Chapter 14
Producer Prices

The Producer Price Index (PPI) measures average changes in prices received by domestic producers for their output. Most of the information used in calculating producer price indexes is obtained through the systematic sampling of industries. In the mining and manufacturing sectors, price information from virtually every industry is captured. By contrast, although PPI coverage of the service sector of the economy is substantial (more than 70 percent), it remains incomplete. The PPI program also includes data that track other sectors of the economy: agriculture, fishing, forestry, utilities (natural gas and electricity), and construction.

As of January 2014, the PPI program included the following indexes:

• Price indexes for approximately 535 mining, forestry, utility, construction, manufacturing, and services industries; over 500 indexes for groupings of industries; and more than 4,000 indexes for specific within-industry product and service categories;

• More than 3,700 commodity price indexes for goods and about 800 for services (seasonally adjusted and not seasonally adjusted), organized by product, service, and end use;

• Over 600 indexes for aggregate measures of price change, including the aggregation system for final demand–intermediate demand (FD–ID).

Together, these elements constitute a system of price measures designed to meet the need for both aggregate information and detailed applications, such as following price trends for specific industries and products, as well as the need for tracking price movements at a more aggregated level relative to the overall economy.

Background

Known until 1978 as the Wholesale Price Index, or WPI, the PPI is one of the oldest continuous systems of statistical data published by the Bureau of Labor Statistics (BLS), as well as one of the oldest economic time series compiled by the federal government. When it was first published in 1902, the index covered the years from 1890 through 1901. The origins

of the index can be found in an 1891 U.S. Senate resolution authorizing the Senate Committee on Finance to investigate the effects of tariff laws "upon the imports and exports, the growth, development, production, and prices of agricultural and manufactured articles at home and abroad."[1]

The first index published, with its base period 1890–99, was an unweighted average of price relatives for about 250 commodities. Since that time, many changes have been made

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[1] Senate Committee on Finance, *Wholesale Prices, Wages, and Transportation*, Senate Report No. 1394, "The Aldrich Report," Part I, 52nd Congress, 2d sess., March 3, 1893; and U.S. Department of Labor, *Course of Wholesale Prices*, 1890–1901, Bulletin No. 39, March 1902, pp. 205–09.

in the sample of commodities, the base period, and the method of calculating the index. For example, a system of weighting was first used in 1914, and major expansions of the sample and reclassifications were implemented in 1952 and 1967.

The PPI program's original intent was to measure changes in prices received for goods sold in primary markets of this country. The conceptual framework and economic theory guiding the program's evolution, though more implicit than explicit, concentrated on obtaining the price received by either a domestic producer or an importer for the first commercial transaction.

A major limitation of the original methodology was its reliance on judgmental sampling of commodities and producers; that is, commodities and producers were selected without the use of probability-based statistical methods. This practice resulted in a system that was too heavily composed of volume-selling products made by larger firms. As a result, the PPI did not adequately reflect the behavior of the multitude of products whose individual transaction values might have been small, but that collectively accounted for a sizable portion of the economy. Another result of judgment-based sampling was that the output of many industries was completely overlooked. Before the transition to the current probability-based statistical method, which began in the late 1970s, products covered by the PPI program accounted for only about half of the total value of output from the mining and manufacturing sectors. The practice of assigning equal weight to price reports from each producer of a given commodity, regardless of any disparity in size among these firms, may have caused additional distortions.

Another limitation of the earlier methodology was its commodity orientation, which, although important, was not compatible with the industry orientation of most other federal economic time series. The PPI's unique commodity classification scheme made it difficult to compare producer price movements with data for most other economic variables, which at that time were expressed in terms of the Standard Industrial Classification (SIC).

These and other weaknesses in the PPI program, combined with increased development of the theory of price indexes in preretail markets, spurred several changes in terminology and operations during the 1970s. The 1978 change in the program name from Wholesale Price Index to Producer Price Index, for example, was intended to reemphasize the fact that the PPI program was based on prices received by producers of goods and services from whoever made the purchase. Also in 1978, the new nomenclature was accompanied by a shift in the analytical focus from the All Commodities Price Index (which was popularly called the Wholesale Price Index) to the Finished Goods Price Index and the other commodity-based stage-of-processing (SOP) price indexes.

Beginning in the mid-to-late 1970s, the PPI transitioned from judgmental sampling by commodity to probability-based sampling by industry, organized in accordance with the SIC. This overhaul was phased in gradually, until the transition to the current methodology was essentially completed in January 1986. Over the two decades that followed, the PPI

allocated substantial resources toward expanding its coverage of the services and construction sectors. With the release of PPI data for January 2004, the PPI program replaced the SIC with the North American Industry Classification System (NAICS).

Culminating the longstanding PPI objective to expand coverage, in January 2014 the PPI transitioned to the FD–ID aggregation system from the SOP model. By incorporating indexes for services, construction, government purchases, and exports, and by more than doubling PPI coverage of the U.S. economy to over 75 percent of in-scope domestic production in its primary aggregation system, the FD–ID model improves upon the SOP system that preceded it.

Description of Survey

Universe

The PPI universe consists of the output of all industries in the goods-producing sectors of the U.S. economy—mining, manufacturing, agriculture, fishing, and forestry—as well as the output of the natural gas, electricity, and construction industries. Recycled goods that compete with those made in the goods-producing sectors, such as waste and scrap materials, also are outputs that are part of the survey. Imports no longer are included within the PPI universe; however, the BLS International Price Program publishes price indexes for both imports and exports. (See chapter 15.) Goods shipped between establishments owned by the same company (termed *interplant* or *intracompany transfers*) are included, as is a substantial percentage of the domestic production of goods specifically made for the military.

The output of the services sector and other sectors that do not produce physical products also is conceptually within the PPI universe. As of January 2014, the PPI program covered more than 70 percent of the service sector's output, publishing data for selected industries in the following sectors: wholesale and retail trade; transportation and warehousing; information; finance and insurance; real estate brokering, rental, and leasing; professional, scientific, and technical services; administrative, support, and waste management services; health care and social assistance; and accommodation. For the construction sector, selected indexes for nonresidential construction industries, maintenance and repair construction, and nonresidential construction contractor services also are published.

Prices

One crucial task in designing a price index is defining what constitutes the price whose changes are to be measured. A seemingly simple question such as "What is the price of steel?" is unanswerable until the definition of *price* is made more specific.

For industries in sectors other than wholesale and retail trade, the PPI price is defined as the net revenue accruing to a specified producing establishment from a specified kind of buyer for a specified product shipped, or service provided, under specified transaction terms on a specified day of the

month. This definition points out several price-determining variables that must be clarified before a cooperating business establishment can report a meaningful product or service price to the BLS. For example, if a company charges more for a red widget than a white one, color is one of the price-determining variables; if all widgets sell for the same price, regardless of color, color is not a price-determining variable. The type of buyer also can be a price-determining variable. For instance, if a car rental company offers different rental rates to business travelers, leisure travelers, and customers who are replacing their vehicle under an insurance agreement, then buyer type is a price-determining characteristic. Under this circumstance, the PPI sample of prices representing each type of transaction would be appropriately weighted.

Because the PPI is meant to measure changes in net revenues received by producers, changes in excise taxes—revenues collected by producers on behalf of the federal, state, and local government—are not reflected in the index. But changes in rebate programs, in low-interest financing plans, and in other sales promotion techniques are reflected to the extent that these policies affect the net proceeds ultimately realized by the producer for a unit sale of a good or the provision of a service. Thus, if an auto manufacturer offers retail customers a rebate of $500, the manufacturer's net proceeds are reduced by $500 and the PPI for manufactured new cars would reflect a lower price. However, if an automobile dealer offers its customers an additional rebate whose cost is absorbed by the dealer rather than the manufacturer, the rebate would not affect the PPI for auto manufacturing but would be included in the PPI for automobile dealers. (The Consumer Price Index (CPI), of course, would reflect a customer rebate, regardless of whether it was sponsored by the manufacturer or the dealer.)

In contrast to all goods-producing industries and most service-providing industries, establishments engaged in wholesale and retail trade purchase goods primarily for direct resale to other businesses and consumers. The PPI views wholesalers and retailers as suppliers of distributive services (rather than goods), because little, if any, transformation of these goods takes place. This approach implies that the output of a wholesale or retail trade establishment is represented by the difference between its selling price of a good and the acquisition price for that same item. Gross margin prices reflect the value added by the establishment for services such as marketing, storing, and displaying goods in convenient locations and making the goods easily available for customers to purchase.

The statistical accuracy of producer price indexes depends heavily on the quality of the information voluntarily provided by respondents. The BLS emphasizes to cooperating businesses the need for reports of realistic transaction prices, including all discounts, premiums, rebates, allowances, and so forth, rather than list or book prices. The use of list prices in the PPI program has been, and continues to be, the exception rather than the rule. Even before the conversion to the current methodology for sampling a representative set of net transaction prices, a BLS survey showed that only about 20 percent of commodity indexes were based on list prices. Inasmuch as the current methodology is more systematic than the older methodology in concentrating on actual transaction prices, the use of list prices is even less frequent now.

Neither order prices nor "futures" prices are collected by the survey, because the PPI tries to capture the price for output being shipped in that same month, not some other time. Changes in transportation costs are reflected in PPIs only when the producing company delivers the product itself without hiring a third-party shipper.

Most prices refer to one particular day of the month, namely, the Tuesday of the week containing the 13th of the month; this pricing date can range between the 9th and the 15th. There are exceptions for some products and services, however. For example, a number of farm products are priced on a day of the week other than Tuesday, and some service industries report prices that reflect average changes for some portion of the month or for the entire month. Although most prices for goods reported to the PPI program are free-on-board (f.o.b.) point-of-production prices, some prices are those quoted on organized commodity exchanges or at central markets. This practice is used most often for farm products.

Product change and quality adjustment

The same product usually is priced month after month; therefore, it is necessary to provide a means for bridging over changes in detailed specifications so that only actual price changes for comparable products and services are measured. An adjustment is especially important when a product is replaced by a new one. Even when companies report their prices on the basis of altered transaction selling terms (e.g., price per 1,000 sold instead of price per 100) or when there is a change in the number or identity of companies reporting to the BLS, routine steps are taken to ensure that only true price changes influence the index.

When a company respondent reports a price that reflects a physical change in a product or a change in the characteristics of a service, the BLS uses one of several quality adjustment methods. The *direct comparison method* is used when the change in the specification is so minor that no product cost differences result. In this instance, the new price is compared directly with the last reported price under the former specifications and the affected index reflects any price difference.

However, when changes in physical characteristics of a product cause product cost differences, the BLS attempts to make an accurate assessment of real price change by systematically taking account of differences in quality. The *explicit quality adjustment* method is especially important with automobiles, machinery, and other types of goods that undergo periodic changes in their model. The usual method of quality adjustment involves the collection of data from companies in the PPI sample reporting on the costs they incurred in connection with the quality change. For example, if the manufacturer's price of a new-model car is $500 more than the price for the previous model year's version, and if $200 of that increase is due to the extra product cost and normal margin associated with the addition of government-mandated safety

equipment, then the real price has risen by only $300. In that case, the change in the passenger car index will reflect only that amount, not the nominal price rise of $500.

Unfortunately, it is not always possible to obtain a value for a quality adjustment. If, for instance, the respondent is unable to estimate the difference in production cost between an old item and a new one, or if an explicit comparison between an entirely new product and a previous product is not feasible, then no quality adjustment value will be forthcoming. In such cases, the BLS may have to assume that any difference in price between the old and the new items is due entirely to differences in quality. If possible, the BLS then employs the *overlap method of quality adjustment*, under which prices are collected for both the old and the new item over a designated period and a particular month is chosen as the overlap month. The difference between the prices of the two items in the overlap month is assumed to represent the value of the difference in quality between the items. For purposes of calculating the official price index, the BLS uses price changes for the old item through the overlap month but thereafter follows price changes only for the new item.

In some instances, when the reporter is unable to provide information about the resource costs of changes in product attributes, a different yardstick is employed to measure these missing values. For example, it is difficult to estimate the value of improvements or deteriorations in products, such as computers and semiconductors, manufactured by companies in "high-tech" industries. These industries frequently develop new products that are technologically superior, yet cost less to produce, than the products they replace. This situation contrasts sharply with those which call for conventional quality adjustment methods, which assume that increased resource costs for producing a product are necessary for improved performance. The inverse relationship between cost changes and quality changes in high-tech industries requires many different techniques for the construction of an index, especially in the area of quality adjustment.[2] An alternative quality adjustment technique using hedonic regressions has been incorporated into PPI adjustment processes.[3] Hedonic regressions estimate the functional relationship between the characteristics embodied in the products in a market and the products' prices. Such regressions yield estimates of "implicit prices" for specified product characteristics that may be used to value the improvement in quality resulting from changes in the various characteristics embodied in a product. The value of the improvement in quality can then be removed from the reported price change, yielding a measure of the pure price change that is appropriate for the PPI.

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[2] See James Sinclair and Brian Catron, "An experimental price index for the computer industry," *Monthly Labor Review*, October 1990, pp. 16–24, **http://www.bls.gov/opub/mlr/1990/10/art2full.pdf**.

[3] Since January 1991, the Bureau has published a computer price index incorporating these quality adjustment procedures. In addition, series for other high-tech industries related to computers may incorporate these techniques of adjusting for technological changes in the characteristics of a product.

Classification

The PPI family of indexes is divided into several major classification systems, each with its own structure, history, and uses. However, indexes in all classification systems draw from the same pool of price information provided to the BLS by cooperating company reporters. The three most important classification structures are (1) industry, (2) commodity, and (3) FD–ID.

Industry classification. A producer price index for an industry is a measure of changes in prices received for the industry's output sold outside the industry (i.e., its net output). Measures—or indexes—of price change classified by industry form the basis of the program. These indexes reflect the price trends of a constant set of goods and services that together represent the total output of an industry. Standardized industry-based index codes provide comparability with a wide assortment of industry-based data on other economic phenomena, including productivity, production, employment, wages, and earnings.

For more than 20 years, the PPI program used the SIC system as the structure for the collection and presentation of industry-based price data. However, that system received increasing criticism about its inability to handle rapid changes in the U.S. economy. Developments in information services, new forms of health care, an expansion in the service sector, and the advent of high-tech manufacturing are examples of industrial changes that could not be studied under the SIC system.

The PPI program began publishing industry-based price data organized in accordance with NAICS with the release of data for January 2004. Developed in cooperation with Canada and Mexico, NAICS represents one of the most profound changes in statistical programs focusing on emerging economic activities. It uses a production-oriented conceptual framework to group establishments into industries on the basis of the primary activity in which they are engaged. Establishments using similar raw-material inputs, similar capital equipment, and similar labor are classified under the same industry.

In general, there may be as many as three kinds of product price indexes for a given industry. Every industry has primary product indexes that show changes in prices received by establishments in the industry for products made primarily, but not necessarily exclusively, by that industry. The industry within which an establishment is classified is determined by those products which account for the largest share of the establishment's total value of shipments. In addition, most industries have secondary product indexes that show changes in prices received by establishments in the industry for products made chiefly in some other industry. Finally, some industries may have miscellaneous receipts indexes to show price changes in other sources of revenue received by establishments within the industry.

Commodity classification. The commodity classification structure of the PPI organizes products by similarity of end use or similarity of material composition, regardless of

whether the products are classified as primary or secondary in their industry of origin. This system is unique to the PPI and does not match any other standard coding structure, such as NAICS or the U.N. Standard International Trade Classification. The historical continuity of index series, the needs of index users, and a variety of ad hoc factors were important in developing the PPI commodity classification. Prior to January 2009, the commodity classification system included only goods-based price indexes. With the release of data for January 2009, PPI expanded the commodity classification structure to include services and construction products.

The commodity classification system is organized as a hierarchical structure that starts with major commodity groupings (at the 2-digit level of aggregation). Major groupings 01 through 15 encompass commodity-based goods indexes. Major groupings 30 though 61 include services-based commodity indexes, and major grouping 80 encompasses construction-based commodity indexes. Each major commodity grouping includes (in descending order of aggregation) subgroups (at the 3-digit level), product classes (4-digit level), subproduct classes (5- and 6-digit level), item groupings (7-digit level), and individual items (8-, 9-, and 10-digit levels).

Commodity-based FD–ID classification. The FD–ID system replaced the PPI stage-of-processing system as PPI's primary aggregation model with the release of data for January 2014. The FD–ID model expands coverage beyond that of the SOP system through the addition of services, construction, exports, and government purchases.[4]

Commodity-based FD–ID price indexes regroup commodities at the subproduct class (six-digit) level, according to the class of buyer and type of commodity. The two primary classes of buyers included in the FD–ID system are final-demand (personal consumption, capital investment, government, export) buyers and intermediate-demand (business purchases, excluding capital investment) buyers. The main source of data used to determine the class of buyer is the table titled "Use of commodities by industries, before redefinition" from the Benchmark Input–Output Data Tables of the United States, produced by the U.S. Bureau of Economic Analysis (BEA).[5] In many cases, the same commodity is purchased by different types of buyers. As a result, commodities are often included in several FD–ID indexes. For example, regular gasoline is purchased for personal consumption, export, government use, and business use. The PPI program publishes only one commodity index for regular gasoline (wpu057104), reflecting sales to all types of buyers, and this index is used in all FD–ID aggregations, regardless of whether the gasoline is sold for personal consumption, as an export, to government, or to businesses. Proportions based on BEA "Use of commodities by industries" data are used to allocate the correct

portion of the total weight of gasoline to each use category. In cases when buyer type is an important price-determining characteristic, indexes are often created on the basis of the specific type of buyer. For example, within the PPI category for loan services, separate indexes for consumer loans and business loans were constructed.

Final demand. The final-demand portion of the FD–ID structure measures price change for commodities sold as personal consumption, as capital investment, to government, and as exports. The system is composed of six main final-demand price indexes: goods; trade services; transportation and warehousing services; services excluding trade, transportation, and warehousing; construction; and overall final demand.

The final-demand goods price index measures price change for both unprocessed and processed goods sold to final demand. Fresh fruits sold to consumers and computers sold as capital investment are examples of transactions included in this index. The final-demand trade services index measures price change for the retailing and wholesaling of merchandise sold to final demand, generally without transformation. (Trade indexes measure changes in margins received by wholesalers and retailers.) The final-demand transportation and warehousing services index tracks price change for transportation of passengers, as well as transportation of cargo sold to final demand, and includes prices for warehousing and storage of goods sold to final demand. The price index for final-demand services less trade, transportation, and warehousing measures price change for all services other than trade and transportation sold to final demand. Publishing, banking, lodging, and health care are examples of these services. The final-demand construction index tracks price change for new construction and maintenance and repair construction sold to final demand. Construction of office buildings is an example of a commodity that is included in the final-demand construction index. Lastly, the overall final-demand index combines the other five final-demand component indexes in order to track price change for all types of commodities sold to final demand.

Intermediate demand. The intermediate-demand portion of the FD–ID system tracks price change for goods, services, and construction products sold to businesses as inputs to production, excluding capital investment. The system includes two parallel treatments of intermediate demand. The first treatment organizes intermediate-demand commodities by type. The second organizes intermediate demand commodities into production stages, with the explicit goal of developing a forward-flow model of production and price change.

The treatment having to do with intermediate demand by type of commodity organizes commodities by similarity of product. This treatment is composed of six main intermediate-demand price indexes: unprocessed goods; processed goods; trade services; transportation and warehousing services; services less trade, transportation, and warehousing; and construction.

[4] For more information relating to the FD-ID structure, see Jonathan C. Weinhagen, "A new, experimental system of indexes from the PPI program," *Monthly Labor Review*, February 2011, pp. 3–24, **http://www.bls.gov/opub/mlr/2011/02/art1full.pdf** .

[5] See "Benchmark Input–Output Accounts" (U.S. Bureau of Economic Analysis), **http://www.bea.gov/industry/index.htm#benchmark_io**.

The price index for unprocessed goods for intermediate demand measures price change for goods that have undergone no fabrication and that are sold to businesses as inputs to production. Crude petroleum sold to refineries is an example of an unprocessed good sold to intermediate demand. The index for processed goods for intermediate demand tracks price change for fabricated goods sold as business inputs. Examples are car parts sold to car manufacturers and gasoline sold to trucking companies. The index for trade services for intermediate demand measures price change for the services of retailing and wholesaling goods purchased by businesses as inputs to production. The price index for transportation and warehousing services for intermediate demand measures price change for business travel, as well as for transportation and warehousing of cargo sold to intermediate demand. The index for intermediate-demand services less trade, transportation, and warehousing tracks price change for nontrade and nontransportation services purchased by firms as inputs to production. Legal and accounting services purchased by businesses are examples of the services measured by this index. Finally, the price index for construction for intermediate demand measures price change for construction purchased by firms as inputs to production. Given that new construction is categorized in the final-demand portion of the economy as capital investment, this index tracks only price change for maintenance and repair construction purchased by firms.

The production flow treatment of intermediate demand is a stage-based system of price indexes. These indexes can be used to study price transmission across stages of production and on into final demand. The system is constructed in a manner that maximizes the forward flow of production between stages, while minimizing backflow of production. The production flow treatment contains four main indexes: intermediate-demand stages 1, 2, 3, and 4. The main sources of data used to develop these indexes were the BEA tables titled "Use of commodities by industries, before redefinition" and "Make of commodities by industries, before redefinition."[6]

Indexes for the four stages were developed by first assigning each industry in the economy to one of four stages of production. Industries were assigned to stages with the goal of maximizing net forward flow between stages. Net forward flow is defined as

(forward shipments of the industry stage + inputs received from previous stages of processing) – (backward shipments of the industry stage + inputs received from forward stages of processing).

The PPI program implemented a two-step procedure to attempt to maximize net forward flow. In the first step, a set of rules was used to assign industries to stages and select the appropriate number of stages for the system. The set of rules used to assign industries to the four stages is summarized as follows:

1. Assign an industry to stage 4 if shipments sold to final demand ≥ 75 percent of industry production.

2. Assign an industry to stage 3 if shipments sold to final demand and to stage 4 ≥ 65 percent of industry production and shipments sold to final demand < 75 percent of production.

3. Assign an industry to stage 2 if shipments sold to final demand, to stage 4, and to stage 3 ≥ 65 percent of industry production; and shipments sold to final demand and to stage 4 < 65 percent of production; and shipments sold to final demand < 75 percent of production.

4. Assign an industry to stage 1 if the industry does not meet any of conditions 1, 2, and 3.

The PPI program examined many different numbers of stages and sets of rules before selecting the ones just described. The program eventually chose the aforementioned system because it performed very well in terms of maximizing net forward flow and minimizing internal flow.

After the assignment of industries to stages by sale of output, the second step in the procedure to maximize net forward flow was to examine the effects on net forward flow of moving individual industries to stages to which they were not originally assigned. In cases in which there were substantial gains to net forward flow, industries were moved to the new stage. The PPI production-flow-based system exhibits strong forward flow and little backflow. After weighting, 83.6 percent of transactions in the system are forward flowing, 5.7 percent are back flowing, and 10.7 percent are internally flowing.

The final step in constructing stages for the production-flow-based intermediate-demand indexes was to determine the commodities to be included and weights to be used in the indexes. The production flow indexes track prices for inputs consumed by industries, as opposed to prices for the output produced by industries, in each of the four stages of production. The BEA use table was consulted to determine the commodities consumed by industries in each of the four stages. The production flow indexes exclude the weight for inputs both produced and consumed within an industry production stage, thereby eliminating any multiple counting of price change. The fourth-stage intermediate-demand index, for example, tracks price change for inputs consumed, not produced, by industries included in the fourth stage of production. Recall that industries classified in the fourth stage of production produce mostly goods and services sold to final demand. The intermediate-demand index for stage 4 therefore measures price change for the inputs to production of industries that produce primarily final-demand goods, services, and construction (stage-4 producers).

Examples of heavily weighted goods-producing industries in stage 4 are the manufacture of light trucks and utility vehicles, the manufacture of automobiles, and the manufacture of pharmaceuticals. Retail trade, food service and drinking places, and hospitals are examples of heavily weighted ser-

[6] Ibid.

vice industries included in stage 4, which also includes all new construction industries. Examples of goods consumed by stage-4 industries are motor vehicle parts, commercial electric power, plastic construction products, biological products, and beef and veal. Engineering services, machinery and equipment wholesaling, long-distance motor carrying, and legal services are examples of services consumed by stage-4 industries.

Examples of highly weighted goods-producing industries included in stage 3 are motor vehicle parts manufacturing, animal (except poultry) slaughtering and processing, and semiconductor manufacturing. Services industries classified into stage 3 include wholesale trade; insurance carriers; architecture, engineering, and related services; and hotels and motels. Examples of goods consumed by stage-3 industries are slaughter steers and heifers, industrial electric power, and hot rolled steel bars, plates, and structural shapes. Commissions from sales of property and casualty insurance, business loans, temporary help services, and administrative and general management consulting services are examples of services commonly consumed by stage-3 industries.

Petroleum refineries; electricity generation, transmission, and distribution; natural gas distribution; cattle ranching and farming; and plastic materials and resin manufacturing are among the goods-based industries assigned to stage 2. Examples of service industries that are heavily weighted in stage 2 are management of companies and enterprises; non-depository credit intermediation and related activities; insurance agencies, brokerages, and related activities; and services to buildings and dwellings. Goods commonly purchased by stage-2 industries include crude petroleum, natural gas, formula feeds, and primary basic organic chemicals. Examples of services that are heavily weighted in the intermediate-demand stage-2 index are legal services, business loans, and cellular phone and other wireless telecommunication.

Goods-producing industries in stage 1 include oil and gas extraction, paper mills, and grain farming. Real estate, legal services, and advertising services are examples of highly weighted service industries included in stage 1. Examples of goods consumed by stage-1 industries include gasoline and commercial and industrial electric power. Examples of services commonly consumed by stage-1 industries are solid waste collection, chemicals and allied products wholesaling, and guestroom or unit rental. All inputs purchased by stage-1 industries are, by definition, produced either within stage 1 or by later stages of processing, leaving stage 1 less useful for price transmission analysis.

Other. There are several additional classification structures within the PPI family of indexes. For example, PPIs for goods are available by durability of product. The allocation of individual commodities to durability-of-product categories (such as durable manufactured goods and total nondurable goods) is based on the U.S. Census Bureau definition: products with an expected lifetime of less than 3 years are classified as nondurable, and products with a longer life expectancy are considered durable goods. Special commodity grouping in-

dexes (such as indexes for fabricated metal products, selected textile mill products, prescription pharmaceuticals, and over-the-counter pharmaceuticals) rearrange PPI commodity data into different combinations of price series. In 1986, the BLS began publishing indexes that measure changes in prices of two kinds of inputs into construction industries: material inputs and supply inputs.

Most PPIs, whether commodity oriented or industry oriented, are national, rather than regional, in scope. However, regional price indexes are published for a few selected items, such as electric power distribution, ready-mix concrete, and construction sand and gravel, for which price-determining regional markets are the rule rather than the exception.

Data Sources and Collection Methods

An industry as a whole is the basic starting point for sampling, and each industry has an individually designed and tailored sample. The first step in selecting a sample is to construct a frame that includes all the establishments classified within that industry. The primary source for compiling this list of the universe of establishments is the Unemployment Insurance system, because most employers are legally required to participate in it. Supplementary information from other publicly available lists is used to refine the industry's frame of establishments. For example, for service-sector industries in particular, it is sometimes necessary to use frames other than the list from the Unemployment Insurance system so that additional establishment data can be analyzed.

The next step in constructing an industry sample consists of clustering companies' establishments into price-forming units. Each member of a price-forming unit must belong to the same industry; establishments in a profit center that belong to another industry are excluded in this step. An establishment is defined as a production entity in a single location. Two establishments may occupy the same or adjacent space if they are separable by physical identification, recordkeeping, or both. Establishments are the units for which production and employment data usually are collected; however, in many cases establishments are not the appropriate unit for the collection of producer price data. For example, several establishments owned by a single firm may be operated as a cluster and constitute a profit-maximizing center. In such cases, the business maximizes profits for the cluster as a whole, rather than for any one establishment.

Once a list of price-forming units in an industry has been compiled, the list may be stratified by variables appropriate for that industry. The criterion for identifying the sampling strata is whether price trends may be different for different values of a variable. For example, the size of the production unit may cause differences in production technologies and, as a result, different responses to changes in demand or input costs. Some industries may be characterized by geographically independent markets, which may become strata. Within each stratum, units usually are ordered by size in order to ensure a proportionate distribution of the sample.

The next step is to assign the number of units to be selected in each stratum. This number may be in direct proportion to the value of shipments by units in each stratum, but if there is evidence that some strata have more heterogeneity in price change, those strata will be assigned a greater proportion of the total sample than their simple shipment values would require. Finally, a sample of price-forming units is selected systematically, with a probability of selection proportional to its size. Ideally, the proper measure of size would be the total revenue of the unit. In practice, however, employment is used as a proxy, because employment information is more readily available.

Once an establishment or cluster of establishments is selected for pricing, a BLS field economist visits the unit to solicit its cooperation. The management of the unit is assured that its assistance is completely voluntary, that any information it agrees to provide to the BLS will be used for statistical purposes only, and that the BLS will hold that information in confidence to the full extent permitted by law.

If the establishment agrees to participate in the PPI program, the BLS field economist proceeds to select those transactions which are to be priced through time from among all of the unit's revenue-producing transactions. A probability sampling technique called disaggregation is used to select the transactions. The disaggregation procedure assigns, to each category of items shipped and to each category of other types of receipts, a probability of selection proportional to the value of the category within the reporting unit. The categories selected are broken into additional detail in subsequent stages, until unique items or unique types of other receipts are identified.

Even after a physically unique item has been selected, it is usually necessary to disaggregate further. If the same item is sold at more than one price, then the conditions which determine that price—such as the size of the order, the type of customer, and so forth—also must be selected on the basis of probability. This method for identifying the terms of sale (or transaction terms) both ensures that the same type of transaction is priced over time and eliminates any bias in the selection of the terms of sale. (To view a sample PPI program initiation questionnaire, link to **http://www.bls.gov/ppi/bls_ form_1810e.pdf**.)

To minimize the reporting burden on cooperating establishments, the initiation interview process usually is completed in less than 2 hours. Subsequently, reporting establishments agree to supply prices for those items selected on an agreed-upon schedule—usually monthly, but sometimes less often. The PPI program has developed a secure Web-based reporting system so that respondents can provide price updates via the Internet. This system replaces mail and fax procedures, which were employed previously. The PPI program continues to encourage the conversion to the secure Web-based price-reporting method. It is expected that the transition to Internet-based reporting of price information will result in program efficiencies, reduced respondent burden, and improved index quality. For those respondents who prefer it, BLS Form 473P (**http://www.bls.gov/ppi/bls_ form_473p.pdf**) is used to report prices through the U.S. mail and by fax. Overall, respondent cooperation generally remains high, although some companies decline to participate from the beginning and others drop out of the program over the course of the sample's timeframe.

The publication of company-specific data in identifiable form is prohibited in the statistical and research work of the BLS. Data from firms participating in the PPI program are protected to ensure respondent confidentiality even within the BLS, so that only those few staff members with an absolute need to know can identify a respondent. Furthermore, the BLS has publication criteria that prevent the inadvertent revelation of a respondent's identity to the public through movements in a published index.

The BLS sample of each industry's producers and output must be updated periodically to account for changing market conditions. This procedure, called resampling, takes place relatively often for industries marked by dynamic changes in production methods, by technological transformation, or by substantial producer entry or exit. More stable industries need to undergo resampling less frequently. In practice, many of the reporting establishments and products included in the sample may be the same both before and after resampling.

Data Processing

Producer price indexes are the output of a series of computer subsystems that automate most operations. Although previously limited to relying upon mainframe computers, PPI data processing now relies on microcomputer and local area network (LAN) technologies.

After BLS field representatives secure the cooperation of a reporting establishment, the product descriptions, terms of transaction, prices, and company contact information are entered into a data collection system. The BLS regional and national office staffs are then able to review the data electronically to ensure their consistency and completeness. At that point, paper or electronic survey forms that are tailored specifically to each establishment can be prepared. Paper or faxed forms are sent to reporting establishments on an agreed-upon schedule, while respondents reporting price information through the secure Web-based Internet site receive email notices when scheduled price updates are requested.

In the BLS price-update system, paper or faxed survey forms returned by respondents are scanned by an optical character reader, which logs in each form and captures the essential data elements. When Web-based respondents provide price update information, BLS computer systems capture these changes directly. BLS economists then verify the reported information, checking for changes that might have been missed by the character reader, reviewing Web-based respondent entries, and double-checking large price movements. This price-update system makes possible the collection and processing of the current prices of more than 100,000 items, as well as any changes in the price-determining characteristics of those items.

Using data from the price-update system, the estimation system calculates the indexes and generates a variety of outputs for the BLS Internet site and for printed statistical tables. These automated data-processing systems for the PPI facilitate the accuracy and timeliness of published PPI data and protect the confidentiality of data supplied by the respondents.

Estimating Procedures

Index calculation
In concept, the Producer Price Index is calculated according to the modified Laspeyres formula

$$I_t = (\sum Q_a P_t / \sum Q_a P_o) \times 100,$$

where

I_t is the price index in the current period;

Q_a represents the quantity shipped during the base period;

P_t is the current price of the commodity; and

P_o is the price of a commodity in the comparison period.

An alternative formula more closely approximates the actual computation procedure:

$$I_t = \left[\left(\sum Q_a P_o \left(\frac{P_t}{P_o} \right) \right) \Bigg/ \left(\sum Q_a P_o \left(\frac{P_{t-1}}{P_o} \right) \right) \right] \times I_{t-1}.$$

In this form, the index is the weighted average of price relatives—that is, price ratios for each item $\left(\frac{P_t}{P_o} \right)$. The expression $Q_a P_o$ represents the weights in value form, and the elements P and Q (both of which originally relate to period a, but are adjusted for price change from period *a* to period *o*) are not derived separately. When specifications or samples change, the item relatives must be computed by linking (multiplying) the relatives for the separate periods for which the data are exactly comparable.

Weights
If the PPI system were composed merely of indexes for individual products, with no grouping or summarization, there would be no need to devise a comprehensive weight structure. However, given the desire for numerous indexes for groupings of individual products, there is a need for a weight system that will let more important products have a greater effect on movements of groupings. Without such a weight system, a 10-percent rise in gasoline prices would have no more importance within the index structure than a 10-percent rise in greeting card prices.

Product and commodity aggregation weights. A price index for even the most finely detailed commodity or product (usually termed a *cell index*) cannot be calculated without applying a policy for weighting the individual prices reported to the BLS for each item. Reports from some establishments are given more weight than those from others, in accordance with value-of-shipments data provided to BLS field representatives during the initial interviews with reporting establishments. The data are adjusted by BLS probability selection techniques.

To calculate product and commodity indexes for levels of aggregation above the cell index, the BLS compiles weights on the basis of values of shipments derived from information provided by the Census Bureau and a few other sources.[7] Industry index weights, however, are based only on values of shipments for those aggregations of products made within the same industry; shipment values for the same products made in other industries are not counted.

Industry net output weights. In compiling price indexes for six-digit NAICS industries, as well as for more highly aggregated industry groups, the BLS employs net output values of shipments as weights. Net output values of shipments include only shipments from establishments in one industry to establishments in other industries or to final demand. By definition, then, net output values of shipments differ from gross output values of shipments by excluding shipments among establishments within the same industry, even if those establishments are owned by separate, independent firms. The meaning of *net output* depends on the index grouping. The net output for total manufacturing, for example, would be the value of manufactured output shipped outside the entire manufacturing sector—for example, to the construction sector or to consumers. The BLS constructs net output price indexes through the use of data on detailed industry flows from input–output tables compiled by the BEA and from other detailed industry data.

Weights for commodity groupings. Weights for individual commodity price indexes and, in turn, for commodity grouping price indexes are based on gross values-of-shipments or revenue data, as compiled by the Census Bureau and a few other sources. These weights, which are in contrast to the net output weights used for industry indexes, represent the total selling value of goods, services, or construction products produced or processed in the United States, f.o.b. production point, exclusive of any excise taxes. Since January 1987, values of shipments between establishments owned by the

[7] Information currently used to calculate weights throughout the PPI family of indexes is taken largely from the following censuses conducted by the Census Bureau of the U.S. Department of Commerce: (1) *Census of Manufactures*, (2) *Census of Mineral Industries* (which includes oil and gas production), (3) *Census of Agriculture*, and (4) *Census of Service Industries*. Other current sources of weighting include the Energy Information Administration of the U.S. Department of Energy and the National Marine Fisheries Service of the U.S. Department of Commerce. Weights are updated at approximately 5-year intervals.

same company (termed *interplant* or *intracompany transfers*) have been included in commodity and commodity grouping weights; interplant transfers had been excluded from the weight structure before then.

Commodity and commodity grouping weights are updated periodically to take into account changing production patterns. Since January 2012, these weights have been derived from the total value of commodities reported in the 2007 economic censuses. From January 2007 to December 2011, the weights were derived from the 2002 economic censuses. From January 2002 to December 2006, the 1997 economic censuses were used. Between January 1996 and December 2001, the 1992 economic censuses were the basis for commodity grouping weights. From January 1992 through December 1995, 1987 values of shipments formed the foundation for commodity and commodity grouping weights. From January 1987 through December 1991, 1982 weights were used. Between January 1976 and December 1986, 1972 weights were used. Updated weights are incorporated into the PPI system in a manner that does not require the recalculation of indexes for earlier periods.

The BLS does not publish the actual values used as weights, but does publish what is called a *relative importance* for each commodity and commodity grouping. For goods, the relative importance of an item represents its basic value weight, including any imputations, multiplied by the relative price change from the weight date to the date of the relative importance calculation, expressed as a percentage of the total value weight of the All Commodities Index. For wherever-provided services, individual commodity relative importance figures are presented as a percentage of their two-digit aggregate group. Data showing the relative importance of commodities with respect to the FD–ID aggregation system also are available. The BLS calculates relative importance data for December of each year. Except when entirely new weights are introduced from the latest industrial censuses or when a sample change affects a given grouping, relative importance data usually change from one December to another solely because of relative price movements. The relative importance of a commodity will rise if its price rises faster than the All Commodities Index. Conversely, a commodity whose price falls or rises more slowly than the All Commodities Index will show a smaller relative importance relative to the All Commodities Index. The BLS does not, however, use published relative importance data as fixed inputs to the calculation of monthly price indexes. Rather, each commodity's actual weight value fluctuates each month in accordance with that commodity's previous price movements. Theoretically, the BLS could calculate and publish a new set of relative importance data every month. Relative importance data for any given commodity grouping also change when the grouping's components are subjected to a change in sample.

FD–ID indexes. For detailed FD–ID indexes, weights are allocated to detailed indexes at the subproduct class (i.e., six-digit) level of the commodity code series. Detailed FD–ID indexes are in turn aggregated to broader FD–ID indexes, such as the index for final demand, and also to FD–ID indexes for special groupings, such as the index for final demand less foods and energy.

The value weight of a single subproduct class index may be allocated among several different commodity-based FD–ID categories to reflect different classes of buyers. For example, a portion of the value weight of the citrus fruits index has been assigned to the index for unprocessed goods for intermediate demand in order to represent the proportion of citrus fruit sold to food processors; most of the rest of the value weight for this grouping has been assigned to the index for finished consumer foods. The allocations of these value weights to various FD–ID categories currently are based on input–output studies for 2002 conducted by the BEA. The total relative value weight for a subproduct class within the FD–ID system is equal to the total relative value weight for that subproduct class within the All Commodities Index classification scheme.

Current and archived relative importance figures for goods indexes as a percentage of the All Commodities Index, wherever-provided services indexes as a percentage of their respective two-digit groupings, and allocations of subproduct class indexes relative to their FD–ID aggregate indexes appear in tables of relative importance data published on the PPI home page of the BLS website (**http://download.bls. gov/pub/special.requests/ppi/**).

Missing prices

If no price report from a participating company has been received in a particular month, the change in the price of the associated item will, in general, be estimated by averaging the price changes for the other items within the same cell (i.e., for the same kind of products) for which price reports have been received.

Rounding policy

Whenever rounding is performed to prepare PPI data for publication, indexes are rounded to the tenths decimal place. To derive monthly or annual average indexes, the BLS bases its calculations on unrounded data; index figures are rounded during the final step only. Before 1991, annual averages for index series based on commodity code data were calculated with the use of the rounded published indexes for the individual months. This is no longer the case. Annual averages for industry indexes always have been based on unrounded monthly indexes. When the BLS displays percent changes in association with any index data, the changes are calculated on the basis of the published rounded indexes.

Seasonal adjustment

The PPI program publishes seasonally adjusted time-series data on a monthly basis. The program utilizes both direct and indirect seasonal adjustment methods. Direct seasonal adjustment is accomplished by applying seasonal factors to unadjusted data to remove within-year seasonal patterns. Indirect adjustment is a method of seasonal adjustment used for aggregate series such that directly adjusted component indexes are combined into a higher level time series.

Direct adjustment. The PPI program tests series that are eligible for direct seasonal adjustment, and if seasonality is found, the series are seasonally adjusted. Currently, six-digit, four-digit, and three-digit commodities are eligible for direct adjustment. Both seasonality testing and direct seasonal adjustment are accomplished with the use of X-13 ARIMA, a software package published by the U.S. Census Bureau for seasonal adjustment applications.[8] Within X-13 ARIMA, PPI seasonal adjustments are based on the X-11 variant of the Census II seasonal adjustment method. The X-11 variant is a filter-based approach that employs moving averages to estimate trend and seasonal components in turn. Components are refined through several iterations of weighted moving averages. By default, X-13 ARIMA uses the multiplicative time-series decomposition model

$$Y_t = T_t S_t I_t.$$

In this model, Y_t is the value of the observed series, T_t represents the trend-cycle component, S_t denotes the seasonal component, and I_t is the irregular component. To enable the use of symmetric moving-average filters on a series, X-13 ARIMA uses an autoregressive integrated moving-average (ARIMA) modeling facility to forecast and backcast observations at the endpoints of the data.

The PPI program utilizes three primary measures—$F(s)$, M7, and Q—to determine whether a particular PPI should be seasonally adjusted. $F(s)$ is a measure of stable seasonality, M7 determines the amount of moving seasonality relative to the amount of stable seasonality, and Q is a weighted average of several diagnostic statistics. Indexes that are found to exhibit a level of seasonality warranting adjustment are directly adjusted by applying a seasonal factor to the unadjusted index according to the formula

$$I_s = I_u / \text{SF} \times 100,$$

where

I_s is the seasonal index value,

I_u is the unadjusted index value, and

SF is the seasonal factor.

Seasonal factors indicate the seasonal pattern of a time series and are derived from historical unadjusted data. PPI typically uses 8 years of unadjusted monthly data in developing factors and testing for seasonality.

Intervention analysis. Nonseasonal events such as natural disasters or wars can distort the underlying seasonal pattern of an index. Intervention analysis entails estimating and removing the effects of these events from indexes prior to testing

them for seasonality and developing seasonal factors. The goals of intervention analysis are to determine whether a seasonal pattern exists and to estimate seasonal factors correctly despite distortions that might arise in the pattern. The PPI program applies intervention analysis to selected directly adjusted indexes. Indexes are eligible for intervention analysis if they make up at least 1 percent of any of the following FD–ID indexes: final-demand goods, final-demand services, unprocessed goods for intermediate demand, processed goods for intermediate demand, and services for intermediate demand. All PPIs that meet the relative importance criteria are examined for the possibility of intervention analysis. X-13 automatic outlier detection, a regression-based program that searches for and identifies statistically significant intervention variables, is the primary tool used to select candidates. Each year, the program is run on all series that are eligible for intervention analysis. Indexes for which automatic outlier detection finds significant interventions are then analyzed further as potential intervention candidates.

Indirect adjustment. The FD–ID indexes are indirectly seasonally adjusted by aggregating lower level indexes that are their components. Seasonally adjusted components are used when available (i.e., when the lower level index was shown to be seasonal and a seasonal index was calculated); otherwise, unadjusted indexes are used. In addition to the FD–ID indexes, four- and three-digit commodity indexes that are aggregates of six-digit intervention indexes are indirectly adjusted. In this manner, interventions estimated for lower level indexes are indirectly included in their aggregate indexes.

Yearly revisions and projected factors. Each year, with the release of the January data, PPI seasonal factors are recalculated to reflect price movements that occurred during the just-completed calendar year. Seasonal factors are recalculated for the previous 5 years, and all seasonally adjusted data are updated on the basis of these new factors. After the yearly revision, directly adjusted PPIs for the upcoming year are calculated with the previous year's set of seasonal factors.

Analysis and Presentation

Analysis

In 1978, with the transition to the SOP system, the PPI saw its first major shift in analytical focus since the beginning of the program. Prior to 1978, economic analysis of the PPI was focused on the All Commodities Index and the Industrial Commodities Index, as well as other indexes for highly aggregated major two- and three- digit commodity groupings. During the 1970s, when price changes were particularly volatile, it became clear that these indexes were subject to *multiple-counting bias*. Briefly, multiple-counting bias means that price changes for components that go through many stages of processing have an excessive influence on aggregate index series. The problem is common among highly aggregated PPI commodity groupings because their price changes are calculated from price changes of commodities at several stages of the production process, in which each individual price

[8]The reference manual for the ARIMA X-13 software package is available from the U.S. Census Bureau at **http://www.census.gov/ts/x13as/ docX13AS.pdf**. Full documentation, including access to the software package, is available at **http://www.census.gov/srd/www/x13as/**.

change is weighted by its total gross value of shipments in the weight-base year. The introduction of the SOP system partly corrected this problem by creating the categories of finished goods (completely processed goods destined for household consumption or capital investment) and crude goods (unprocessed goods to be used for further processing). The SOP index for intermediate goods, however, still included multiple counting, because many processed goods for intermediate (business) demand go though several levels of fabrication as materials, supplies, and components prior to their transformation to final-demand goods.

To illustrate the multiple-counting problem, suppose that the price of raw cotton rises sharply. If the price increase is passed through by spinners of cotton yarn and thread, then by weavers of gray cotton fabric, then by producers of finished cotton fabric, and, finally, by shirt manufacturers, the single price increase for the raw cotton would have been included five times in the All Commodities Index and four times in both the Industrial Commodities Index and the major commodity grouping index for textile products and apparel. Inasmuch as prices throughout the economy are always changing at different rates, multiple counting can result in rates of change for aggregated price indexes that are highly misleading, both because prices of raw materials tend to be more volatile than prices of final-demand goods and because gross output values are used as weights for major commodity groups. Specific, detailed commodity indexes, such as six- and 8-digit commodity-based PPIs, are effectively free of this multiple-counting defect.

The January 2014 transition of the PPI from the SOP system to the FD–ID system is arguably of greater significance than the earlier shift to the SOP system. The FD–ID system provides for a roughly 50-percent expansion of coverage related to final-demand goods, through the introduction of indexes for government purchases of goods and exports of goods. The final-demand portion of this system also includes, for the first time, indexes tracking changes in prices for services to final demand—trade services, transportation and warehousing services, and other services for final demand— as well as an index for final-demand construction.

Within the intermediate-demand portion of the FD–ID system, two parallel treatments of intermediate demand are now provided. Under the commodity-type treatment of intermediate demand, the indexes for unprocessed goods for intermediate demand and processed goods for intermediate demand (formerly titled crude goods for further processing and intermediate materials, supplies, and components, respectively) are augmented with a set of indexes tracking services sold as intermediate demand: business purchases of trade, transportation and warehousing, and other services. An index tracking prices for maintenance and repair construction for intermediate demand also was introduced.

The second treatment of intermediate demand is a production flow treatment based on a four-stage model. The production flow treatment of intermediate demand can be used to study price transmission across four stages of production leading to final demand. The resulting system is constructed in a manner that maximizes the forward flow of production between stages while minimizing backflow.

Stage-4 producers produce primarily goods and services for final demand, and the stage-4 intermediate-demand index measures price changes for products and services purchased by stage-4 producers. Stage-3 producers produce primarily goods and services for stage 4, and the stage-3 intermediate-demand index measures price changes for products and services purchased by stage-3 producers. Stage-2 producers produce primarily goods and services for stage 3, and the stage-2 intermediate-demand index measures price changes for products and services purchased by stage-2 producers. Finally, stage-1 producers produce primarily goods and services for stage 2, and the stage-1 intermediate-demand index measures price changes for products and services purchased by stage-1 producers. All inputs purchased by stage-1 industries are, by definition, produced either within stage 1 or by later stages of processing, leaving stage 1 less useful for price transmission analysis.

The FD–ID system improves upon the SOP system in several areas. First, the FD–ID system provides more complete coverage than the SOP system through the addition of services, construction, exports, and government purchases. Providing more complete coverage allows for more accurate inflation analysis. Second, through stage creation and net weighting, the production flow treatment of intermediate demand eliminates the multiple-counting problems found in the processed-goods portions of intermediate demand within both the SOP and the FD–ID systems, again leading to more accurate inflation analysis. Finally, the production flow treatment of intermediate demand facilitates potential price transmission analysis.

Presentation

PPIs usually are issued in the second or third week of the month following the reference month. The specific monthly release dates for a given year are posted to the BLS website prior to the beginning of that calendar year. All PPIs are available at the time of release, 8:30 a.m., and are considered officially published at that time. Data may be obtained over the Internet or by contacting the PPI program staff.

In 1995, the BLS began posting PPI time-series data, news releases, and technical materials to its website (**http://www. bls.gov/ppi**). The PPI home page provides mechanisms that permit users to download, in HTML, spreadsheet, or text format, nearly all current and discontinued PPI time-series data. The site also provides access to PPI news releases, which focus on major FD–ID categories and the commodity indexes that lead changes in the FD–ID indexes. Over time, many PPI reference files, as well as explanatory documents, also have been added to the site.

The monthly *PPI Detailed Report* is available on the PPI website on the day PPI data are issued. This report includes most indexes within the PPI family of indexes that are not seasonally adjusted. The report also shows yearly percent changes, unadjusted monthly percent changes, and a few seasonally adjusted indexes and percent changes. In addi-

tion, the publication contains a narrative section explaining the most important price movements within the major FD–ID categories for that month. When appropriate, special technical articles discuss the latest changes in the PPI sample (usually effective in January and July of each year), updates in seasonal adjustment factors or weights, or other changes in methodology or presentation. Occasionally, longer articles provide more in-depth explanation of the economic background underlying recently observed price movements. The *PPI Detailed Report* does not include information on actual dollar prices for any item.

Seasonally adjusted data. Because price data are used for different purposes by different groups, the BLS publishes seasonally adjusted, as well as unadjusted, data each month. For economic analysis of short- to medium-term price trends, seasonally adjusted data usually are preferred because they are designed to eliminate the effect of changes that normally occur at about the same time and are about the same magnitude each year. Among such changes are price movements resulting from a host of factors, including normal weather patterns, regular production and marketing cycles, new-model-year motor vehicle introductions, seasonal discounts, and holidays. Data that are seasonally adjusted can therefore reveal long-term trends more clearly.

Normally, over-the-month and quarterly analyses of PPI price movements are based on seasonally adjusted data. Unadjusted data are used for analysis when a series has not been selected for seasonal adjustment, as well as for the analysis of year-over-year trends. Because seasonal adjustment is a tool for enhancing economic analysis, indexes that BLS deemphasizes for the purpose of economic analysis are deliberately not seasonally adjusted. In particular, those PPIs which are subject to the multiple-counting problem described earlier, such as the All Commodities Index and the indexes for the major commodity groupings, are not available on a seasonally adjusted basis.

The unadjusted versions of PPI data are of primary interest to those who need information that can be more readily related to the dollar values of transactions. For example, unadjusted data typically are used in price escalation clauses of long-term sales or purchase contracts.

Revised data. All PPIs are routinely subject to revision 4 months after their original publication, to reflect late reports and corrections reported by company respondents. Once revised, unadjusted indexes are considered final. (However, seasonally adjusted indexes also are revised on an annual basis, as described in the next paragraph.) When PPIs are first released, they typically are based on a substantial portion of the total number of returns that eventually will be received from respondents. Hence, subsequent revisions normally are minor, especially at the more highly aggregated grouping levels. Changes in previously published data caused by a processing error are indicated by a notice on the PPI website or in the *PPI Detailed Report*; such occurrences are rare.

At the beginning of each year, the previous 5 years of seasonally adjusted data are recalculated to take into account more recent seasonal patterns from the just-completed calendar year. This revision is carried out in addition to the regular monthly revision to indexes 4 months after their original publication. As a result, seasonally adjusted indexes are recalculated five times, on an annual basis, until the index is outside of the 5-year recalculation period. The revised 5-year histories for seasonally adjusted data are made available each year with the release of January data in mid-February.

Calculating index changes. Movements of price indexes from one month to another should be expressed as percent changes, rather than as changes in index points, because the latter are affected by the level of the index in relation to its base period while the former are not. Each index measures price changes from a reference period defined to equal 100.0. Many commodity-oriented PPI series have an index base of 1982 = 100, but many other indexes, including most FD–ID indexes, began after 1982 and have a base date indicating the month and year of their introduction. The following example of the computation of index point change and 12-month percent change is based on the unadjusted PPI for final demand for December 2010 and December 2011:

Index point change

December 2011 Final-Demand Price Index	106.0
Minus December 2010 Final-Demand Price Index	102.7
Equals index point change	3.3

Index percent change

Index point change	3.3
Divided by December 2010 Final-Demand Price Index	102.7
Equals	0.032
Multiplied by 100	0.032×100
Equals percent change	3.2

An increase of 10 percent from the base period (November 2009) for the Final-Demand Index would be shown as an index level of 110.0 and would be expressed in dollars as "Prices received by domestic producers of a systematic sample of final-demand products have risen from $100 in November 2009 to $110 today." Likewise, a current index of 90.0 would indicate that prices received by producers of final-demand products have fallen 10 percent from what they were in the base period.

From time to time, the BLS has updated the standard base period for PPIs. The last major index rebasing occurred in January 1988, when index base dates were recalculated to 1982 = 100; before that, 1967 was used as the standard base year. For reasons explained earlier, any change in the index base period leaves calculations of the percent changes for any index virtually unaffected. However, care must be taken to ensure that indexes referring to one base period are not incorrectly compared against indexes for the same series expressed with reference to a different base period.

Because prices for food and energy have tended to be erratic, over time some economists have come to focus attention on indexes that measure price changes for intermediate-demand and final-demand goods to the exclusion of food and energy as clearer measures of what is sometimes referred to as the *underlying rate of inflation*. Among the goods indexes that exclude food and energy are the PPIs for final demand less foods and energy, finished goods less foods and energy, processed goods less foods and energy, and unprocessed goods less foods and energy.

Uses and Limitations

Producer price indexes are used for many purposes by government, business, labor, universities, and other kinds of organizations, as well as by members of the general public.

Economic indicator

Since 1978, the finished-goods index and other indexes that constitute the SOP system have been some of the nation's most closely watched indicators of economic health. Movements in SOP indexes have been used to study the transmission of inflation though the economy, including the stages of production, and as a potential leading indicator of retail inflation as measured by the BLS Consumer Price Index. With its transition to the FD–ID system in January 2014, the PPI has expanded coverage of the final-demand portion of the U.S. economy by roughly 300 percent by including indexes for goods sold to government and goods sold for export, as well as measuring the changes in prices for many services sold to households, to capital investment, to government, and for export. From an intermediate-demand perspective, the commodity-type treatment now tracks price movements for services purchased by businesses, in addition to price movements for processed and unprocessed goods, roughly doubling PPI coverage of the intermediate-demand portion of the economy. The production flow model of intermediate demand tracks price changes as they course through the various stages of production. This treatment provides an opportunity to systematically monitor and assess to what degree changes in rates of inflation faced by producers at earlier stages of production are transmitted to subsequent stages, including final demand. The commodity-type treatment also provides an opportunity to track inflation passthrough; however, this treatment, while less complicated, is also less systematic and rigorous in its construction. In sum, taken in its entirety, the FD–ID system is well suited for analyzing the inflation transmission process.[9]

Although some users of price index data attempt to employ PPI data as a potential leading indicator of the CPI, there are many reasons that price movements in the PPI and the

CPI can diverge. The differences can be classified into three main areas: scope and coverage, categorization, and other technical differences.[10]

Scope and coverage differences. The scope of the personal consumption portion of the PPI includes all marketable output sold by domestic producers to the personal consumption sector of the economy. The scope of the CPI includes goods and services provided by business or government, paid for by consumers, and for which explicit user charges are assessed. The most heavily weighted item in the All Items CPI—owners' equivalent rent—accounts for approximately 24 percent of the overall index. Owners' equivalent rent is the implicit rent that owner occupants would have to pay if they were renting their homes and is included in the CPI to capture the cost of shelter for owner-occupied housing units.[11] The PPI does not include owners' equivalent rent, which is out of scope because it is not a domestically produced, marketable output.

The CPI comprises goods and services purchased by domestic consumers and therefore includes imports. The PPI, in contrast, does not include imports, because imports are, by definition, not produced by domestic firms. Also, the CPI includes only components of personal consumption that are directly paid for by the consumer, whereas the PPI includes components of personal consumption that are not paid for by the consumer. For example, the PPI includes medical services paid for by third parties, such as employers or the federal government. The CPI, in contrast, includes only payments made directly by consumers for medical care. The final difference in scope between the PPI and CPI occurs in regard to services whose prices contain an interest rate component. The CPI excludes changes in interest rates or interest costs.[12] The CPI includes some services, such as ATM banking services, whose prices have an interest rate component, but does not include the interest rate component of these services. The scope of the PPI, by contrast, encompasses services, such as banking services and insurance services, whose prices include an interest rate component. Thus, within the PPI, changes in interest rates will affect price indexes for banking and insurance, whereas changes in interest rates do not affect the CPI.

In contrast to the CPI, the PPI does not currently have complete coverage of services. The PPI program began expanding coverage beyond mining, manufacturing, agriculture, and

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[9] See Jonathan Weinhagen, "An empirical analysis of price transmission by stage of processing," *Monthly Labor Review,* November 2002, pp. 3–11, **http://www.bls.gov/opub/mlr/2002/11/art1full.pdf**.

[10] The CPI program publishes three official CPIs: the CPI for All Urban Consumers (CPI-U), the CPI for Urban Wage Earners and Clerical Workers (CPI-W), and the Chained CPI for All Urban Consumers (C-CPI-U). For a more detailed comparison of PPI with CPI and other government statistics, see Jonathan C. Weinhagen, "Comparing new final-demand producer price indexes with other government price indexes," *Monthly Labor Review*, January 2014.

[11] Spending to purchase and improve houses is considered investment and thus is not in the scope of the CPI. Investment in residential housing is in the scope of the PPI, but would be classified in the investment portion of final demand, as opposed to the personal consumption component. As of 2013, the PPI's coverage of the construction sector of the economy was incomplete and did not include residential construction.

[12] See *BLS Handbook of Methods*, chapter 17, "The Consumer Price Index," p. 3, **http://www.bls.gov/opub/hom/pdf/homch17.pdf**.

utilities in the mid-1980s, introducing its first services price index in 1985, and the program's effort to expand coverage into the services sector of the economy is ongoing. In January 2014, the PPI covered approximately 72 percent of services, as measured by revenue reported in the 2007 census. Because the PPI does not have complete coverage of services, a number of services included in the CPI are absent from the PPI for personal consumption. Among the most important of these services are education services, composing slightly over 3 percent of the CPI, and residential rent, accounting for approximately 6.5 percent of the CPI.

Categorization differences. The PPI and the CPI categorize a number of goods and services differently within their structures. Categorization differences for goods and services are mitigated at high levels of aggregation, but can create discrepancies at lower levels. The PPI, for example, considers utilities, such as electric power and natural gas, to be goods, while the CPI categorizes utilities as services. The two indexes also differ in their categorization and treatment of trade and transportation. The PPI generally separates the costs of transporting, retailing, and wholesaling of goods from the goods themselves and classifies trade and transportation as services. In contrast, prices for goods, as measured by the CPI, typically include the value of the goods, the value of transporting the goods, and the trade margins associated with the sale of the goods.

Other technical differences. Several technical differences also exist between the PPI and the CPI. The PPI and the CPI-U are both constructed with the use of a modified Laspeyres index formula, but the CPI updates weights every 2 years and the PPI updates weights every 5 years. In addition, the CPI implements a geometric mean formula at the item level that the PPI does not. The geometric calculation reduces substitution bias, leading to lower measures of inflation in periods of price increases. The PPI attempts to collect prices for a specific day of the month (the Tuesday of the week containing the 13th), while the CPI collects prices throughout the month. Finally, prices measured by the CPI include sales and excise taxes, while prices measured by the PPI exclude these taxes.[13]

Deflator

PPI data for capital equipment are used by the U.S. Department of Commerce to calculate the gross domestic product (GDP) deflator and many of its components. PPI data at all levels of industry and commodity aggregation can be used to deflate dollar values expressed in current dollars to constant-dollar values for a variety of economic time series, such as inventories, sales, shipments, and capital equipment replacement costs. To illustrate the deflation concept, suppose that nominal values of shipments for a given industry have doubled over a 10-year span. If the PPI for that industry has tripled over the same span, then the "real" (that is, inflation-

adjusted) value of shipments for the said industry actually has declined; in that case, higher prices would more than account for the doubling of dollar shipment values, and physical volume would implicitly have fallen.

Private business uses

Private firms use PPI data to assist their operations in a variety of ways, in addition to using the data for general economic analysis or as a deflator of some other quantity. PPIs frequently are cited for price escalation purposes in long-term sales or purchase contracts as a means of protecting both the buyer and the seller from unanticipated surges or drops in prices. For example, an escalation clause might specify that the price for x number of widgets being sold by company A to company B each year will go up or down by a specified fraction of the percentage of change in material costs, as measured by one or more specified PPIs (often in conjunction with the change in a measure of labor costs, such as the Employment Cost Index). A PPI data user survey done in 2012 suggests that trillions of dollars in contract values are tied to PPIs through these price escalation clauses, which are common in both government and private sector contracts.[14]

Companies also use PPI data to compare changes in material costs they incur against changes in the PPI for the material in question. By the same token, they can compare changes in the prices they charge for their own output with changes in the PPI for the same kind of product. PPI data are employed as well in econometric models, forecasting, market analysis, and academic research. PPIs are frequently used in last-in, first-out (LIFO) inventory accounting systems by firms wishing to avoid the kind of "phantom profits" that might appear on their books with a first-in, first-out (FIFO) inventory accounting system.

Discontinued data

Those wishing to follow PPI data for a particular series over a prolonged timespan should be aware that the BLS is more likely to discontinue highly detailed indexes than aggregated indexes. During the industry resampling process, for example, an industry-level index commonly maintains continuity, but indexes for detailed products within that industry may be discontinued and replaced by indexes for items that are new or that previously had not been selected for tracking. Finely detailed indexes also may be vulnerable to temporary suspension of publication, due to low response rates. When a detailed index disappears, either temporarily or permanently, the BLS routinely recommends that users who had been following that index either choose another detailed index within the same product grouping or switch their attention to a more highly aggregated grouping index.

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[13] Ibid.

[14] See Producer Price Indexes: *Escalation Guide for Contracting Parties* (U.S. Bureau of Labor Statistics, May 14, 2012), **http://www.bls.gov/ppi/ppiescalation.htm**.

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