

## Price measures of new vehicles: a comparison

*The Consumer Price Index, the Producer Price Index, and the International Price Program all analyze price changes in new vehicles; however, these indexes' movements are only weakly correlated because of methodological differences in sampling, pricing, the analysis of incentives, and other aspects of survey design*

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**T**he automobile industry is a vital and dynamic component of the U.S. and global economies. Faced with competition spurred by technological advances and global demand, the industry has attracted significant attention from policymakers, the media, unions, and businesses in the last several years. In the United States, the automobile industry employed more than 1 million workers in 2006.<sup>1</sup> U.S. production during this period was 11.4 million units,<sup>2</sup> and U.S. consumers purchased 16.5 million cars and trucks. At the same time, foreign manufacturers with factories in the United States have significantly increased their presence in this country.<sup>3</sup> In recent years, U.S. automakers have been facing restructuring, financial stresses, and competitive challenges to their traditional market shares. Furthermore, U.S. consumers, exposed to record high gasoline prices, are being offered a growing choice of hybrid-fueled vehicles. As the range of vehicle models, features, and options has grown, consumers have been gaining access to more and better information about these characteristics via the Internet. In this competitive market, price incentives offered by both domestic and foreign automakers to U.S. consumers have become the industry norm.

The automobile industry presents many challenges to anyone trying to measure accurately the average price change of new ve-

hicles. Over the years, the Bureau of Labor Statistics (BLS) has often been asked why its three programs that measure changes in new vehicle prices—the Producer Price Index (PPI), Consumer Price Index (CPI), and International Price Program (IPP)—have often trended differently despite the fact that they measure the same industry.

This article explains the differences among the three programs' methods of index calculation, analyzes these differences, and elucidates the implications of the new passenger car price indexes. Through detailed examples, the article conveys how sampling, pricing, consumer and dealer incentives, exchange rates, and model year changeover with quality adjustments are handled differently by each program. This article shows that the discrepancies among the indexes are largely the result of methodological differences among the programs; however, the article also emphasizes that these methodological differences have an economic basis and are usually a product of differences in the scope and measurement objective of each index.

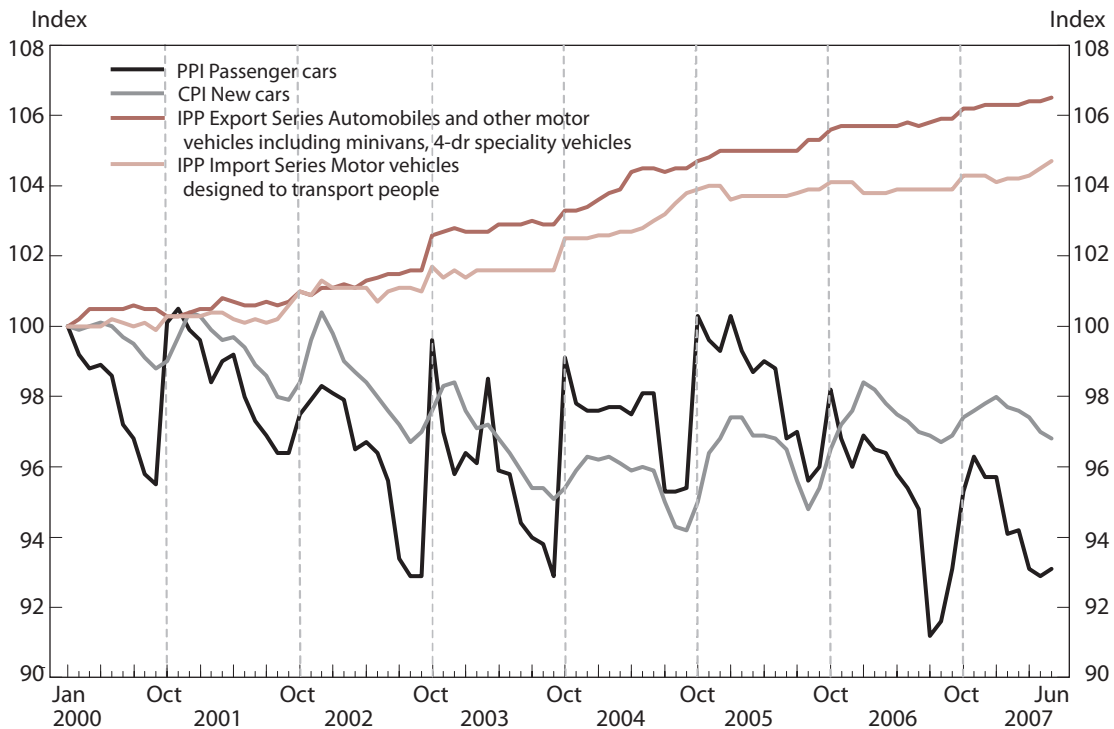
### Overview of recent price trends

Chart 1 offers a graphical overview of the Bureau's new vehicle price index series from January 2000 to June 2007. Visual analysis of the chart reveals the striking variation in the behavior of these indexes. Specifically, the

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**Chart 1. BLS new vehicle indexes, not seasonally adjusted, January 2000–June 2007**

[Rebased, Jan 2000 = 100]



NOTE: PPI data March 2007–June 2007 are preliminary.

chart shows that the two IPP series did not experience the same degree of annual price volatility as the PPI and CPI, and that the two IPP series increased during this period while the PPI and CPI slightly decreased. These variations are attributable to the different measurement objectives among the price indexes, to the different program methodologies, and to the prevailing economics of the new vehicles market during this period.

The relative stability of the IPP new vehicle export and import series can be explained by the absence of rebates and incentives offered to consumers of new model vehicles. The IPP series strictly measure prices between overseas agents, domestic producers, and importers. These prices do not reflect the price decreases used for promotions by dealerships and, therefore, they produce relatively steady monthly changes. The PPI and CPI include rebates and incentives, along with the price increases that accompany the introduction of new model year vehicles towards the latter half of the year, and these contribute to more volatility from month to month.

Comparing the PPI and CPI new-vehicle price indexes, the PPI series is more volatile than the CPI series because its sample transitions completely to the new year's mod-

els in October, typically resulting in a large, spiking price increase. The CPI's transition to the newer models is done over a span of months, producing smoother increases in the index while the transition is occurring. The impact of the transition to the new models is less pronounced in the IPP series because it is not affected by changes in incentives and, as a result, does not exhibit the associated rise and fall of prices.

The divergence in the long-term trends of the IPP indexes (which have increased) compared with the PPI and CPI (which have decreased) is also the result of the inclusion of incentives in the PPI and CPI. Because of the highly competitive nature of markets for new vehicles during the period of the study, the value of manufacturer-offered incentives hit record levels about a dozen times prior to leveling off in 2005. These attempts to appeal to the marketplace through lower prices mean that as the value of the incentives increased, the true prices of new vehicles fell, resulting in end-of-year prices that were lower than the previous year's prices. Compounded, these decreases produced downward trends in the PPI and CPI, while the IPP indexes remained insulated from the competitive pricing seen at the manufacturer-to-dealer and the consumer levels. The

types of vehicles included in the various measures, as well as the number of models tracked in the respective market segments, also contribute to the trend differences. The IPP Import Index includes a larger proportion of luxury vehicles and the IPP Export Index includes a larger proportion of sport utility vehicles (SUVs), both of which are relatively more expensive types and models of vehicles and contribute to the upward trends of those indexes. The balance of this article explains in more detail these differences among the new vehicle indexes.

### **Methodological differences among the programs**

Differences in the types of prices that each program tries to measure contribute to a disparity in price index movement among the indexes. Chart 1 displays this disparity, showing that it is especially strong in the short run. The PPI measures the average change over time in the selling price received by domestic producers, the CPI measures changes in the estimated transaction price consumers pay to auto dealers, and the IPP measures changes in import and export prices paid at the U.S. border minus shipping and customs fees. Cars manufactured abroad but sold in the United States are in scope for the IPP Import Index and the CPI, but out of scope for the PPI. Cars manufactured and sold in the United States are in scope for the PPI and CPI, but not for the IPP. Cars manufactured in the U.S. and sold abroad are in scope for the PPI and the IPP Export Index, but not for the CPI. Before examining the movements of the new-car indexes, this article describes differences among them in sampling, pricing, treatment of model year changeover, quality adjustment, and price incentives. Such differences help explain the differences in the movements of the indexes and are referenced in the section that discusses index movements. A complete comparison of index methods for the three programs is shown in the appendix.

The indexes chosen for this study were selected because the types of vehicles covered by each index are similar, although there are some differences. The PPI's passenger cars index and CPI's new cars index provide a similar comparison. The closest match in the IPP's export series is Automobiles and other motor vehicles including minivans, 4-dr specialty vehicles. The IPP import series closest match is Motor vehicles designed to transport people.<sup>4</sup> Although the IPP indexes include a wider variety of vehicles, all of these indexes include cars, and the PPI and CPI include cars exclusively. Therefore, this article refers to them as "car" indexes and not "vehicle" indexes.

*Sampling.* The scope of the PPI includes automobile manufacturers with factories located in the United States. Every 5 years, the pool of available manufacturers is resampled, and BLS representatives visit the sampled companies to request their participation in the survey. All of the manufacturers' domestically produced vehicles are in the sample universe. Vehicles with the highest revenue have a higher probability of selection using the probability-proportional-to-size sampling technique. Selection of the vehicle options is based on the percentage of customers selecting an option installed on the model, which is known as the penetration rate. The PPI sample is generally smaller than the CPI sample.

The CPI new car pricing area universe is the entire urban United States. Its area sample consists of 87 geographic primary sampling units (PSUs), which are urban areas across the Nation. The Telephone Point-of-Purchase Survey asks households in each PSU about their new vehicle expenditures to establish which dealerships to visit for pricing. Selected dealers are visited by a BLS representative to disaggregate the universe of new cars<sup>5</sup> sold to consumers on the basis of dollar volume sales in order to identify and choose cars for data collection from the sampled dealerships. Specifically, this is done by selecting a unique car make, followed by a model within that make, and lastly a unique trim level within the model. Given that car models tend to have various styles with different equipment, the trim level is used to distinguish among the available performance levels or equipment package options. For example the "EX" and "LX" are trim levels for a Honda Accord model. Once a trim level is selected, the dealer is asked to reference the invoice of the last car sold with that trim level in order to complete the vehicle description including options. The CPI sampling process usually yields three distinct vehicles with equipment options to price in each sampled dealership. In total, about 1,500 vehicles are priced at 500 dealerships; about half of the vehicles are cars. The sample of dealerships is replaced at the rate of 25 percent each year.

The sample of exports for the IPP is derived from U.S. Census Bureau data from shippers' export declarations, and the sample of imports is derived from consumption entry documents.<sup>6</sup> The IPP employs the probability-proportional-to-size technique to determine which companies compose the sample. After companies are selected, the IPP chooses individual vehicles for pricing by disaggregating according to model, trim level, and options. Each vehicle stratum is sampled every 2 years on an ongoing basis. This ensures that the IPP's sample captures current market trends. The IPP's motor vehicle index is different from both the CPI's and PPI's motor vehicle in-

dexes because it includes a broader category of vehicles.<sup>7</sup>

Comparison of the sampling methods reveals three distinctions. The first is the types of vehicles included in the samples. The CPI and PPI only include cars, whereas the IPP includes cars, minivans, sport utility vehicles, and trucks. The second involves manufacturing location; the CPI includes both U.S.- and foreign-produced cars, the PPI sample represents U.S.-produced cars, the IPP Export Index represents U.S.-produced cars, and the IPP Import Index represents foreign-produced cars. The third factor is the smaller sample sizes of the PPI and IPP compared with the CPI's sample size. This is due to the extent of manufacturers' participation, which determines for how many vehicles manufacturers will provide data and how often they provide those data.

**Pricing.** The PPI measures prices received by manufacturers for the new cars they produce and sell. The price data are *net prices*, which are prices paid to the manufacturer inclusive of the manufacturer's discounts to the buyer. The PPI national office collects prices from manufacturers via a monthly survey, and the prices reflect sales for the Tuesday of the week containing the 13th of the month.

The type of price usually collected for the car index is a dealer net price (that is, what the dealer pays for the

vehicle). The dealer net price reflects sales from the manufacturer to the dealer and deducts rebates and low rate financing given by the manufacturer. If these incentives are only available in some regions or on some transactions, a national average value for all sales of that model is calculated. Price or discount information received after an index is first published is incorporated into the final index released four months after original publication. If discount information is not available before the index is calculated, then a first-published index is released based on all data available at the time. Table 1 provides an example of the types of prices and price adjustments applicable to each of the price indexes and shows how they are used to estimate reported prices.

The CPI measures the price of a new car to the consumer at the retail level. Typically, new car prices are negotiated between the buyer and the dealer, so the CPI reflects the negotiated price by estimating a transaction price on the basis of recent sales including markups, rebates, and/or concessions. Also included in CPI pricing but not included in IPP and PPI pricing are charges for the new vehicle's transportation to the dealer, dealer preparation of the vehicle, and sales taxes as shown in table 1.

Prices in the CPI are collected bimonthly in most metropolitan areas. However, prices in New York, Los Angeles,

Prices and price adjustments	PPI	CPI	IPP Export	IPP Import
	Domestically produced cars	Domestically and foreign-produced cars	Cars, golf carts, SUVs, mobile homes, minivans	Cars, golf carts, SUVs, mobile homes, minivans
Reported price.....	\$18,750	\$21,550	\$20,600	\$20,075
<b>Prices</b>				
Border price.....	( <sup>1</sup> )	( <sup>1</sup> )	20,000	20,000
Dealer net price.....	20,000	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )
Retail base price.....	( <sup>1</sup> )	22,000	( <sup>1</sup> )	( <sup>1</sup> )
Transportation charge.....	( <sup>1</sup> )	800	( <sup>1</sup> )	( <sup>1</sup> )
Dealer preparation.....	( <sup>1</sup> )	100	( <sup>1</sup> )	( <sup>1</sup> )
Optional equipment.....	1,000	1,100	1,000	1,000
Subtotal.....	21,000	24,000	21,000	21,000
<b>Price adjustments</b>				
Consumer rebate.....	<sup>2</sup> (1,000)	<sup>2</sup> (1,000)	( <sup>1</sup> )	( <sup>1</sup> )
Low rate financing.....	<sup>2</sup> (500)	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )
Dealer rebate.....	<sup>2</sup> (750)	( <sup>3</sup> )	( <sup>1</sup> )	( <sup>1</sup> )
Concession.....	( <sup>1</sup> )	<sup>2</sup> (2,000)	( <sup>1</sup> )	( <sup>1</sup> )
Duty.....	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	<sup>2</sup> (525)
Taxes.....	( <sup>1</sup> )	550	( <sup>1</sup> )	( <sup>1</sup> )
Freight.....	( <sup>1</sup> )	( <sup>1</sup> )	<sup>2</sup> (400)	<sup>2</sup> (400)
<sup>1</sup> Not applicable. <sup>2</sup> This figure is subtracted from the subtotal. <sup>3</sup> Included in concession.				

and Chicago are obtained monthly. Price data collection occurs throughout the entire month and is done by BLS representatives assigned to various dealerships. Typically, three distinct cars are priced in a sampled dealership. If a particular model and trim level was not sold in the past 30 days, it is deemed temporarily unavailable for pricing. If at least one car of a particular model and trim level was sold, the estimated transaction price is based on sales of that car over the past 30 days; average markup, rebate, and/or concession are estimated. The CPI's use of the 30-day pricing reference period and pricing throughout the month are techniques that may contribute to a lag in the reflection of price change that does not apply to the PPI and IPP, for which prices collected reflect one specific reference day.

The concession is the negotiated segment of the consumer transaction price with the dealer; concessions are common, which means that consumers typically do not pay list price for a new car. Typically, list prices do not change from month to month. An example of the impact a concession has on a new car price in the CPI versus the impact it has on a new car price in the other car indexes is illustrated in table 1. Pricing starts with the retail base price and then adds transportation charges, options, and dealer preparation charges. Then the price is adjusted for additional markup and discounting due to concession and/or rebate. These markups, concessions, and rebates are all estimated on the basis of sales over the past 30 days for the model and trim level in question.

Rebates and concessions are major contributors to the monthly CPI car price index movements. These two price discounts work hand-in-hand; if the rebate spikes up the concession may fall, and if the rebate is reduced, the concession may rise. This tends to offset the impact of new rebate offers.

The International Price Program produces measures of price change for goods and services imported into the United States and exported from the United States. By conceptual definition, the IPP seeks to capture import prices at the port of entry and export prices at the port of exit. A variety of types of prices are eligible for inclusion, including intrafirm prices as well as trade between unrelated parties.

These import and export price indexes are utilized to deflate various foreign statistics produced by the Census Bureau and the Bureau of Economic Analysis. In order to be compatible with these measures, IPP price data are adjusted for duty and freight costs. As illustrated in table 1, these adjustments are unique to these measures and are not used for the CPI or PPI price data. Another factor that applies to the IPP and not to the PPI or CPI is the use of

exchange rates. Although the majority of manufacturers who trade overseas price their products in U.S. dollars, some traders price vehicles in local currencies. To convert foreign currencies to U.S. dollars, the IPP receives exchange rate conversion factors for the major foreign currencies from the University of British Columbia Pacific Exchange Rate Service each month. Although exchange rates fluctuate over the course of the month, the IPP uses the average monthly exchange rates from this source.

The IPP national office collects prices monthly directly from U.S. international traders and manufacturers. Data used in these indexes are collected via mailed forms or via the Internet. The reference date for data used in IPP indexes is the first day of each month. The IPP revises its data 4 months after the initial release in order to account for data that were not collected in time for index calculation but have since been collected. Although the IPP collects prices on the first day of each month, late data that arrive within the 4 month time frame are used in calculating revised measures. Table 1 shows that the CPI and PPI prices are subject to more adjustments than are the IPP indexes, which helps to explain the differences in volatility and long-term trends among the indexes described in the earlier discussion of chart 1.

*Model year changeover and adjusting for quality change.* The CPI and PPI programs both began making price adjustments to account for quality changes in new vehicles with the introduction of the new vehicle models in 1966 (1967 models). Every year, typically in late summer and early fall, automobile and truck manufacturers introduce updated models to the market. In most cases, the new cars are similar enough to the previous models that the prices of both models can be compared with each other without the application of an adjustment. However, if a manufacturer significantly changes the quality or functionality of a new car, BLS applies an adjustment to factor out the price change associated with the change in quality.<sup>8</sup>

The three BLS price programs use information gathered directly from car manufacturers and secondary sources to estimate the values for quality change adjustments. Each program follows the same basic guidelines for new model introduction; however, there are a few differences in how certain quality changes are handled. BLS places new car quality characteristics into five categories. All three programs make adjustments for the changes in each of the categories, with one exception noted in the second category. The first category includes changes in the safety of a car that are either federally mandated or proven to be effective. These include airbags, seatbelts, brake systems,



seat designs, back-up alerts, and crumple/crash zones.

The second category covers mandated changes that affect the healthfulness of the outside environment, such as emissions improvements as legislated by State governments or the Federal government. In this category, there is one notable difference among the programs—the treatment of mandated pollution control measures by the CPI. Whereas the PPI and IPP make quality adjustments for changes arising from air-pollution mandates, beginning in 1999 the CPI stopped making such adjustments. The basis for the decision was that price changes that derive from mandated product changes and that affect only public goods, like air quality, are essentially taxes levied on the purchasers of new cars and should be reflected as price increases in the index. This is consistent with the CPI’s practice of including changes in taxes when they affect the prices paid by consumers for market goods.<sup>9</sup>

The third category pertains to changes made to mechanical or electrical features. This category includes changes in steering, braking, engine efficiency, and transmission systems, among others. The fourth category includes changes in design or materials that affect the durability or strength of an item. Examples include the switch to halogen headlamps, to platinum tipped spark plugs, and to flexible body panels.

The final category encompasses changes that affect comfort or convenience. These upgrades include redesigned seat belts, remote door locks, navigation systems, and flexible body panels, as well as changes in storage capacity. BLS does not make quality adjustments for style changes, such as pin striping or leather-wrapped steering wheels. Adjustments also are not made for manufacturer quality claims that are improvements of failed or defective components.

The quality adjustment values provided by the manufacturers are based on resource costs. BLS defines resource costs as all direct and indirect costs, including research and development, incurred in the manufacture or purchase of components and the assembly and installation associated with an equipment change, including the manufacturer’s mark-up. Resource cost factors into both the PPI and IPP. For the CPI, this value is marked up to the retail price level. In general, a quality change tends to be a small portion of the entire new vehicle price. Based on the model year changeovers from 2000 to 2007, the yearly average per-car retail quality adjustment ranged from \$25 to \$310, with an average of \$125.

Chart 1 illustrates that October is typically the

month when the PPI and the IPP export samples switch completely to the new model year and in which the quality adjustments are applied.<sup>10</sup> Note that the IPP introduces the majority of the new model year export vehicles into the Export Index in October. In some cases, however, new model introduction occurs when more than half of the cars sold are the new model. Import vehicles are introduced when more than half of the cars imported are the new model. The introduction period for IPP import vehicles is typically August through November. The similar average October increase between the Import and Export indexes is purely coincidental given the typical 2-month interval between the times when new vehicles are introduced in each respective index. The CPI always introduces new models into the index when more than half of the cars sold are the new model. The introduction period for the CPI is typically from September in the current year to February the following year.

Although the three price programs employ different methodologies for introducing new vehicle models into the index, new model introduction generally results in price increases for each program. The following table illustrates 1-month percent changes from September to October for the PPI, CPI, and IPP indexes. The PPI shows much larger percentage increases each October than do the CPI and the IPP indexes. The PPI showed an average October increase of 5.6 percent from 2000 to 2006.

<i>Year</i>	<i>PPI</i>	<i>CPI</i>	<i>IPP Export</i>	<i>IPP Import</i>
Average.....	5.6	0.5	0.4	0.4
2000.....	6.1	-.3	.2	.4
2001.....	1.4	.6	.3	.4
2002.....	9.0	.9	1.0	.7
2003.....	8.4	.4	.4	.9
2004.....	6.6	1.1	.2	.1
2005.....	3.0	1.5	.3	.2
2006.....	3.5	.6	.3	.4

During the years listed in the table, the increases in the PPI ranged from 1.4 percent in 2001 to 9.0 percent in 2002. The CPI increased an average of 0.5 percent. During the study period, both IPP export and import motor vehicles increased 0.4 percent on average. The larger magnitude of the PPI October increases is due to the complete model year changeover to new models with few or no incentives. For the CPI, the sample of cars priced in October is a mix of current and newer model years. For example, in 2006, the CPI car sample

mix was 42 percent 2007 models and 58 percent 2006 models. The newer model year cars reflect price increases, whereas the older models reflect price decreases caused by discounting to clear out the older models. The only exception to the October increases from 2000 through 2006 was the slight 0.3-percent decline in the CPI in October 2000, which reflected how the CPI prices a larger portion of the older models during October, a month known for heavy discounts. The 1-month percent changes for a program may be larger in one year than the next year because of an array of issues. However, the differences among the programs in a given year are primarily due to each program applying quality adjustments at its own time.

*Incentives.* Understanding the use of incentives in the passenger cars indexes is important because incentives are responsible for most of the monthly changes in price other than model year change. Incentives are tracked by the CPI and PPI but not by the IPP, thus contributing to the differences in the long-term trends seen in chart 1. In the context of this article, incentives are programs offered by the car manufacturers to stimulate sales. The three most common programs are consumer rebates, dealer rebates, and low interest rate financing. Some manufacturers also provide additional rebates for specific customer segments such as first-time buyers, students, and the military.

Consumer rebates are provided by manufacturers as an incentive directly to the customer at the point of sale to reduce the net price of the car. Consumers normally elect to credit this consumer cash rebate as a down payment against the new car's purchase price. Manufacturers may also provide cash incentives directly to dealers, known as dealer rebates. The dealers may or may not choose to pass some part of this rebate on to their customers.

There are many instances in which customers are allowed to choose either a cash rebate or a low interest financing offer. In still other cases, customers may benefit from both the cash rebate and the low interest financing offer in combination. It is important to note that the low interest rate financing quoted in the offer is normally based on the top customer credit tier, and as a result not all consumers are eligible for this best rate.

The PPI includes consumer rebates and dealer cash rebates as well as low interest financing offered by manufacturers. Ideally, the PPI would include only the incentives in effect on the pricing date. However, some data may only be available as monthly averages for each vehicle line. Manufacturers provide the PPI program with information on their cost of providing low interest financing loans,

the value of cash rebates, and the acceptance rate for the incentives. In cases when incentives are offered on only some vehicles for sale, such as when regional incentives or programs allowing the customer to choose either low interest rate financing or a cash rebate are offered, the PPI program calculates a national average value for the incentives on the vehicle in question.

The CPI includes an estimated average of the consumer rebates available over the past 30 days for each model in the sample. An estimated average is used because rebate amounts may vary over the collection period and different types of rebates may be offered, such as those for the military or recent graduates. Beginning in January 1999, the CPI stopped measuring finance charges on vehicle loans. This change was made on conceptual grounds.<sup>11</sup>

The CPI is the ratio of the cost of a set of items in one period to its cost in another period. Financing the consumption of an item indicates the purchaser has decided to consume that good today by forgoing the consumption of other goods in the future. This "price" the consumer pays in order to choose current consumption over future consumption is the interest rate on the loan. Forgoing future consumption in exchange for consumption today causes the financed good to become, in a sense, a financial debt or liability. However, the CPI is principally focused on estimating actual consumption at retail prices in the most current period only; this gives a clearer picture of the cash-value prices consumers would pay at the retail outlet.<sup>12</sup>

Financing motor vehicles is arguably different from other forms of retail financing because vehicle financing terms can influence negotiations over the final purchase price. On rare occasions a dealer will offer "special financing" terms without explicitly offering a reduced price alternative. In these cases dealers would presumably be willing to negotiate an equivalent price concession to purchasers who either do not select or do not qualify for the financing deal. The CPI respondents are asked to provide an estimate of this concession.

The IPP does not include incentives in its index calculation. The primary reason is that companies providing vehicle price data to the IPP are principally multinational companies that trade from one subsidiary to another. For example, a sedan may be produced in Japan by a Japanese manufacturer and then traded to a subsidiary in the United States. In this case, it is more cost effective for one subsidiary simply to adjust prices rather than offer incentives, which are much more costly to implement.

Whether incentives are included in the prices used by the price indexes is ultimately a question of scope. The PPI reflects consumer rebates, dealer rebates, and low in-

terest rate financing because these incentives affect the prices producers receive for their vehicles. The CPI does not directly reflect low interest rate financing, but it does include an average of consumer rebates and dealer rebates in the negotiated price because these incentives directly affect the prices consumers pay for an automobile. The IPP does not include any incentives because they are not a factor in the derivation of prices paid at the border for imports and exports.

## Index comparisons

This section examines historical index data from 2000 to 2007 to reveal trends and statistical relationships in the BLS new passenger car indexes. To measure how the programs' indexes diverge from or track each other, the indexes are analyzed using three approaches. The first approach is a graphical treatment describing the movements and trends across each program. The second approach uses qualitative explanations highlighting key methodological issues, industry events, and shifts in consumer demand, rebates, or dealer incentives. The third approach is a comparison of correlations between the data series.

*Index trend analysis.* As seen in chart 1, the PPI trended downward from 2000 to 2007, while the CPI trended downward from 2000 through mid-2003 and then began an upward trend. The PPI is characterized by relatively sharp monthly movements. There are visible short-term co-movements in both series; in fact, the evidence indicates that the two series also trend together in the long run but are weakly correlated.

Chart 2, which presents the 1-month percent changes in the new cars indexes from February 2000 to June 2007, more clearly shows the sharper PPI movements compared with the movements of the other data series. The PPI spikes coincide with model changeover each October. This is followed by sharp drops each November representing the resumption of incentives offered from manufacturers to dealers. Unlike the PPI, the CPI monthly percentage movements generally stay within the 1-percent range. Furthermore, the CPI October percentage increases tend to lag behind the PPI increases in time because of the CPI's gradual phase-in of new model introductions with less generous incentives and rebates.

As shown in chart 1, the long-term trends of the IPP export and import vehicle series diverge from the PPI and CPI series during the sample period. The CPI and PPI trend downward, whereas the IPP indexes exhibit upward trends. These divergences can be partially attributed to dif-

ferences in the product compositions among the indexes. The IPP Import Index is composed of a higher proportion of luxury vehicles in comparison with the CPI and PPI new vehicle indexes. Recent trends indicate that import nameplate manufacturers (foreign firms producing in the United States) prefer to build lower cost vehicles in the United States and import luxury vehicles from overseas. The sales of higher priced vehicles in this market segment have grown each year since 2000. This demand level appears to be less elastic and has allowed import manufacturers to regularly raise prices on most import models in this class of vehicle.

In an analogous trend, a noteworthy factor affecting export price movement during this period has been strong demand in foreign markets for domestically produced sport utility vehicles. Domestic SUV production and sales to both domestic and international customers have risen steadily from 2000 to 2007 and contributed to the long-term rise in the export price index.

Also contributing to the differences in long-term trends between the IPP indexes and the PPI and CPI is inclusion of incentives in the PPI and CPI but not in the IPP. As mentioned in the "Overview of recent price trends" section, the highly competitive nature of markets for new vehicles during the period of the study has resulted in substantial incentives being offered at the manufacturer-to-dealer and the consumer levels, and these incentives are reflected in the PPI and CPI indexes. The IPP index, in contrast, does not include incentives, because companies providing vehicle price data to the IPP are principally multinational companies that trade from one subsidiary to another.

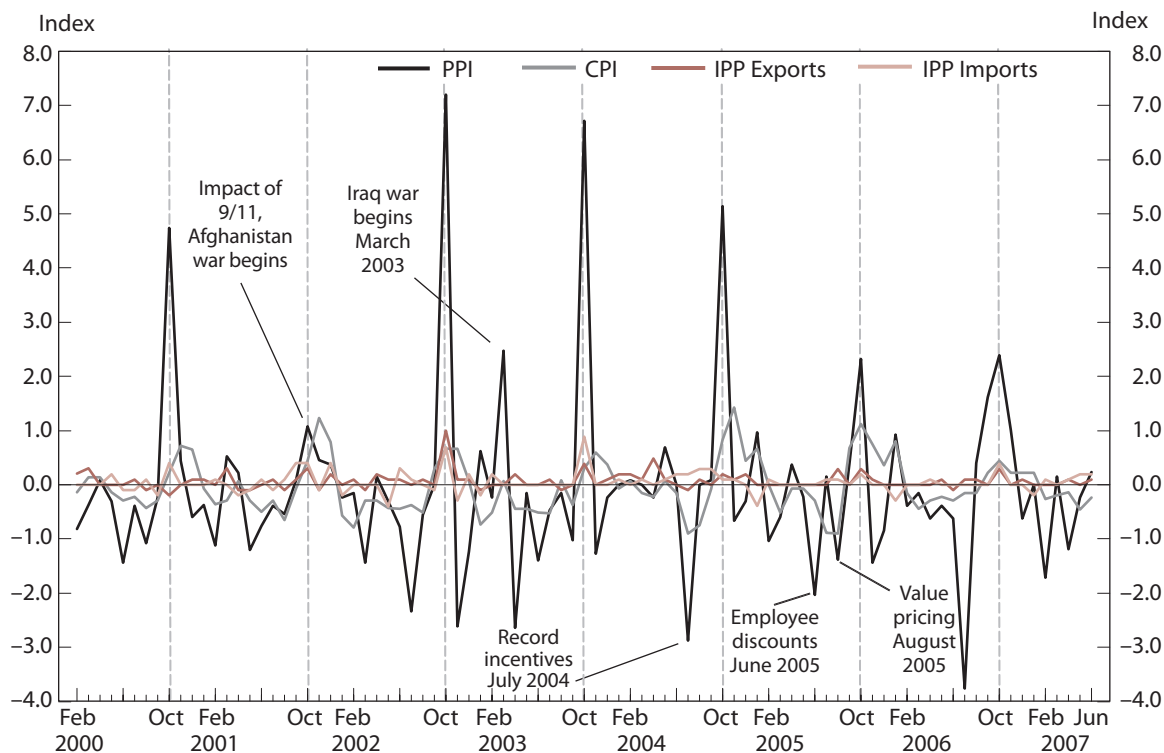
Chart 2 illustrates that in the short term the IPP import and export indexes often exhibit differing index movements. These short-term differences can be partially attributed to differences in how new models are introduced into the import and export indexes. For the Import Index, few new vehicles are introduced over a longer period of time, resulting in modest index changes during new model introduction. In contrast, for the Export Index, 100 percent of new model introduction occurs in October. This produces generally smaller increases in the Import Index and less frequent but larger increases in the Export Index.

*Qualitative analysis.* In 2001, the September 11 terrorist attacks on the United States and start of the war in Afghanistan affected the PPI. The typical October spike for the PPI was nearly absent due to extensive special low finance deals intended to offset slumping sales over this



**Chart 2. Events occurring among 1-month percent changes for new vehicles indexes, February 2000–June 2007**

[Rebased, January 2000 = 0]



period. The CPI, by contrast, which does not reflect low finance incentives, registered a relatively normal increase for the new 2002 models. The IPP also increased slightly because of the introduction of new models.

The PPI's large October 2002 spike occurred as automakers sought to return to aggressive model year switchovers, after a relatively weak previous year, by raising 2003 model prices and offering fewer incentives compared with the summer months. This was followed in November by a sharp price decline of 2.6 percent in the PPI, whereas the CPI moved up to its November peak. Both the IPP Import Index and the IPP Export Index rose nearly 1 percent in October 2002, reflecting the new model switchovers, but the imports series moved slightly higher at this time. This reflected an increase of approximately 0.5 percent by the Euro versus the dollar.

The March 2003 spikes in the PPI and CPI were attributed to the start of the Iraq war, and they reflected economic uncertainty among manufacturers, dealers, and consumers. In April of that year, the PPI fell as incentives were reinstated. Car importers and exporters kept prices stable because their shipments were not affected.

In April 2004, the IPP Export Index exhibited its largest upward movement of the year, reflecting vehicle exporters'

general ability to raise prices during the year for current models. Record incentives were introduced in July 2004, causing both the PPI and CPI to decline substantially. This record incentives level was exceeded in September. Automakers, however, were able to quickly cut incentives and raise prices on new models between September and October 2004, resulting in the PPI's highest level since January 2000. (See chart 1.) In January 2005, the PPI rose to an even higher level as manufacturers again raised prices and cut incentives.

In 2005, employee discounts were offered to all consumers. These discounts were later replaced with "value pricing"<sup>13</sup> as another means to attract consumers. As a result automakers were able to clear out the 2005 model year cars, and this in turn contributed to the drop in the CPI prior to the model year changeover. Later in 2005, automakers chose to move up some model year introductions from October to September. These early model year introductions caused both the CPI and PPI to increase in September. The following October, however, the normally large PPI spike was diminished because of the shift in introduction month.

During 2006 and 2007, the new car market continued to be very price competitive. Demand for fuel-efficient cars was strong because gasoline prices remained high. The gener-

ally unchanging trend of the CPI appeared to hold. The July 2006 PPI decline was due to summer low interest financing promotions, which the CPI does not reflect. In September 2006, the PPI posted an upward movement attributed to a drop in incentives unusual for that time of the year. The following October, the PPI experienced greater-than-normal incentives offered by manufacturers to dealers on new 2007 models, moderating the expected October spike.

*Correlation analysis.* Previous discussions and graphical analyses indicate that there are substantial differences among the methodologies and also among the movements of the new vehicle price indexes. These differences are primarily the result of each program’s unique measurement objective. In spite of these methodological differences, graphical analysis indicates that the new vehicle indexes often exhibit similar movements. Correlation analysis can be used to determine the degrees of similarity or difference between the new car indexes. If strong positive correlations exist, then the indexes reflect common industry dynamics despite their unique methodologies. Weak or non-existent correlations would be evidence that the differing index methods result in largely dissimilar data movements. It is possible for correlations to be spurious or coincidental, however. Strong correlations that persist for long periods are more strongly indicative of a true relationship than are weaker correlations.

The table below presents correlations between the 1-month percent changes of the PPI, CPI, and IPP indexes calculated using data from January 2000 to June 2007, not seasonally adjusted. Statistically, the relationships between the PPI, CPI, and IPP indexes do not appear to be strong. The correlation coefficient for the PPI and CPI is about 0.38, which is less than the correlation between the PPI and the IPP Export Index (0.44) and also less than the correlation between the PPI and the IPP Import Index (0.49). The correlation coefficients between the CPI and IPP are the weakest. This indicates that the CPI and IPP series diverge more in their monthly movements than do the PPI and IPP series, which often use similar data.

<i>Index</i>	<i>PPI</i>	<i>CPI</i>	<i>IPP Export</i>	<i>IPP Import</i>
PPI.....	1 ...	...	...	...
CPI.....	.379	1	...	...
IPP Export....	.439	.221	1	...
IPP Import....	.487	.053	.442	1

To further detect whether strong relationships exist among the series, the indexes were seasonally adjusted to remove regularly occurring cycles throughout the year that might obscure the relationships between the indexes.<sup>14</sup> When correlations of the 1-month percent changes from the resulting seasonally adjusted indexes are compared—as illustrated in the following table—the correlations among the series are weak. For example, the PPI–CPI correlation falls from 0.38 to 0.08, and the relatively weak 0.49 correlation between the PPI and IPP Import Index drops by more than half to 0.22 after seasonal adjustment. Evidenced by the larger values in the previous table, it is clear that cyclical movements, such as the regular October model year changeovers, account for much of the correlations in the not seasonally adjusted data. In summary, the correlations provide statistical evidence that significant data divergences exist among the car indexes but that the indexes share some common features.

<i>Index</i>	<i>PPI</i>	<i>CPI</i>	<i>IPP Export</i>	<i>IPP Import</i>
PPI.....	1 ...	...	...	...
CPI.....	.083	1	...	...
IPP Export....	.165	.082	1	...
IPP Import....	.22	-.136	.25	1

THE THREE BLS PRICE PROGRAMS—the PPI, CPI, and IPP—all publish price indexes for new cars. It is often assumed that these indexes trend similarly, but this article has shown that this assumption is not accurate. A graphical comparison of the indexes shows differences in both month-to-month volatility and in long-term trends for the 2000 to 2007 period. The article explains these graphical differences by outlining the differences in scope and measurement objectives among the indexes. Where these differences in scope translate into methodological differences, the article discusses how the differing methods in areas such as sampling, data collection, the treatment of rebates and incentives, and adjusting for quality change may produce indexes that differ greatly in both the short and the long term. Major economic and political events are cited and their impact on the indexes is discussed. Finally, correlation analysis is employed in order to show that the correlations between all pairs of indexes are weak. □

## Notes

<sup>1</sup> This study uses the automobile manufacturing industry classifications 3361, 2, and 3 from the North American Industrial Classification System. For employment data in this industry, see Current Employment Statistics, U.S., all employees, on the Internet at <http://data.bls.gov/cgi-bin/srgate> (visited July 22, 2008). To retrieve the data, type the code CEU3133600101 into the series id(s) box.

<sup>2</sup> See [www.census.gov/mtis/www/mtis.html](http://www.census.gov/mtis/www/mtis.html) (visited June 10, 2008).

<sup>3</sup> For the purpose of this article, import vehicles are those that are built outside U.S. borders.

<sup>4</sup> Codes for the four indexes are: PPI Passenger cars (Commodity code 1411031), CPI New cars (SS45011, CPI-U, U.S. city average), IPP Export Series, Automobiles and other motor vehicles including minivans, 4-dr specialty vehicles (HICP code 8703), and IPP Import Series Motor vehicles designed to transport people (HICP code 8703).

<sup>5</sup> The CPI includes new motorcycles, though they represent a minor weight.

<sup>6</sup> The IPP employs the Harmonized Classification System (by industry); BEA Classification (by end use); and the NAICS System (by industry). For more information, see the *BLS Handbook of Methods*, chapter 15, on the Internet at [www.bls.gov/opub/hom/homch15\\_a.htm](http://www.bls.gov/opub/hom/homch15_a.htm) (visited July 15, 2008).

<sup>7</sup> The IPP universe of vehicles includes automobiles, SUVs, golf carts, all terrain vehicles (ATVs), and motor homes. The IPP vehicle sample, like the PPI sample, utilizes the probability-proportional-to-size sampling technique.

<sup>8</sup> The three price programs follow the BLS procedures called "Guide-

lines for Quality Adjustment of New Vehicle Prices," on the Internet at [www.bls.gov/cpi/cpiautoqguide.pdf](http://www.bls.gov/cpi/cpiautoqguide.pdf) (visited July 15, 2008).

<sup>9</sup> See Dennis Fixler, "Treatment of Mandated Pollution Control Measures in the CPI," *CPI Detailed Report* (Bureau of Labor Statistics, Sept. 1998).

<sup>10</sup> In instances when new model introduction does not occur in October, each price index will include the new model vehicle when data is received from the manufacturer. This is commonly referred to as a mid-model year launch.

<sup>11</sup> "Changing the Item Structure of the Consumer Price Index," Oct. 16, 2001, on the Internet at [www.bls.gov/cpi/cpiwl001.htm](http://www.bls.gov/cpi/cpiwl001.htm) (visited June 10, 2008).

<sup>12</sup> Examples for which the CPI normally does not seek to measure interest payments include houses, items whose prices are based on lay-away plans, or any other financial transaction or instrument.

<sup>13</sup> A pricing discount is provided by the manufacturer and lowers the listed sticker prices; these are often offset by a reduction in dealer-to-consumer incentives.

<sup>14</sup> BLS publishes seasonally adjusted indexes for the PPI and CPI vehicles series cited here but does not produce seasonally adjusted estimates for the corresponding IPP indexes. Published seasonally adjusted data from the PPI and CPI are estimated using the Census Bureau's X-12-ARIMA method. The seasonal data are subject to strict production requirements and are revised over several years. Thus, a simplified seasonal adjustment analysis was applied in this study to compare all four series. For more information on seasonal adjustment in BLS, see <http://stats.bls.gov/cpi/cpisameth.htm> (visited June 10, 2008).

**APPENDIX: Detailed comparison of the PPI, CPI, and IPP**

	Category	Producer Price Index (PPI)	Consumer Price Index (CPI)	International Price Program (IPP)
<b>OVERVIEW</b>	<b>Product objective</b>	Measure changes in producer selling prices.	Measure changes in consumer prices.	Measure changes in import and export prices.
	<b>Product coverage</b>	Passenger cars and light trucks (14,000 lbs. or less) produced in the United States	New passenger cars and light trucks purchased by consumers for personal use. Included are both domestic and import manufacturers. The number of vehicles in the sample fluctuates. In December 2006 the sample included 539 dealerships pricing 762 cars and 729 trucks.	Harmonized 8703—automobiles, SUVs, golf carts, and ATVs, both diesel and gasoline.
	<b>Classification system(s)</b>	Industry-based indexes are classified according to the North American Industry Classification System (NAICS). Commodity-based indexes are classified according to an internal BLS system.	Internal BLS system	Samples are based on the Harmonized System (HS). Indexes are published on the basis of HS, Bureau of Economic Analysis (BEA) End Use, and North American Industry Classification System (NAICS).
	<b>Calculation</b>	Modified Laspeyres formula	Hybrid Index—Laspeyres and Geometric Means	Modified Laspeyres formula
<b>SAMPLE</b>	<b>Sampling frequency</b>	Every 5 years	Outlet sample is updated every year by 20–25%	Every 2 years
	<b>Sample universe</b>	All motor vehicle producers with manufacturing plants in the United States	All new vehicles sold in the U.S. for personal use. The geographic areas for sampling are 87 primary sample units (PSUs).	Vehicle importers and exporters (primarily marketing units and manufacturers)
	<b>Includes vehicles manufactured outside the U.S.</b>	No	Yes, if sold in the United States	Import index: yes. Export index: yes given item clears U.S. customs first.
	<b>Weighting</b>	Index divided into cells using census value of shipment data for each cell. Within cells, vehicles are weighted by manufacturer.	Reflects expenditures reported by households for the Consumer Expenditure Survey for the years 1993–1995. A 2-year rotation beginning in 2002. New vehicle weight in CPI is 4.983%.	Based on trade dollar values provided by U.S. Customs (imports) and U.S. Census Bureau (exports)
	<b>Vehicle discontinued</b>	Vehicles are not substituted mid-sample unless they are discontinued.	Vehicles are not substituted unless they are no longer available for sale.	Vehicles are not substituted mid-sample unless they are discontinued or phased out.
	<b>Transitioning to a new model year</b>	Transition to the new model year starts when the new vehicles are first shipped to dealers. This usually occurs in October.	The transition occurs when the new model year vehicle’s dollar volume sales exceed those of the old model year for the tracked vehicle. This is determined separately for each vehicle at each dealer. This roll-over usually starts in September and can last 4 to 6 months.	For exports, the transition occurs in October in some cases or when new models exceed 50 percent of models exported in the remainder of cases. For imports, transition occurs when over 50% of the vehicles are new.



	Category	Producer Price Index (PPI)	Consumer Price Index (CPI)	International Price Program (IPP)
PRICES	<b>Type of price collected</b>	Net price that dealers pay to motor vehicle manufacturers. Net price reported does not include discounts or holdback (manufacturer's payment to assist with dealer financing). Discounts are reported separately.	Price consumers pay to dealers. The reported price is estimated based on sales over the past 30 days. The reported price includes: base price, transportation charge, dealer preparation charges, options, markup, concession (haggling), rebate, non-sales taxes (e.g. luxury taxes) and sales tax.	For imports and exports: net prices paid at the border
	<b>Discounts applied in index</b>	Yes. Dealer and customer incentives, including cash rebates and financing incentives that are paid by the manufacturer	Yes. Includes estimated averages for concessions and consumer and dealer rebates based on sales for the model in question over the past 30 days. CPI has not included special financing rates since 1998.	No
	<b>Taxes</b>	No	Yes	No
	<b>Pricing frequency</b>	Price used in index is the price on one specific day in the middle of the month (the Tuesday of the week containing the 13th).	Prices are collected throughout the entire month. Prices are collected bi-monthly in the majority of PSUs and monthly in New York, Los Angeles and Chicago.	First day of each month.
QUALITY ADJUSTMENT PROCESS	<b>Quality adjustment data used</b>	Change in production cost (direct and indirect costs plus manufacturer's mark-up) due to change in quality.	Same as PPI, plus markup to retail.	Same as PPI
	<b>Quality adjustment formula</b>	$\text{New base price} = (\text{new price} \times \text{old base price}) \div (\text{new price} - \text{value of quality adjustment})$	$\text{Quality adjusted price} = \text{old price} \times \text{quality adjustment factor} \div (1 - \text{quality adjustment factor})$	Same as PPI
	<b>Procedure used when a tracked vehicle is discontinued, and no comparable vehicle is available</b>	Link using net prices so the index shows no change.	If it is an uncomparable model year changeover, the quote weight is imputed by the price change of other model year changeover quotes in the geographic area in question.	Same as PPI
	<b>Obtaining quality adjustment data</b>	Detailed QA data is obtained directly from the manufacturers for every vehicle in the sample and applied directly to each vehicle.	PPI detailed QA information used as proxies are applied. Research and secondary sources are also used to estimate other QA changes not captured in the PPI data.	Same as PPI
	<b>Quality adjust for emissions</b>	Yes	No, since January 1999.	Yes

	Category	Producer Price Index (PPI)	Consumer Price Index (CPI)	International Price Program (IPP)
<b>INDEX</b>	<b>Types of indexes published</b>	Indexes by industry and by commodity. The motor vehicle index includes indexes for passenger cars, light trucks (14,000 lbs. or less), motorcycles, and heavy trucks.	New Vehicle Index New Cars and Trucks Index New Cars Index New Trucks Index	BEA auto includes: autos, SUVs, golfcars. BEA trucks include: light and heavy duty.
	<b>Prices not reported by deadline</b>	Prices not reported are estimated by cell relatives; that is, their movement is estimated to be the same as that of the weighted average of all valid prices in the cell.	The quote weight is imputed by the price change of the other new vehicle quotes in the same geographic area.	Same as PPI
	<b>Revision period</b>	Final index is published 4 months after first published index	None. Indexes are final when published.	Final index is published 3 months after the first published index.
	<b>Regional data published</b>	No	Yes, by region and city	No
	<b>Seasonally adjusted data published</b>	Yes	Yes	No