Fitness of Use Criteria for Price Index Deflators in National Income Accounting
A Case Study: Mutual Stock Fund Management

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Abstract:

Most statistical agencies in developed countries are working to expand the coverage of their price indexes to better represent the services sector. Relative to the durable and non-durable goods producing sectors, services often present measurement challenges that are difficult to address in an operational environment. This paper presents a case study of how the Producer Price Index program conceptualized and then executed a price measurement methodology for the output of the Investment Advice industry, while simultaneously testing the deflation properties of its methodology for fitness of use in the national accounts.

Introduction

Statistical agencies continue to expand their coverage into the services sector which has led to a constructive dialogue with national income accounting practitioners. The dialogue has often focused on the fitness of certain price indexes for separating price change from quantity change. The deflation properties of a price index are partly dependent on how statistical agencies respond operationally to the conceptually difficult price measurement challenges presented by service industries such as finance, consulting or medical care. Several criteria can be used to access the accuracy and relevance of deflators that vary according to the complexity of the price measurement challenge. Some of the basic tenets followed by the Producer Price Index (PPI) program to review fitness of use are listed below.

I.   Price measures are operationally defined
     a.   The PPI model is based on industry revenue functions holding input requirements fixed.
     b.   Constant quality indexes are a function of input requirements

II.   Criteria used to test the assumptions in I.
     a.   Modeling the relationship between the revenue function and the price mechanism used to quantify price change.
     b.   Changes in output quality are related to changes in input requirements relative to a reference period. (Violation of the fixed inputs assumption require a valuation adjustment that approximates the marginal cost difference between the current and reference period input requirements)

The minimum framework in section I and the validating criteria in section II may seem obvious, but appropriate measures of output prices for many service industries are widely recognized as problematic in the price literature.

The following review will explore some of the issues that the PPI has confronted in its assessment of the deflation properties of a price index for the output of the Investment Advice industry. Investment Advice was chosen as a case study partly because a reliable secondary data source was identified and available to empirically test the robustness of the PPI's chosen price mechanism using the criteria of section II-a. The criteria in section II-b, appropriate measures of quality change for Investment Advice output, are more difficult to quantify and test in a brief review and are therefore left for future research.

Conceptualizing the Price Measurement Problem

The Producer Price Index (PPI) program has included Investment Advice (IA) among the industries slated for coverage as part its on-going expansion into the services sector. Mutual fund portfolio management, the focus of this review, is the most important IA service, accounting for almost 70 percent of industry revenues.[1] The Investment Company Institute (ICI), an industry trade association, defines the services provided by mutual fund portfolio management as *making investment decisions that are based on extensive knowledge and research of market conditions and the financial performance of individual companies and specific securities. As economic conditions change, the manager may adjust the mix of a fund's investments to adopt a more aggressive or defensive posture to meet its investment objectives.*[2]

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[1] The U.S. Bureau of Census estimated total IA (SIC 6282) revenues in 1997 were $53 billion. The Investment Company Institute estimated that, in the same year, mutual fund portfolio management revenues were $36.5 billion.

[2] "Guide to Mutual Funds", published by the Investment Company Institute and available on-line at www.ici.org/.

Prior to the publication of an IA price index the following conceptual measurement challenges should be resolved:

- What is the correct unit of measure for investment advice output?

- What is the correct unit of measure for investment advice output prices?

A resolution of these questions is complicated by an industry pricing strategy that ties investment advice revenue to changing portfolio asset values. In other words, exogenous factors such as a volatile and unpredictable equity market have a potentially strong influence on nominal price and revenue change at the establishment and industry level.

The Relationship Between Mutual Funds and Investment Advisors

Mutual funds are owned by shareholders that elect a board of directors to oversee operations and determine a fund's investment goals (described later). The board of directors has the responsibility of contracting for the services of a separate legal entity known as an investment advisor (also called mutual fund manager).[3] Investment advisors are paid by mutual funds to select and manage the securities that make up a fund's portfolio consistent with its stated investment objective. Investment advisors are currently contracted by mutual funds to manage more than $7.0 trillion in portfolio assets. The advisor's fee is usually the largest mutual fund expense and the only one considered in this review.

Mutual Funds Broadly Defined

A mutual fund is an investment company that pools money from shareholders to acquire a diversified portfolio of securities. Mutual fund portfolios are structured to meet stated investment objectives that carry an implied risk profile. Both investment objectives and the methods used to meet objectives vary according to the type of fund. The ICI estimates that there were more than 8,000 mutual funds in the year 2000 that could be categorized into four basic sectors.[4] They are listed by order of importance in table 1.

Table 1

Mutual Fund Type	Assets Under Management*
Stock Fund	$3.962 trillion (57%)
Money Market Fund	$1.845 trillion (26%)
Bond Fund	$0.808 trillion (12%)
Hybrid (stock and bond) Fund	$0.349 trillion (5%)

From ICI membership survey that includes approx. 95% of domestic mutual fund assets

Because four sectors are inadequate measures of fund diversity, the ICI further disaggregates mutual funds into investment objective categories. For instance, stock funds are assigned by ICI to one of 33 categories determined by a portfolio's equity composition. Examples of several ICI investment categories used to classify stock funds are listed below:

- Aggressive Growth Funds: Invest primarily in common stocks of small companies.
- Growth Funds: Invest primarily in common stocks of well-established companies
- Emerging Market Funds: Invest primarily in companies based in developing regions of the world.
- Income-equity Funds: Invest primarily in companies with a consistent record of dividend payments.

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[3] According to the ICI "Virtually every mutual fund is externally managed and thus relies upon outside businesses to provide services to shareholders."

[4] The ICI estimated the total number of Open-end mutual funds in the U.S. at 8,027 and the total number of non-U.S. funds at 45,423. Interestingly, the only country with more mutual funds than the U.S. is Korea with 11,677. In terms of assets, U.S. funds were valued at $7.26 trillion as of Sept. 2000 while non-U.S. funds were valued at $4.88 trillion.

The ICI's categorization of stock funds are still somewhat general and may be further refined to describe those funds that specialize in narrowly defined sectors such as biotech, communications, or semiconductors. The proliferation of investment objectives offered by the mutual fund industry continues to grow to meet the requirements of individual and institutional investors.[5]

A fund's investment objective determines whether the type investment advice services paid for are active or passive. An example of a passively managed fund is one with a portfolio that duplicates the securities underlying a tracking or benchmark index such as the S&P 500. As you might expect, passively managed index funds pay lower investment advice fees than actively managed funds.[6] In both cases, the investment advice fee almost always is stated in terms of basis points or a percentage of portfolio assets:

$$IAFEE=BP*PV$$

Where IAFEE is the investment advice fee, BP is basis points and PV is portfolio value. It is the investment advice fee that is of primary interest to the PPI program.

Some Requirements for a Conceptually Correct Price for IA Services

In determining the conceptually correct price and subsequent measure of price change for IA services, the PPI's pricing framework must be considered. The PPI is based on a fixed-input output price index (FIOPI) model. The FIOPI is designed to compare producer revenues in different time periods, holding inputs and technology constant. In the PPI's Laspeyres formula, input requirements are fixed by the reference period's revenue function. Because the PPI cannot capture the universe of transactions that account for an industry's revenue, individual transactions are sampled. The preferred price in the PPI framework is one that reflects changes in industry revenues holding inputs fixed. Therefore, one of the litmus tests for a conceptually "correct" IA price is that changes in price are proportionate to changes in revenue, restricted by the aforementioned assumptions of the PPI model.[7]

Determining the correct price for IA services also is dependent on the accurate identification and measurement of output. Implicit in this requirement is an understanding of the industry's basic production process. The inputs that flow into the production process and then are transformed to output substantially determine the nature of the service produced and the transaction that the PPI should sample. Many of the inputs provided by investment advisors to maximize output can be thought of as soft inputs, which include analytical skills and market, industry and company knowledge.[8] The relative quantities of soft inputs may change over time as they are used to develop portfolio strategies that best respond to events in the marketplace. As for output, industry experts seem to have a consistent general definition of the output services provided by investment advisors, which they describe as *creating a portfolio that blends different types of stocks and bonds to achieve the maximum return for a given level of risk*.[9] The industry definition suggests that portfolio values may be an appropriate option for measuring relative changes in nominal IA output.

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[5] According to ICI, from 1990 to year-end 2000, the number of mutual funds grew from 2,900 to 8,200.

[6] Large index funds based on the S&P 500 tend to pay portfolio management fees of 0.30 percent or less, while it is not unusual for actively managed funds to pay management fees of 1 percent or more.

[7] The proper adjustment for quality change or even what constitutes investment advice quality change will not be addressed in this review, but quality change in the FIOPI model occurs only when the fixed inputs requirement is violated. Such violations require an adjustment equal to the change in marginal cost plus normal markup associated with the new input requirements. The valuation or identification of changing input requirements present some interesting conceptual challenges for investment advice services that may be explored in a follow-up review.

[8] In this context, maximizing output revenues is equivalent to maximizing the portfolio's yield or rate of return. This view is consistent with the industry pricing practice of charging fees based on a percentage of portfolio assets. If the fee percentage is stable, nominal revenue for IA services change proportionally with a portfolio's rate of return.

[9] www.university.smartmoney.com/Departments/Investing101. Morningstar and the Investment Company Institute offer similar descriptions of mutual fund advice.

Availability of Price Data for IA Services

Mutual fund advisors generally can provide the PPI program with the following types of information:

- The investment advice fee stated in basis points.
- The rate of growth in the value of invested assets over specified time periods.
- The portfolio asset value as of specified points in time.

Different price relatives can be constructed using this information. The most obvious measures are described in the examples below.

Example A:

If a change in the nominal price of IA services is defined as a change in basis points then a price relative $(\mathbf{PR_{BP}})$ can be stated as:[10]

$$\mathbf{PR_{BP}} = \frac{\mathbf{BP_t}}{\mathbf{BP_{t-1}}}$$

$\mathbf{PR_{BP}}$ may not, however, capture the complete transaction price that the industry has established as a rate times a value. Because basis points often are static for extended periods of time, $\mathbf{PR_{BP}}$ is likely to deviate from the "price" implied by a rate times a changing value. A recent GAO report (see references) to Congress stated that, "The fees that the advisor and other service providers deduct from the fund's assets represent the price of the services they perform." The report found that from 1990 to 1998 mutual stock fund assets grew 833 percent and mutual fund advisor revenues grew 801 percent. Since investment advisors explicitly price their services through fees stated as a percent of asset values that change proportionally with asset growth rates, one can argue that $\mathbf{PR_{BP}}$ should be adjusted for growth rates, as illustrated in example B.

Example B.

If a change in the nominal price of IA services is defined as the ratio of basis points adjusted by the growth rate $(\mathbf{GR_t})$ of a reference period portfolio, then a price relative $(\mathbf{PR_{BPR}})$ can be stated as:

$$\mathbf{PR_{BPR}} = \frac{\mathbf{BP_t}}{\mathbf{BP_{t-1}}}(1 + \mathbf{GR_t})$$

If the assumptions of the FIOPI model are not violated, then it appears that example B passes the previously mentioned litmus test, namely, that the relevant transaction price is one that has a proportional relationship to changes in nominal revenue, holding inputs fixed. Alternatively, an explicit valuation of the advisor's fee could incorporate the actual portfolio values in two periods as in example C.

Example C.

If a change in the nominal price of IA services is defined by the ratio of current and reference period prices determined by $\mathbf{BP * PV}$, then a price relative $(\mathbf{PR_{BPV}})$ could be stated as:

$$\mathbf{PR_{BPV}} = \frac{\mathbf{BP_t PV_t}}{\mathbf{BP_{t-1} PV_{t-1}}}$$

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[10] The most basic index of price change is expressed as a percentage that shows how the current price differs from a reference or base period price. The comparison price, $\mathbf{BP_c}$, is divided by the base price, $\mathbf{BP_b}$, to form the ratio $\mathbf{BP_c}/\mathbf{BP_b}$. This ratio is the price relative and a basic index number is obtained by multiplying the price relative by 100. The price change represented by an index number is usually expressed as a percentage change rather than a change in the level of the index as: $[(\text{Index}_c - \text{Index}_b)/\text{Index}_b]*100$.

The asset value of PV_t includes the portfolio growth rate relative to PV_{t-1} as in example B, but does not control for inflows or outflows, which it seems clear should be excluded from measures of price change.[11] Because flows of funds are included, PR_{BPV} has the undesirable property of entangling output change with price change.

Deflation Properties for Nominal Measures of IA Price Change

The price relatives described in examples A, B and C were constructed from the types of data that can be provided to the PPI by the IA industry. Measures of real output will differ depending on which measure of price change is used to deflate nominal revenue in the national accounts. To summarize, three price relatives that can be calculated using information readily available from industry reporters in the PPI's monthly production environment are:

•A ratio of basis points: PR_{BP}

•A ratio of basis points adjusted by growth in the *value of funds invested at the start of the period*: PR_{BPR}

•A ratio of basis points adjusted by portfolio growth including inflows and outflows of funds: PR_{BPV}

To illustrate the deflation properties for each of the price relatives assume that the services provided by the IA industry are limited to a single portfolio. Hypothetical data are presented below to establish a reference point for different measures of IA revenue change.

Reference Period (t-1)	Comparison Period (t)
$PV = \$10,000,000$	$PV = \$11,000,000$
$BP = 25\ (0.0025\%)$	$BP = 25\ (0.0025\%)$
	$GR = 0.06\ (6\%)$
	$NFF = \$400,000$

The reference and comparison period data are used in example D to construct price indexes based on the three measures of price change. Note that BP is unchanged, but the comparison period portfolio value has grown \$1 million due to a growth rate (GR) of 6 percent and a net flow of funds (NFF) equal to \$400,000. Relative to the reference period value, net flow of funds may represent new accounts or additional share purchases from current shareholders or both.[12]

Example D.

$$I_{BP} = \frac{BP_t}{BP_{t-1}} \qquad\qquad I_{BPR} = \frac{BP_t}{BP_{t-1}}(1+GR) \qquad\qquad I_{BPV} = \frac{BP_t PV_t}{BP_{t-1}PV_{t-1}}$$
$$= 1.00 \qquad\qquad\qquad\qquad = 1.06 \qquad\qquad\qquad\qquad\qquad = 1.10$$

Nominal revenue is deflated by an appropriate price index to estimate a measure of real output. Deflation should answer the question, how much of the change in IA revenue, $BP_t PV_t - BP_{t-1}PV_{t-1}$, is due to price change and how much, if any, is due to output (real) change? The deflation properties for each of the price indexes are compared in example E.

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[11] Relative to the reference period portfolio, flow of funds represent more or less investment advice output (new input requirements) depending on whether the flows are positive or negative.

[12] Shareholder redemptions also influence the net flow of funds value.

Example E.

Reference Period IA Revenue

$$BP_{t-1}PV_{t-1} = \$10,000,000*0.0025 = \$25,000$$

Comparison Period IA Revenue

$$BP_t PV_t = \$11,000,000*0.0025 = \$27,500$$

Deflator	C$/Deflator)	=	DC$
I_{BP} = 1.00	27,500/1.00	=	27,500
I_{BPR} = 1.06	27,500/1.06	=	26,000
I_{BPV} = 1.10	27,500/1.10	=	25,000

Real Change in Revenue

I_{BP} : DC$-R$=2,500

I_{BPR} : DC$-R$=1,000

I_{BPV} : DC$-R$=0

C$**=nominal comparison period revenue; **DC$=deflated comparison period revenue;

R$=reference period revenue

Because BP is unchanged between t-1 and t, the I_{BP} deflator treats any change in IA revenue as change in output. Conversely, I_{BPV} treats any change in IA revenue as price change (inflation). Only I_{BPR} isolates output change, defined by flow of funds, from price change. This output change is measured in the example as a $1,000 increase in revenue ($26,000 - $25,000) which equals the $400,000 flow of funds * 25 basis points. There may be other price deflators that could isolate changes in investment advice output but the range of deflators included in example E are constructed only from data that are directly available to the PPI program from mutual fund investment advisors.

An Empirical View

The choice of I_{BPR} as the "best" deflator in the previous section was based on the premise that, at a minimum, the real difference between investment advice revenues in two periods should be equal to the change in revenue due to net flows. However, a more rigorous test of the deflation properties of I_{BPR} is possible. The test is based on two data sources. The first is an unpublished price index from a PPI sample of IA fees for Money Market Funds, Bond Funds, Stock Funds and Hybrid Funds. To simplify, only IA fees for stock funds are considered.[13] The second data source is from an ICI report that tracks more than 4,300 portfolio values on a monthly basis that account for more than 90 percent of the assets of U.S. based mutual stock funds. The ICI report separates the dollar value of net flows (new sales, redemptions and net exchanges), which can be used to estimate changes in the value of IA output as described above. Because the PPI's coverage of mutual stock fund advisors is based on a relatively small sample, it will be interesting to see if the deflation properties of the PPI yield a measure of real revenue that approximates the measure implied by the ICI data.[14] Note that any changes in the PPI's stock fund advice index due to the BP pricing component must be excluded from comparisons

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[13] Limiting the test to stock fund advisors is in some ways more challenging because their revenues will tend to be more volatile due to the relative volatility of stock fund asset values.

[14] The PPI sample includes 72 mutual stock fund advisors.

with ICI growth rates (recall that $I_{BPR} = \dfrac{BP_t}{BP_{t-1}}(1+GR)$).[15] The comparison period extends over a 9-month period that begins on Jul-00, which corresponds to the PPI's base date for the IA index.

Table 2: ICI Growth Rate for Mutual Stock Fund Portfolio Assets

A Reference Period Mutual Stock Fund Assets July-00 (billions)	B Comparison Period Mutual Stock Fund Assets Apr-01 Including Net Flows (billions)	C Comparison Period Mutual Stock Fund Net Flows Jul-00 to Apr-01 (billions)
4244.1	3718.6	115.4

From "Mutual Fund Facts and Figures, Monthly Assets, Flows and Sales", www.ici.org/facts_figures/current_statistics

Table 2 presents data from ICI that measures the growth rate of essentially the entire value of mutual stock fund assets from Jul-00 to Apr-01, excluding net flows. This net growth rate can be estimated as follows:

$$\textbf{(B-C)/A or (3718.6-115.4)/4244.1= 0.84899}$$

ICI growth rates indicate that mutual stock fund assets fell about 15 percent during a particularly volatile period that saw general declines in most equity markets. The ICI data does not directly measure the change in investment advice revenue or prices during this period, but if BP is unchanged, then an imputed investment advice price index for stock funds will be proportionally equivalent to the change in stock fund asset growth reported by ICI. Table 3 presents aggregate PPI data used to construct the asset growth rate component of its stock fund advisors index, excluding flow of funds.

Table 3: PPI Growth Rate for Mutual Stock Fund Portfolio Assets

A Reference Period Mutual Stock Fund Assets July-00 (billions)	B Comparison Period Mutual Stock Fund Assets Apr-01 Excludes Net Flows (billions)
979.3	766.1

Using the same ratio as in table 2, the net growth rate of stock fund assets sampled by the PPI can be stated as:

$$\textbf{B/A or 766.1/979.3=0.78229}.$$

The PPI measure indicates that stock fund asset values fell about 22 percent compared to the ICI measure of 15 percent.[16] While both the ICI and PPI exhibit significant declines, the PPI measure declines more rapidly. It is difficult to quantify the factors that could explain the difference in PPI and ICI growth rates over a short time span and across a universe that includes funds with literally dozens of different investment objectives (possible differences in product mix due to the PPI's smaller sample). The ICI surveyed over 90 percent of mutual stock funds with reference period asset values of more than $4 trillion, while the PPI sample included funds with reference period assets of only $980 billion. However, another and perhaps more important factor is that the ICI flow of funds does not control for the entry of new funds. In the reference period the ICI survey included 4,134 stock funds, but in the comparison period the number of funds had grown to 4,542. The 10 percent growth in funds,

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[15] The PPI requested each mutual fund advisor to report changes in BP and calculate the growth rate for a reference period portfolio excluding net flows. The growth rate calculation is similar to how mutual funds report performance measures in their prospectus.

[16] The PPI for stock fund advisors actually declined to 0.75998 during this time period due to a small drop in the BP component of the pricing formula. The average weighted BP in the reference period was 50.8 but in the comparison period BP dropped to 49.4.

which represent new entrants relative to the reference period, at least partly contributes to the lower negative growth rate of the ICI relative to the PPI.

Summary

The PPI strategy for constructing price indexes for mutual fund advisors explicitly recognizes the industry practice of pricing services based on a rate times a portfolio value. One of the benefits of this strategy is that nominal fluctuations in equity markets are not transmitted to the national accounts as changes in real output.[17] While a certain amount of ambiguity remains, which should be expected when comparisons are made between different data sets, the ICI and PPI data are so close, it appears that the PPI has been able to effectively operationalize the industry pricing mechanism of

$$\mathbf{I_{BPR}} = \frac{\mathbf{BP_t}}{\mathbf{BP_{t-1}}}\left(\mathbf{1+GR}\right).$$ In so doing, the PPI has also met the industry revenue-pricing mechanism fitness of use criteria described in the opening section. However, $\mathbf{I_{BPR}}$ does not directly address the conceptually difficult issue of identifying and measuring quality change in IA output. Quality change measures for investment advice will have to at least consider the implications of the efficient markets theory or even more specifically the concept of quality change in the context of Malkiel's (1999) updated release of "Random Walk Down Wall Street". A search for the most appropriate methodology that quantifies investment advice quality change in a FIOPI framework may be explored in a follow-up paper.

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[17] National income accountants would likely consider the transmittal of the often volatile swings in equity markets to changes in real output as inappropriate. A deflator based on $\mathbf{I_{BPR}}$ removes this volatility, while still allowing net flows to enter the national accounts as changes in real output.

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