. To support the compilation of reliable and methodologically sound price statistics, the IMF provides technical assistance to help countries develop and improve price indexes. Over the past two decades, IMF staff have delivered more than 1,200 technical assistance and training missions on price statistics compilation. A number of projects on price indexes have been supported by external donors. In addition to these targeted projects, the IMF's RCDCs support over 108 economies in the development of price statistics.

Table 3. Summary Conclusions

CPI	Availability	196 economies				
	Frequency of compilation	Monthly 181 economies		Quarterly 15 economies		
	Timeliness of publication	Less than 1 month 168 economies	Greater than 1 month 13 economies	Less than 1 quarter 8 economies	Greater than 1 quarter 7 economies	
	Classification	COICOP 148 economies			Other 48 economies	
	Geographical coverage (expenditure weights)	National 149 economies	Urban 28 economies		Capital City 19 economies	
	Frequency of updating Weights	Within 5 years 88 economies	6 - 10 years 75 economies	11 - 15 years 27 economies	Greater than 15 years 6 economies	
PPI	Availability	126 economies				
	Frequency of compilation	Monthly 96 economies		Quarterly 22 economies	Other 2 economies	
	Timeliness of publication	Less than 1 month 85 economies	Greater than 1 month 11 economies	Less than 1 quarter 4 economies	Greater than 1 quarter 18 economies	Other 8 economies
	Classification	ISIC Rev. 4 68 economies	ISIC Rev. 3 17 economies	ISIC 10 economies	Other 31 economies	
	Frequency of updating weights	Within 5 years 45 economies	6 - 10 years 58 economies	11 - 15 years 12 economies	Greater than 15 years 11 economies	
	Industrial coverage	More than MMU 34 economies	MMU 51 economies	Less than MMU 41 economies		

Source: Staff estimates; shaded areas highlight international best practices.

This paper focused on current practices with regard to the (1) frequency of updating the weights; (2) coverage of the CPI and PPI; (3) timeliness of CPI and PPI; and (4) classification systems used in CPI and PPI compilation. These practices can be used as benchmarks to assess improvement over time.

A key finding of this paper is that CPIs are universally and frequently compiled, timely, and fairly well-aligned with international classification standards (Table 3). However,

the weights used to compile the index are outdated in 55 percent of economies, and 76 percent of the included economies compile an index with national coverage. Sixty-five economies (33 percent) comply with international standards on all four criteria evaluated in this study - weights, coverage, timeliness, and use of international classifications.

PPIs, compiled by 126 economies, are timely, but there is scope for continued improvement. The major issues identified with the compilation of PPIs are index coverage and the age of weights used to compile the index. Approximately 34 economies (27 percent) cover less than the basic industrial coverage – MMU. There is need to expand PPI coverage to include not only additional activities such as services, but also exports. Regarding the weights, only 36 percent of economies have updated PPI weights within the last five years. Thirty economies (24 percent) comply with international standards on all four criteria evaluated in this study- weights, coverage, timeliness, and use of international classifications. Outdated weights and undercoverage can introduce biases to the indexes and therefore, impact the reliability of these indexes to adequately measure the evolution of prices in the economy.

There are other key criteria that help to validate the soundness of the compilation practices and could be covered by further research. These criteria include using proper index formulae, sampling methods, and the availability of accurate metadata. Discussing these would require more detailed data and assessments of the country practices which are not available at this time. Users should have access not only to the index numbers, but also to the detailed information on compilation methods. The IMF facilitates publication of metadata on the Data Dissemination Standards Bulletin Board, but it is the responsibility of the country authorities to keep the information updated.

The data, resources, and capacity available sometimes restrict price statistics compilation. Surveys required for updating the weights are costly and if no outside funding is available, it might be reasonable to use the scarce resources to improve the data and compilation methods. If the data collected and used for compilation are not reliable, then updating the weights may be postponed. Low-cost improvements that can be achieved in the short term are improvements to data validation processes, treatment of temporarily missing prices, quality adjustment, and using proper index formulas.

According to the joint IMF-OECD questionnaire, a majority of the countries follow market developments in a timely manner and introduce new goods and services into the indexes when they become significant. In the case of replacing disappearing goods with new models, a majority of the economies surveyed take into account the quality change and make adjustments using different quality adjustment methods discussed in the price index manuals.

A survey of 43 economies concluded that 77 percent (33 economies) include e-commerce in their CPI. Fifty-one percent of economies surveyed include e-commerce in their PPIs.

With respect to shared economy services, only 3 of the 43 economies surveyed include these in the CPI. Similarly, only 2 of 36 countries include shared economy services in the PPI. A possible reason for the exclusion is that the shared economy services as a percentage of overall consumption or production is not yet considered to be relevant in many economies.

It would be beneficial to repeat this study in five years to monitor how the compilation of price statistics continues to improve over time. The study could be extended to examine the compilation of other indexes, including export and import price indexes.

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