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Barry Bosworth  
John Bieler  
Michael Kleinrock  
Eric Koepcke  
Ernst R. Berndt

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**ABSTRACT**

The prescription drug component of the Consumer Price Index (CPI) measures recent and past drug price changes, and provides the basis for projecting future price trends and health care expenditures. However, there are concerns about the adequacy of the price data because of recent changes in the structure of the market for prescription drugs. We compare the prescription drug data of the CPI with a large alternative data set from the IQVIA Institute for Human Data Science. We analyze the overall consistency of the data from the two sources, and examine the influence of the large shift from brand to generic drug sales and the increased reliance on third party insurance plans that are excluded from the CPI sampling frame.

Barry Bosworth  
Senior Fellow  
The Brookings Institution  
1775 Massachusetts Avenue  
Washington, DC 20036  
202-797-6122  
bbosworth@brookings.edu

Eric Koepcke  
The Brookings Institution  
1775 Massachusetts Ave. NW  
Washington DC USA 20036  
612-708 - 4125  
koepckeeric@gmail.com

John Bieler  
Economist  
Consumer Price Index  
U.S. Bureau of Labor Statistics  
Washington DC, 20002  
201-691-5407  
bieler.john@bls.gov

Ernst R. Berndt  
MIT Sloan School of Management  
100 Main Street, E62-527  
Cambridge, MA 02142  
and NBER  
eberndt@mit.edu

Michael Kleinrock  
IQVIA Institute for Human Data Science  
mkleinrock@theimsinstitute.org

The prescription drug components of the Consumer Price Index (CPI) and the Producer Price Index (PPI) measure recent and historical drug price inflation, and provide the basis for projecting future price trends and health care expenditures. They also serve as important inputs in the construction of the National Health Accounts. However, there are concerns about the adequacy of these price indexes in light of recent changes in the structure of the market for prescription drugs. To begin with, there has been a large growth in the reliance on generics as Medicare Part D and private insurance have increased the financial incentives to adopt generics. In 2016, it was estimated that unbranded generics accounted for 85 percent of drug prescriptions, compared with 50 percent in 2005.<sup>4</sup> With an unprecedented number of major drugs coming off patent in recent years, mismeasurement in the timing and the extent of the transition to generics could have large consequences.

Furthermore, the BLS's ability to obtain price quotes for the CPI program has been affected by the shift to prescription drug insurance coverage by public and private third-party payers (TPPs). These electronic transactions require information on the identity of the TPP, the beneficiary's identification number, and specific provisions of the benefit plan, such as the copayment rate, information that the pharmacy cannot provide to BLS field staff. As a result, BLS must rely disproportionately on cash transactions that comprise only about seven percent of the retail market, raising concerns about the extent to which they are representative of the overall drug market.<sup>5</sup>

This paper describes an exercise in which we compare the measures of prescription drug prices reported in the CPI and PPI programs with indexes computed from an alternative set of price data compiled by the IQVIA Institute for Human Data Science (IQVIA). There are some fundamental differences in that the CPI aims to measure only the out-of-pocket costs to consumers and the BLS does not have full access to retail transactions that are embedded in prescription drug plans. The analysis is thereby limited to a comparison with the cash transactions of the IQVIA data. The PPI is restricted to drugs produced within the United States,

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<sup>4</sup> <https://www.statista.com/statistics/205042/proportion-of-brand-to-generic-prescriptions-dispensed/>

<sup>5</sup> A recent overview of the major issues involved in the construction of price indexes for pharmaceuticals is provided by Aizcorbe and Nestoriak (2012). See also Berndt and others (2000). A discussion of the evolution of the drug market in response to passage of the 1984 Waxman-Hatch Act is available in Berndt and Aitkin (2011).

excluding imports from both other countries and Puerto Rico, a distinction that is not identified in the IQVIA data. Thus, the analysis is largely limited to a comparison of the CPI data with that of IQVIA.

This paper begins with a description of the basic methodology that is used by the BLS in the construction of the CPI and PPI price indexes. It is followed by an explanation of the prescription drug data from IQVIA. The focus of our exercise is on a comparison of the monthly data from the files of the CPI with corresponding data from IQVIA covering a 5-year period of 2009 to 2013. We construct parallel price indexes from the BLS and IQVIA data for the aggregate of all prescription drugs and for a set of subcomponents. In the aggregate, we find the increase in the IQVIA index substantially exceeds that of the CPI, and the difference remains when the comparison is restricted to a matched set of prescription drugs. In the analysis of the component indexes, we find that the discrepancy between the IQVIA and CPI is heavily concentrated in two therapeutic categories of cardiovascular-renal and skin/mucous membranes. The differences are surprising because the two data sets appear to contain a similar distribution of drug sales.

### **CPI for Prescription Drugs**

Prescription drugs accounted for 10 percent of U.S. national health expenditures in 2015. However, the portion of those costs that are paid directly and recorded as direct out-of-pocket costs to consumers has fallen dramatically, from 82 percent in 1970 and 28 percent in 2000 to 14 percent in 2015.<sup>6</sup> Health insurance now accounts for about 85 percent of the payments, and since the introduction of the Medicare Part D in 2006, the private insurance share has fallen to about 40 percent. All the same, the relative importance of prescription drugs has continued to rise in the CPI, from 0.86 percent in December of 2000 to 1.38 percent in December of 2015.

In most respects, the calculation of the price index for prescription drugs follows a standard procedure used for all goods and services in the Consumer Price Index (CPI). This paper begins with a very brief outline of the most relevant portions of the process used in the construction of the CPI before reporting on the specifics of the analysis of drug prices.<sup>7</sup>

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<sup>6</sup> National Health Accounts, 2016, table 16; available at: <https://www.cms.gov/research-statistics-data-and-systems/statistics-trends-and-reports/nationalhealthexpenddata/nationalhealthaccountsprojected.html>.

<sup>7</sup> A more detailed discussion is available at: <http://www.bls.gov/opub/hom/pdf/homch17.pdf>.

**Overall CPI Methodology.** The CPI is calculated in two stages. The first stage involves the computation of 8,018 *basic indexes* for 38 individual urban or metropolitan areas of the United States and 211 product categories. The weights for the first stage are derived from the construction of local outlet-based sampling frames by item and area. The weights for the second stage are derived from biennial updates of the Consumer Expenditure Survey. Prescription Drugs is one of the 211 product categories (item strata) and is the lowest level at which a published index is computed; i.e., therapeutic class-specific CPIs are not computed or published by the BLS.

Price information is gathered within a larger number of 87 geographical areas called primary sampling units (PSUs). In addition, the 211 product categories are expanded to 305 entry-level items (ELIs) which are the ultimate sampling units. BLS conducts household point-of-purchase (POPS) telephone surveys in the PSUs to develop a sample list of outlets within which specific ELIs will be priced for inclusion in the CPI. The selection of specific items within an outlet-ELI combination is based on a probability-proportionate-to-sales sampling procedure using sales of the items within the outlet. Once selected, individual items are repriced on a monthly or bimonthly basis. Approximately a quarter of the items and outlets within each sample PSU are rotated out each year. BLS field representatives visit about 26,400 outlets each month and collect prices on 85,000 items. Items whose prices are most volatile, such as food at home, energy, and telephone services, are collected on a monthly basis. In addition, all survey items in New York, Chicago and Los Angeles are priced monthly. All other items in other PSUs are priced bimonthly, spread equally across even and odd-numbered months.

The processing of the monthly price data involves the calculation of a price relative for each of the *basic indexes*. Prior to 1999, the construction of the price relatives utilized a Laspeyres index formula (that is a ratio of a weighted arithmetic mean of prices in the current period to the same average of prices in the prior period, using fixed quantity weights). In 1999, the calculation of the price relatives for most basic indexes was converted to a geometric mean formula using fixed expenditure shares as weights, implying that consumers will alter their purchases to offset a portion of the price increase, albeit only within a narrow item-area category.

**Prescription Drugs.** The prescription drug index is a first-stage *basic index* within the CPI, and its calculation follows the standard process of first conducting a telephone POP survey within each PSU to construct a panel of retail pharmacies and their share of consumer prescription purchases. The sampling frame of potential outlets includes stand-alone pharmacies, those associated with grocery stores and other retail establishments, and internet-based pharmacies.<sup>8</sup> Individual outlets rotate out of the sample on a four-year replacement cycle. Second, a sampling frame is constructed within each outlet, based on the revenue obtained from the last 20 prescriptions dispensed at the outlet. The probability of a specific drug's selection is thus proportionate to its share of total revenues generated by the last 20 prescriptions reflecting both its relative frequency of being prescribed and its cost per prescription. Typically, 4-6 prescriptions are selected for sampling within each outlet.

The calculation of the prescription drug price index is similar to that of other components of the CPI in using geometric weights derived from the initial area surveys. The weight of prescription drugs in the overall CPI is based on the Consumer Expenditures Survey of households, and the survey plays a small role in the construction of the basic prescription drug index through the aggregation across areas. New drugs are introduced into the index as part of the regular rotation of outlets and the selection of the item-sampling frame for the outlet. No effort is made to measure the quality-adjusted price of the new drug; thus, its price change in the introductory month is implicitly equivalent to the average change for other prescription drugs within the PSU. Effectively, the difference in the price of new and incumbent goods is assumed to be a measure of the market's valuation of the quality differences in the goods, and it is linked out of the index.

**Generics.** The CPI, however, does incorporate a special adjustment at the time that a brand name drug loses its exclusivity and faces new competition with the introduction of new generic drugs that are frequently offered with deep discounts.<sup>9</sup> A generic drug is a pharmaceutical drug that is equivalent to a brand-name product in dosage, strength, route of administration, quality, performance, and intended use. Most commonly, a generic is judged to

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<sup>8</sup> The CPI includes vaccines and biologics, but it excludes the costs of administering a vaccine. Prescription drugs that are administered in a hospital setting and billed by the hospital as a component part of a larger service are not included in the prescription drug index, but are included as part of the price index for hospital services.

<sup>9</sup> Exclusivity is distinct from a patent as they are granted under different authorities and may not run concurrently.

be comparable to the branded version if both are based on the same molecule, strength and formulation.

The introduction of generic drugs creates a significant problem for the CPI because the first appearance of a generic would normally be treated as a new good, and under the standard practice there would be no price change in the introductory month (Griliches and Cockburn, 1994).<sup>10</sup> Yet, nearly all of the change in the price of a molecule occurs with the first appearance of the generic. The price of the brand often stays the same or actually increases after it loses its exclusivity--the producer of the branded drug frequently introduces its own generic rather than reduce the price of the branded version with strong consumer recognition. Hence, were the standard procedure of the CPI to be applied, nearly all of the price change involved in the transition to the generic would be linked out in the computation of the index. In addition, there is a rapid rise in the generic's penetration of the market that is not captured after its introduction into the sample.

Within the prescription drug series of the CPI, the introduction of a new generic quote is handled by linking the new generic to the old brand with a special code that declares the two series to be comparable. Hence, in the introductory month, the new generic has a price change equal to the difference between the prior value of the branded and the new generic.

The Washington BLS office keeps track of drugs going off patent and sends a message, roughly six months after patent expiration, to the field agents outlining the procedure to check for the introduction of a generic. The agents ascertain if a generic has been introduced at the outlet; and, if so, the shares of generic and branded prescriptions in the prior three months are used to compute relative weights. The six-month delay is designed to give the newer generics an opportunity to build market share. The relative weights are used in a proportionate random draw to give the generic versions a one-time chance for inclusion in future months. The choice between the new generic and the branded version is done once and remains the same for the remainder of the life of the quote.

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<sup>10</sup> See Cleeton, Goepfrich, and Weisbrod (1992) and Aizcorbe and Nestoriak (2012) for their discussions of the complexity of issues associated with the introduction of a new drug.

## **PPI for Prescription Drugs**

The PPI measures the change over time in the prices received by domestic producers of goods and services.<sup>11</sup> The PPI derives its weighting mostly from the value of shipments as reported in the Census Bureau's 5-year economic census.<sup>12</sup> The PPI includes sales to wholesalers, or directly to retailers, long-term care facilities, hospitals, and other outlets. This contrasts with the pharmaceutical component of CPI that measures price change from the perspective of consumers. Pharmaceutical preparations have their own commodity class (0638), and are disaggregated further into eight therapeutic classes, providing more published detail than the CPI.

Following Census classification, the PPI has the manufacturing of active pharmaceutical ingredients fall under NAICS 325411 Medicinal and Botanical Manufacturing, while the manufacturing of the final dosage form of small molecules (discussed above) falls under NAICS 325412 Pharmaceutical Preparations Manufacturing. Large molecule biologics such as vaccines, toxoids, and culture media of plant or animal origin are classified in NAICS 325414 Biological Product (except Diagnostic) Manufacturing. To the extent that injectable vaccines and biologics are administered in outpatient clinics and physicians' offices, but are not dispensed at retail, the set of transactions captured by the various BLS PPIs and the IQVIA Institute for Human Data Science data (discussed in further detail below) do not fully overlap, making comparisons between the BLS PPIs and IQVIA data problematic. Hence, in this research we focus most of our attention on comparison of the CPI with the IQVIA data.

Within the PPI, surveyed products are selected with a probability-based sampling frame of firms that participate in the Unemployment Insurance system. Surveyed firms are asked to report actual transaction prices largely on a monthly basis by internet or mail. The price indexes are computed with a Laspeyres formula. Individual reporting firms' revenues are used to weight

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<sup>11</sup> Importantly, the PPI excludes pharmaceuticals produced in Puerto Rico from its definition of *domestic* production despite the island's role as a primary production location of U.S. drug companies. The value added of pharmaceuticals in Puerto Rico is equal to about 17 percent of the domestic production. Unfortunately, Puerto Rico is also excluded from the Import Indexes where it is treated as part of the United States. Pharmaceuticals manufactured and exported from Puerto Rico are included in the International Price Program (IPP) index for exports.

<sup>12</sup> The latest available economic census data is for 2012.

the indexes at the lowest level. At the aggregate level, the indexes are combined using the product-line data of the economic censuses.

The procedures for pharmaceuticals deviate from this standard procedure by incorporating an annual update of the commodity sample based on information in the Food and Drug Agency's (FDA) Orange Book. For those new drugs that are judged to be therapeutically equivalent to an existing drug, the weight of preexisting drug is split between the old and new version based on relative sales revenue. The new generic is linked into the price index in a fashion that includes any price difference between a branded drug and its generic equivalent.<sup>13</sup> Hence, the PPI incorporates the price change between a branded drug and the first generic in a procedure with a similar outcome to that of the CPI.

### **IQVIA Data**

The IQVIA National Prescription Audit data base tracks prescriptions dispensed at a nationally representative sample of retail, mail order and long-term care pharmacies and is projected to an estimate of total national prescriptions dispensed through these pharmacies on a monthly basis. We limit our analysis to prescriptions dispensed at retail pharmacies, and focus on the 250 most prescribed molecules (measured by number of prescriptions dispensed during May 2013). Individual records represent national totals and distinguish the month, the national drug code (NDC), age group of the patient, and payment type. The distribution by payment type differentiates among Medicaid, Medicare, commercial or other third party payer, and cash. Age refers to the age of the patient to whom the prescription was dispensed, and only identifies those patients as over or under age 65 for about 80 percent of the sample. The data cover the period from March of 2009 to October 2013. . In subsequent analysis, we refer to the data file as IQVIA data. It includes about 7.5 million records and provides a more complete coverage of retail drug transactions than the CPI file. The prescription price is computed as revenue divided by the quantity for each record.

These IQVIA data reflect the perspective of the retail pharmacy, and prices measured at this point in the distribution chain correspond closely to the retail prices that the U.S. Bureau of

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<sup>13</sup> The methodology is discussed in Bureau of Labor Statistics (2011), and Kelly (1997).

Labor Statistics attempts to measure in constructing its monthly CPI Index for Prescription Drugs. The total revenue received by the dispensing pharmacies is the sum of the customer's copayment or coinsurance contribution and the amount (if any) reimbursed to the dispensing pharmacy by the third party payers – Medicare Part D insurer, Medicaid, or commercial or other third party payer. This pharmacy price therefore includes reimbursement for the final dosage form of the active pharmaceutical ingredient, a dispensing fee, and any customer copayment or coinsurance contribution. If the customer presents the pharmacy with a coupon, the value of that coupon is attributed to the patient copayment or coinsurance contribution; how well the IQVIA is able to capture coupon transactions is not publicly known. For our purposes, however, it is important to note that this pharmacy price already includes margins realized by wholesalers, pharmacies and any other distributors, and is therefore generally larger than the price (net of rebates and discounts) received by the brand and generic manufacturers. These rebates and discounts can be substantial, in some cases larger than the amount that consumers actually pay.

## **Data Analysis**

The BLS maintains a data archive of the individual monthly quotes of the CPI. We have extracted data for all of the prescription drug quotes of the CPI covering the months of 2009:3-2013:10, a period that aligns with that of the data file provided by IQVIA. The CPI file is quite large, averaging about 952 price quotes per month, and it includes a monthly average of 245 distinct molecules (overall, there are about 420 molecules, but less in a specific month). In some earlier work, BLS researchers found a match of about 85% of the CPI file with the top 250 molecules by total prescriptions (TRX) as supplied by IQVIA. We also have a considerable number of characteristics for each price quote, but for our current purposes we can focus on a few. The BLS staff did some work to clean up the recorded NDCs in a match to the official codes of the FDA, but the NDC is not integral to the CPI index work. Instead, three key measures of the outlet code id, quote number, and the version number, are sufficient to identify each of our quote series in a given month. Changes in any of these three characteristics normally reflects termination of the old quote series and introduction of a new series. Quotes are collected on either a monthly or a bimonthly basis. The file appears to be quite clean with respect to the price quote and the key identifiers in the sense that recorded values seem very consistent from

month to month. Other characteristics are recorded in a more variable fashion that would require some editing to make them reliable.

The CPI data file also contains information from the National Drug Code Directory on the 2-digit code used to group drugs into 20 major therapeutic classes. We use those categories to provide some disaggregation of the data, computing separate price indexes for each class. The class names and the distribution of IQVIA revenues and CPI quotes by class are shown in Table 1. A total of more than 250 molecules is reported because different NDC's with the same molecule designation may be assigned to different classes if they may have different primary treatment applications. The distribution of the IQVIA data across the CDC classes by reported cash revenue is shown in column 5 and the distribution of CPI price quotes is shown in column 6. The distribution across the therapeutic classes is very similar between the CPI and IQVIA files, suggesting a high degree of similarity in the structures of the two data sets. The correlation coefficient between the two distributions is 0.93. Column 7 displays the distribution of CPI quotes when the sample is restricted to those NDCs that appear in both the CPI and IQVIA files.

A differing dimension of the CPI and IQVIA files is highlighted by noting that the IQVIA file contains 43,493 unique NDCs. Many of these codes represent the same basic product, but differ due to variation in strength and size of the prescription. The CPI file in contrast contains only 2,434 unique NDCs, and we are able to match 1,582 (65%) of those entries with NDCs in the IQVIA file. It is possible that some of the CPI products are not present in the IQVIA because the latter is limited to the top 250 molecules, but we expect a significant portion fail to match because the entry of the NDC in the CPI file is incorrect.<sup>14</sup>

### ***Aggregate Indexes***

As an initial point of comparison, the published CPI, PPI, and constructed measures from the IQVIA data file are shown in Figure 1 for the period of 2009:3 to 2013:10. All the CPI indexes are computed with a BLS program, *the research database calculator*, which duplicates the methodology of the official indexes, but with different sample inputs. The IQVIA indexes are computed as monthly chain-linked Laspeyres indexes. The price measures of the IQVIA data are computed values based on the ratio of national sales for each data record divided by the number

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<sup>14</sup> The NDC is recorded in the CPI file as a text value and some values contain alphabetic characters, which are not part of the NDC system. We tried to correct for those obvious errors in the recorded NDC codes.

of prescriptions. With access to monthly sales data, the IQVIA indexes incorporate a more current weighting structure than that of the CPI indexes for which the estimated weights change with the rotation of the sample.

Several alternative indexes are constructed from the IQVIA data file: (1) using all of the available data series, (2) an index restricted to those NDCs that are present in the CPI file, and (3) an index that further restricts the IQVIA data to NDCs that are present in the CPI and to cash transactions. We expect the third version of the IQVIA price index to be closest to the matched version of the CPI.

We also adjusted the IQVIA data for the introduction of generics in a fashion similar to that used in the CPI. IQVIA supplied us with a data file that identified branded and generic prescription drugs by their NDCs, and their date of introduction. In addition, the file provided a unique code for the combined molecule of each drug and an indication of whether an original brand drug had been used as the reference listed drug (RLD) for a generic in the FDA Orange Book. Thus, by grouping drugs with common combined molecules, we could identify a probable parent RLD for each generic. We identified the introduction of 44 generics in the five years covered by the IQVIA file when the potential NDCs were limited to drugs that were part of the CPI file, and we replaced the price of the generic in its first month with the price of the corresponding branded drug. Thus, the implied price change associated with the shift from the brand to the generic was measured by the price change between the first and second month of the generic's introduction.

The top panel of Figure 1 displays the published indexes of the CPI, PPI, and the third definition of the index from IQVIA. In addition, we report a matched CPI-based index that is restricted to those NDCs that are in both the CPI and IQVIA data files. The CPI shows the slowest rate of increase (an annual average of 3.1%), the PPI rises at an intermediate rate (5.1% per year), and the IQVIA measure increases the fastest (7.1 % per year).

The alternative indexes constructed from the IQVIA data set are shown in the lower panel. The use of all the data in the file actually produces the lowest rate of change, with a pronounced large decline (4.5%) in October of 2012, but that can be traced to one drug that has a

large weight and is not included in the CPI.<sup>15</sup> However, the two indexes that are restricted to NDCs in the CPI, but differ in the additional limitation to cash transactions, have very similar rates of change (annual average increases of 7.6 % and 7.1%). This latter result is surprising in light of the concern that the coverage of the CPI is declining over time as a growing portion of prescription drugs are paid through payment plans. In the IQVIA data file two-thirds of the series by revenue are present in the CPI but cash transactions account for only 4.6 percent of the revenue in the broad measure and a slightly lower 4.2 share for the data set that is restricted to NDCs that are included in the CPI file. However, both series show parallel patterns of decline in the cash share (Figure 2). In addition, the share of transactions that are paid in cash has a pronounced spike in the IQVIA data at the beginning of each year that is probably due to a growing reliance on high-deductible insurance plans, whereby consumers pay a cash price until they reach a deductible threshold and third party insurance kicks in.

We constructed a final alternative price index for the IQVIA file that incorporated a Törnqvist weighting scheme using an average of the expenditure shares of the current and prior month. The index incorporates substitution effects that occur within the monthly interval. It was applied to the version of the IQVIA data limited to cash transactions. Because the Laspeyres index is already computed on a monthly basis with weights from the prior month, the Törnqvist weighting may not have an effect, but it is a more up-to-date representation of the weights. Surprisingly, the Törnqvist index rose slightly more rapidly than the Laspeyres version.

### ***Disaggregated Price Indexes***

We can explore the differences between the IQVIA and CPI datasets in greater detail by constructing indexes for each of the CDC drug classes shown in Table 1. Some of the drug classes have very few entries. Hence, we introduced an additional requirement that the sub-class of the CPI sample include a minimum of one percent of the quotes in the total CPI. That yields 12 sub-classes for which we constructed various alternative price indexes. The 12 categories are identified with an asterisk in column 1 of Table 1. The various panels of Figure 3 display those comparisons. The solid line represents the index from the CPI file that is restricted to those

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<sup>15</sup> We can trace that sharp change to a fall in the price of Asmanex Ttwisthaler, a single drug, but with seven NDCs. It is not surveyed in the CPI. We do not know the reason for the change, but it does not appear to have had a change in patent status.

NDCs that are common to the CPI and the IQVIA samples. Two alternatives are drawn from the IQVIA data file and correspond first to NDCs that matched with those in the CPI (CPI NDCs, CPI CDCs), and a second set of indexes based on further limiting the index to cash sales (CPI NDCs, CPI CDCs, Cash).

Over the full five-year period, the discrepancy between the CPI-based indexes and the cash-based series from IQVIA cumulates to an average of 10 percent in the last month (October, 2013) of the sample, but the differences are very large for 05-Cardiovascular-renal (59%) and 12-Skin/Mucous Membranes (37%). If those two classes are excluded, the average discrepancy falls to 3 percent. The cardiovascular-renal class was among the largest at 17 percent of total revenue, whereas skin/mucous membranes was the smallest.

Second, as with the aggregate index, the disaggregated categories tend to have a larger degree of price increase in the IQVIA data file than in that of the CPI. The increase in the IQVIA indexes exceeds that of the CPI in eight of the 12 categories where we judged the sample to be of sufficient size to yield reliable results.

The third striking feature of the data is the close correspondence between the IQVIA price index for all drug transactions in the class and those that are limited to cash. While that pattern was evident in the aggregate indexes, it continues to hold to a surprising extent in the disaggregated indexes. As a result, the restriction to cash sales has less influence on the indexes that we anticipated.

## **Conclusion**

In this paper, we have used a large alternative data set obtained from IQVIA to construct a benchmark comparison of the Bureau of Labor Statistics' CPI for prescription drugs. We use a methodology close to that of the CPI over a 5-year period and compare the indexes from the two sources. We find that the IQVIA data indicate a more rapid rate of price increase than reported in the CPI for the aggregate of all prescription drugs. In an effort to identify the sources of the difference, we disaggregated the data into 20 therapeutic classes and found that the CPI and IQVIA data sets contain very similar distributions of drugs as measured by the volume of price quotes (CPI) and revenues (IQVIA). We computed price indexes for 12 drug classes for which the samples appeared to be large enough to yield meaningful results. Two of those classes, cardiovascular-renal and skin/mucous membranes were the dominant sources of the

discrepancies, but we could detect no obvious reason for the differences. Furthermore, the increases in the IQVIA indexes exceeded those of the CPI in eight of the twelve classes.

We constructed several additional price indexes to explore further the influence of alternative selection criteria. Inclusion of all payment transactions in the IQVIA file, and not just the cash transactions available to the CPI, had a relatively minor effect. Finally, we experimented with a Törnqvist version of the monthly-chained index for the IQVIA data sample. The result tended to widen the gap between the IQVIA and CPI data sets.

We are left with some puzzlement about explanations for the differences between the indexes constructed from IQVIA and CPI data sets because the IQVIA-based indexes show a general pattern of larger price increases. In some respects, the methodologies used to construct the two data files are quite different. The weighting of specific drugs in the CPI is the result of a series of probabilities that a specific retail outlet within a region will be included in the sample together with a probability-based selection among its most commonly dispensed drugs. In contrast, the IQVIA measures reflect a more direct construction of the price indexes from the basic national sample of prescription drug transactions. However, it is not evident that the differences in the construction of the two data sets would explain the observed differences in price index trends.

## References

- Aizcorbe, Ana, and Nicole Nestoriak. 2012. "Price Indexes for Drugs: A Review of the Issues," in Patricia Danzon and Sean Nicholson (editors) *The Oxford Handbook of the Economics of the Biopharmaceutical Industry*. Available at: [https://www.bea.gov/papers/pdf/price\\_indexes\\_for\\_drugs\\_a\\_review\\_of\\_the\\_issues\\_aizcorbe.pdf](https://www.bea.gov/papers/pdf/price_indexes_for_drugs_a_review_of_the_issues_aizcorbe.pdf).
- Berndt, E. R., and M. L. Aitken. 2011. "Brand Loyalty, Generic Entry and Price Competition in the Quarter Century after the Waxman-Hatch Legislation", *International Journal of the Economics of Business* 18(2):177-201, July.
- Berndt, E.R., Cutler, D.M., Frank, R.G., Griliches, Z., Newhouse, J.P. and Triplett, J.E. (2000) "Medical care price and output" in Culyer, A.J. and Newhouse, J.P. (Eds.) *Handbook in Health Economics* vol. 1a., Elsevier.
- Bureau of Labor Statistics. 2011. "The Pharmaceutical Industry: an Overview of CPI, PPI, and IPP Methodology." Available at <https://www.bls.gov/ppi/pharmpricescomparison.pdf>.
- Cleeton, David, Valy Goepfrich, and Burton Weisbrod. 1992. "What does the Consumer Price Index for prescription drugs really measure?" *Health Care Financing Review*, 13 (3):45-51.
- Griliches, Zvi, and Iain Cockburn. 1994. "Generics and New Goods in Pharmaceutical Price Indexes," *American Economic Review*, Vol. 84, No. 5 (December): 1213-32.
- Kelly, G. G. 1997, "Improving the PPI Samples for Prescription Pharmaceuticals", *Monthly Labor Review* 120(10):10-17.
- Moulton, Brent. 1996. "Bias in the Consumer Price Index. What is the Evidence?" *Journal of Economic Perspectives*, Vol. 10, No. 4 (Autumn):159-77.

**Table 1. Number of Molecules and Drugs/products by Therapeutic Class**

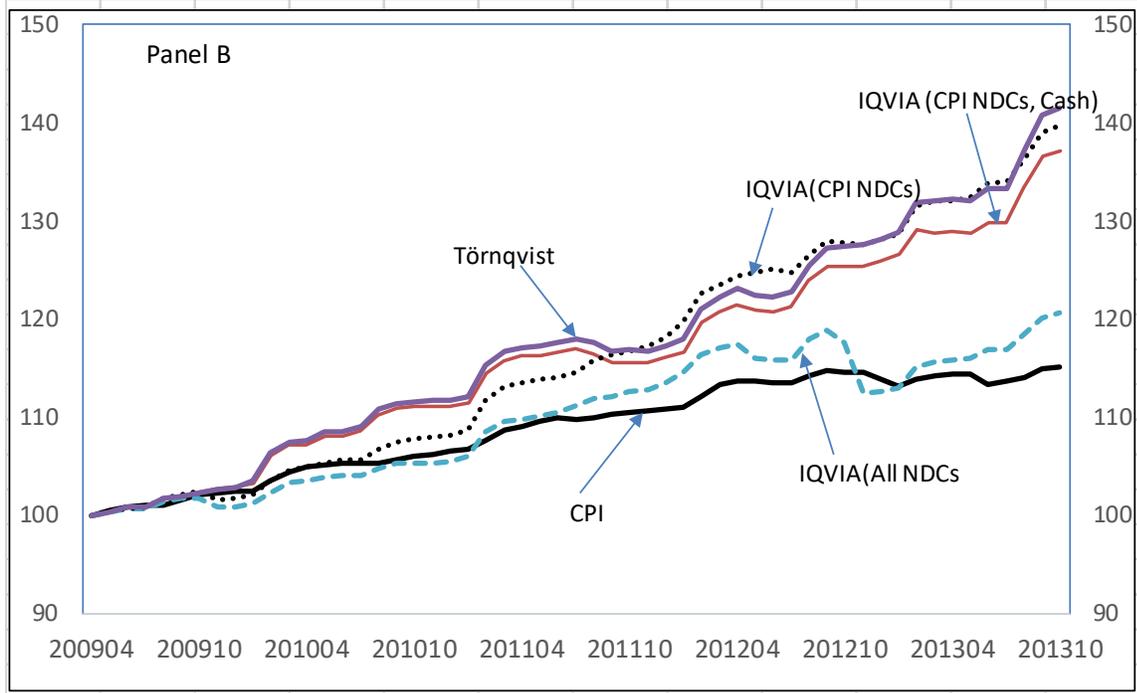
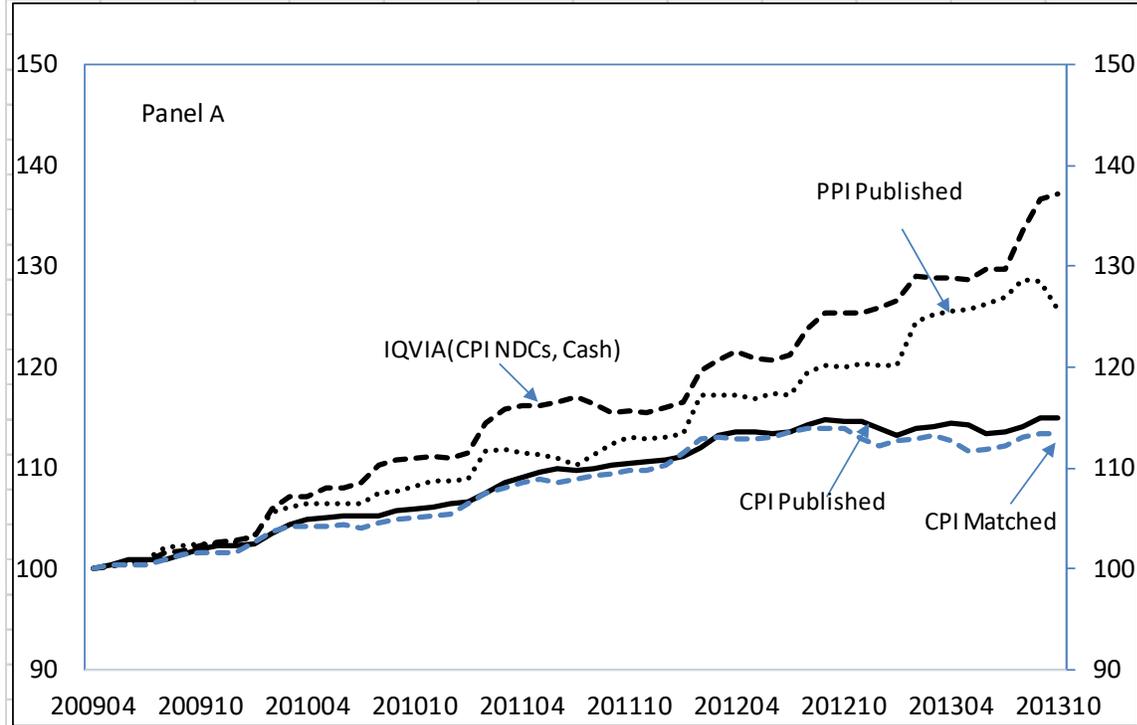
250 most common IQVIA prescriptions limited to NDCs included in the CPI sample with payment in cash

Therapeutic Class	Number of Molecules in IQVIA	Number of Products/Drugs in IQVIA	Class Description	Percent of IQVIA Cash Revenue	Percent of Total CPI Quotes	Percent of Matched CPI Quotes	Coef. Of Variation Matched
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	2	3	Anesthetics	0.55	0.43	0.47	0.55
2	2	2	Antidotes	1.00	0.15	0.19	0.77
3*	29	45	Antimicrobials	7.30	9.11	9.25	0.15
4*	4	6	Hematologics	1.68	2.47	2.38	0.30
5*	46	80	Cardiovascular-Renal	16.95	16.98	17.09	0.21
6*	40	77	Central Nervous Sys.	16.56	14.54	14.85	0.22
7	0	0	Contrast Media/ Radiopharmaceuticals	0.00	0.00	0.00	
8*	13	18	Gastrointestinals	5.21	6.40	6.61	0.18
9*	19	30	Metabolics/Nutrients	7.52	12.65	13.29	0.24
10*	31	85	Hormones/Hormonal Mechanisms	12.14	12.78	12.36	0.31
11	3	4	Immunologies	0.74	0.13	0.06	1.68
12*	11	14	Skin/Mucous Membranes	0.86	1.88	0.81	0.47
13*	21	29	Neurologics	3.65	3.06	4.99	0.45
14	2	2	Oncolytics	0.07	0.76	0.18	0.65
15*	10	15	Ophthalmics	1.46	1.58	1.24	0.21
16	7	7	Otics	0.28	0.25	0.30	1.16
17*	29	50	Analgesics	13.96	7.15	6.72	0.27
18	2	2	Antiparasites	0.04	0.26	0.07	1.43
19*	25	42	Respiratory Tract	9.89	9.32	9.08	0.25
20	4	5	Unclassified/Misc	0.16	0.07	0.04	2.42
21	0	0	Homeopathic Products	0.00	0.00	0.00	
<b>Percentage</b>				<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	
<b>Total</b>	<b>300</b>	<b>516</b>			<b>987</b>	<b>768</b>	

Note: The IQVIA extract is based upon the Top 250 combined molecules and the products within these molecules. The monthly data extends from March 2009 to October 2013. The above classification aggregates to more than 250 molecules because drugs with the same molecule structure may be used within more than one CDC class in the CPI classification. The IQVIA data are limited to cash payments (excluding all payment plans). Column (8) reports the coefficient of variation for the number of quotes in the matched CPI across the 56 months of data.

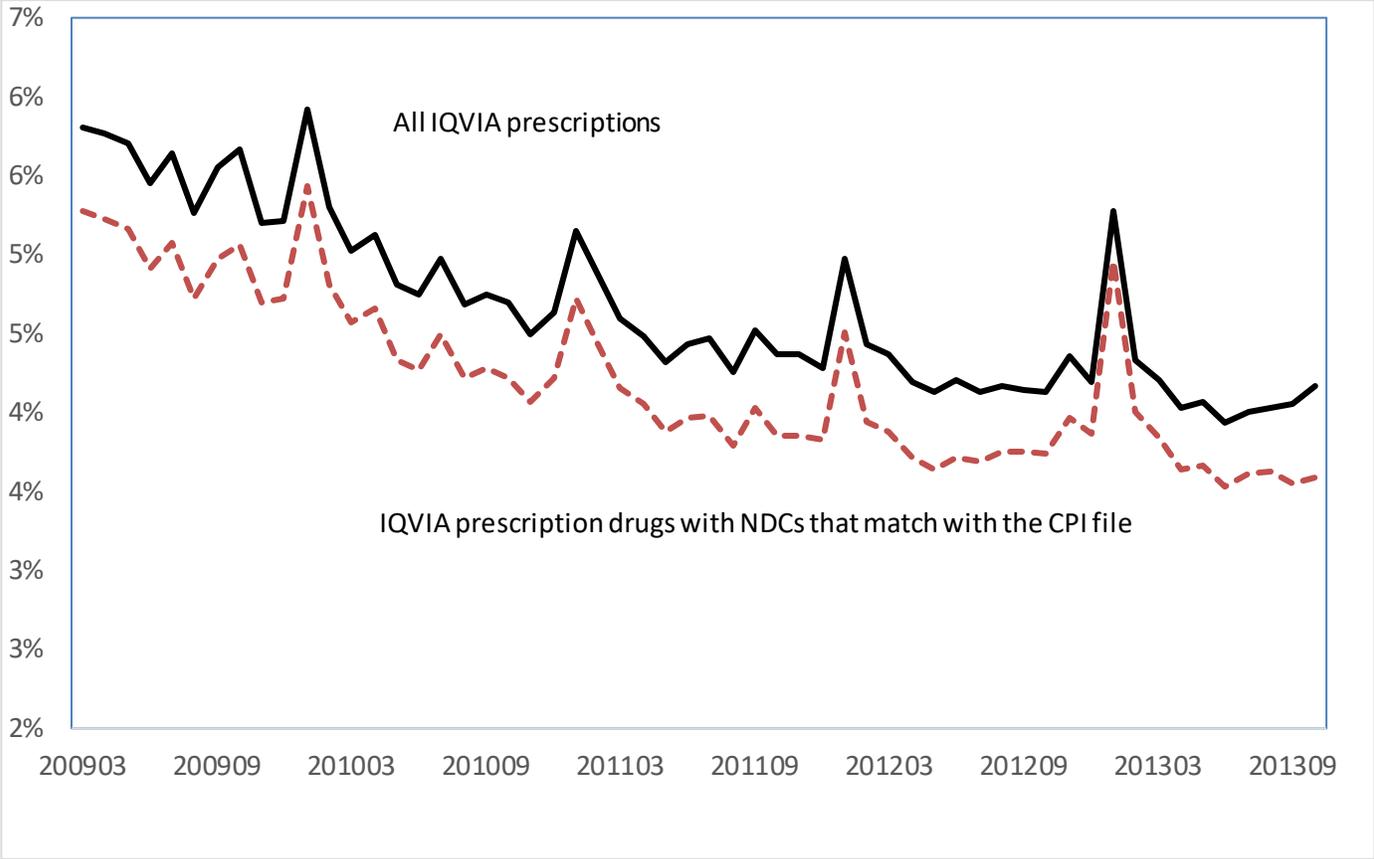
**Figure 1. Aggregate Pharmaceutical Price Indexes 2009:03-2013:09**

CPI, PPI, and Constructed Index from IQVIA Data



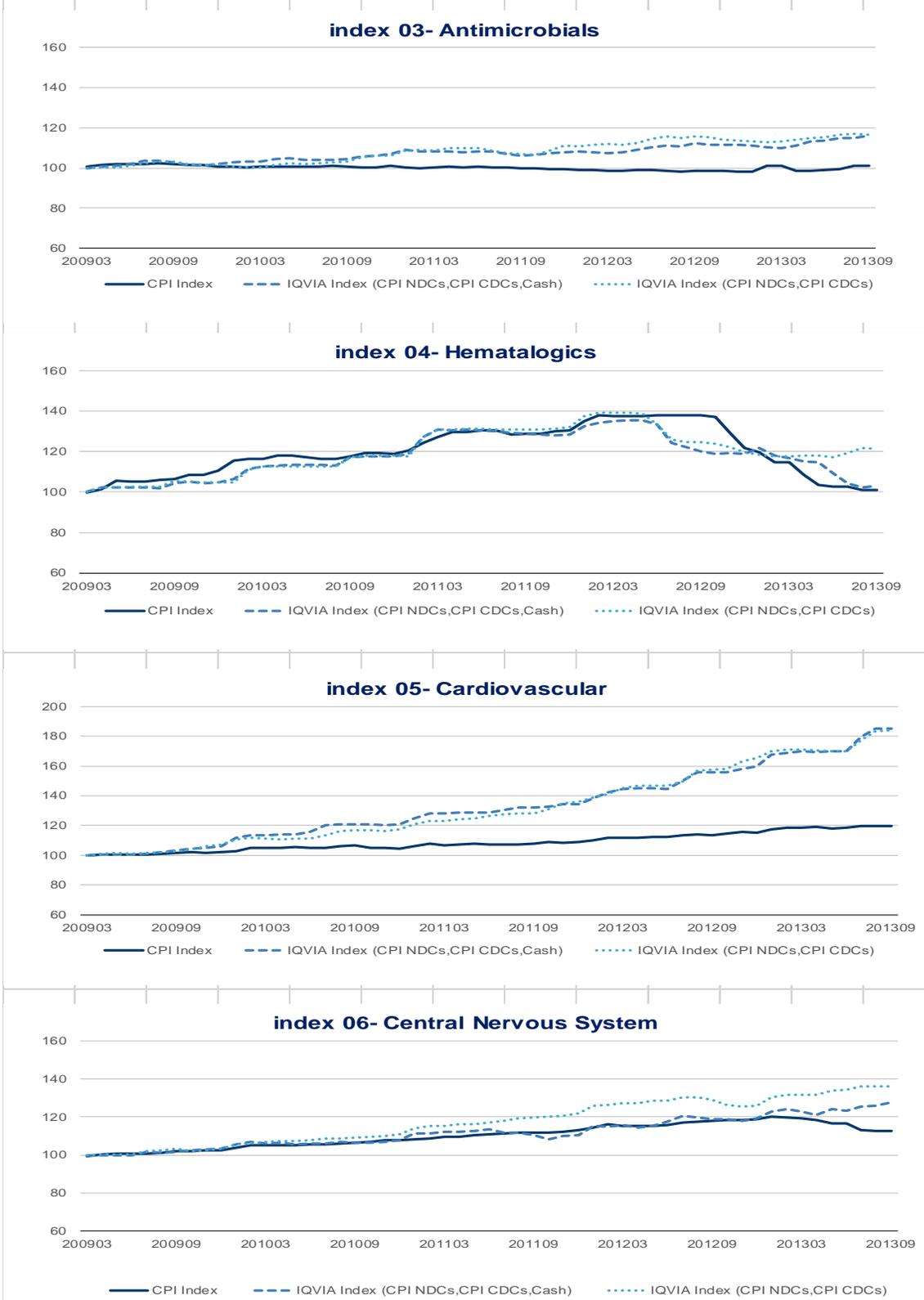
Note: Panel A displays the published price indexes of the CPI and PPI for pharmaceuticals, an index constructed from the IQVIA file that restricts the index to NDCs that are included in the CPI and represent cash transactions, and a CPI-based index that is limited to those quotes whose NDCs matched with the IQVIA data file. Panel B shows the CPI and four alternative index from the IQVIA file that include all NDCs, NDCs that are included in the CPI file, those included in the CPI and restricted to cash transactions, and a Törnqvist version of the cash index.

Figure 2. Percent of Prescription Drug Sales for Cash, 2009-2013



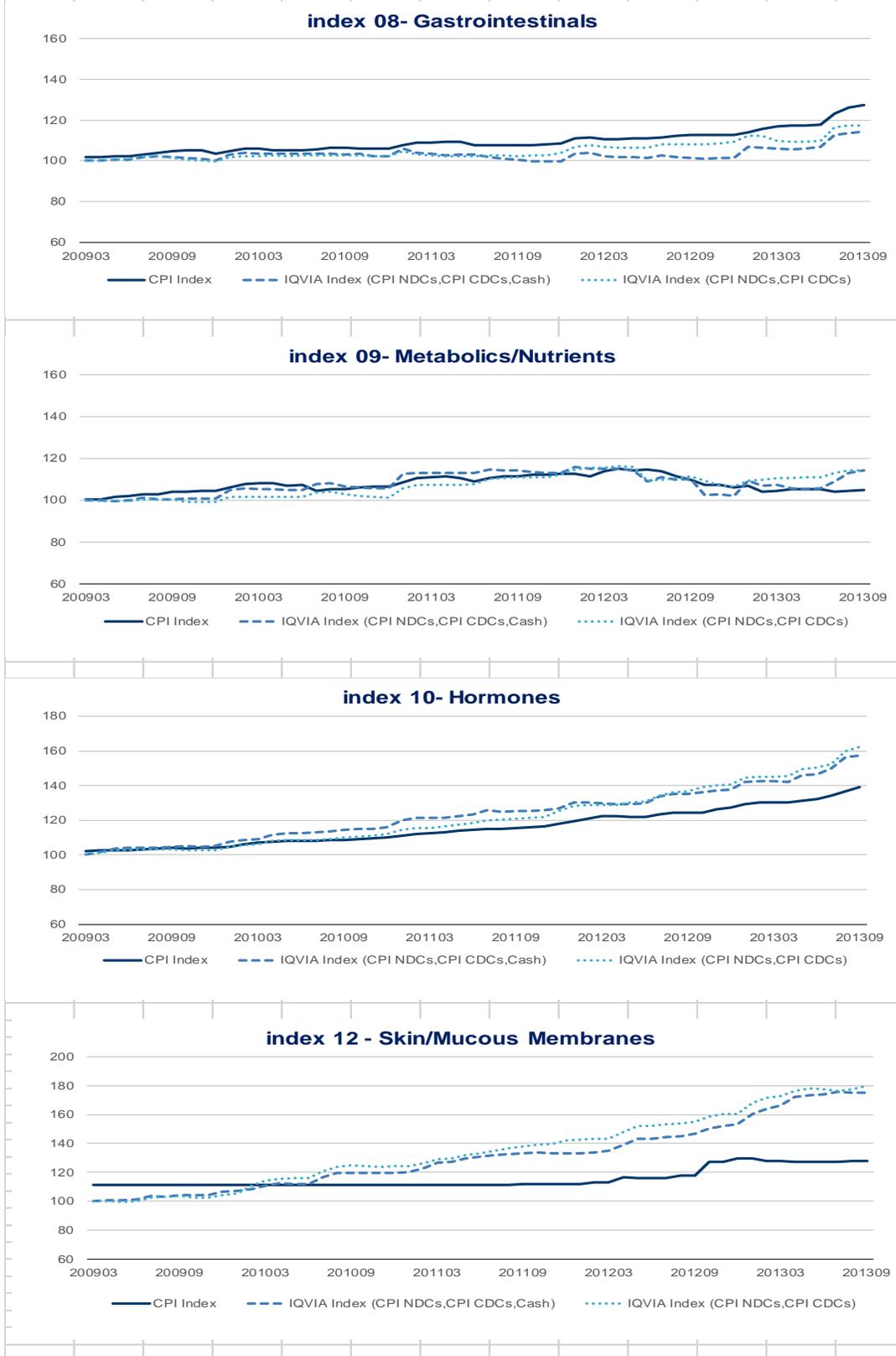
Source: IQVIA data file as described in text.

**Figure 3. Price Indexes by CDC Class, 2009-2013**



*Note: The CPI is from the CPI file. The two IMS indexes are restricted to those NDCs that are included in the CPI. One version is based on all revenues, and the second is limited to cash payments*

**Figure 3. Price Indexes by CDC Class, 2009-2013 (continued)**



**Figure 3. Price Indexes by CDC Class, 2009-2013 (continued)**

