PCE and CPI Inflation Differentials: Converting Inflation Forecasts

By Craig S. Hakkio

The Federal Reserve recently announced it will begin to release quarterly inflation forecasts based on the Personal Consumption Expenditure Price Index. As Chairman Bernanke said, the PCE index is generally thought to be "the single most comprehensive and theoretically compelling measure of consumer prices." At the same time, Bernanke said that "no single measure of inflation is perfect, and the Committee will continue to monitor a range of measures when forming its view about inflation prospects."

Another inflation measure the FOMC will continue to watch closely is the Consumer Price Index. The CPI is better known to the public than the PCE price index, and many contracts and government programs are indexed to it. Both the CPI and the PCE index are important gauges of consumer inflation for policymakers and analysts concerned with price stability.

The public and private sectors alike will want to be able to convert CPI inflation forecasts released by various organizations to PCE inflation forecasts, and vice versa. If the overall and core differentials between PCE and CPI inflation never changed, converting from one measure to

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the other would be as simple as converting temperatures from Celsius into Fahrenheit. But the inflation differentials can change significantly over time. For example, the overall inflation differential for the five years ending in mid-2002 fell from 0.6 percentage point to half that level over the next five years. At the same time, the core inflation differential fell even more sharply, from 0.74 to 0.05 percentage point.

To convert between CPI and PCE inflation projections, economists must construct statistical models to explain and predict the inflation differentials (overall and core), recognizing that the differentials may change over time. Based on the results in this article, a simple conversion factor tells us that core CPI inflation is about 0.3 percentage point higher than core PCE inflation. Using this core inflation differential, it is easy to convert the midpoint of the FOMC's central tendency for 2008 core PCE inflation of 1.8 percent to a core CPI inflation projection of 2.1 percent. Analogously, overall CPI inflation is about 0.4 percentage point higher than overall PCE inflation.

Such conversion factors should be reassessed periodically as economic conditions change and new inflation data become available. This article estimates a set of models that analysts can use to make such conversions. The first section examines the empirical differences between the overall and core inflation measures and shows why these differences matter. The second section shows that no single explanation can account for how the inflation differentials change over time. The third section estimates a set of statistical models that can be used to translate between CPI and PCE inflation forecasts. The fourth section discusses the results of the models.

I. OVERALL AND CORE INFLATION DIFFERENTIALS

The consumer price index and personal consumption expenditure price index are both designed to capture changes in consumer prices. While similar, the two measures have important conceptual differences. One effect of the differences is that CPI inflation tends to be greater than PCE inflation. Another effect is that the inflation differentials between the two measures vary over time.[1]

A number of fundamental differences distinguish the two inflation rates. Produced by the Bureau of Labor Statistics (BLS), the CPI is designed to measure the price of out-of-pocket spending of urban con-

sumers. In contrast, the PCE price index is produced by the Bureau of Economic Analysis (BEA) and measures the prices of goods and services purchased by persons, individuals, and nonprofit institutions in the National Income and Product Accounts—so-called personal consumption expenditures (PCE). In addition to spending by households, PCE measures spending on behalf of households. For example, PCE spending on medical care includes both direct purchases of medical care by households and purchases on behalf of households by employers or government programs. PCE also includes estimated spending on some goods and services that do not have market prices, such as free financial services and employer-funded medical care and insurance programs.

Given such differences between the CPI and the PCE price index, it should not be surprising that they give different readings on consumer price inflation. Charts 1 and 2 offer a long-term perspective of overall and core inflation rates, respectively. From 1985 to mid-2007, the two rates generally follow each other, but not exactly. While the inflation rates are generally higher for the CPI than for the PCE index, the differentials for both overall and core inflation change over time.

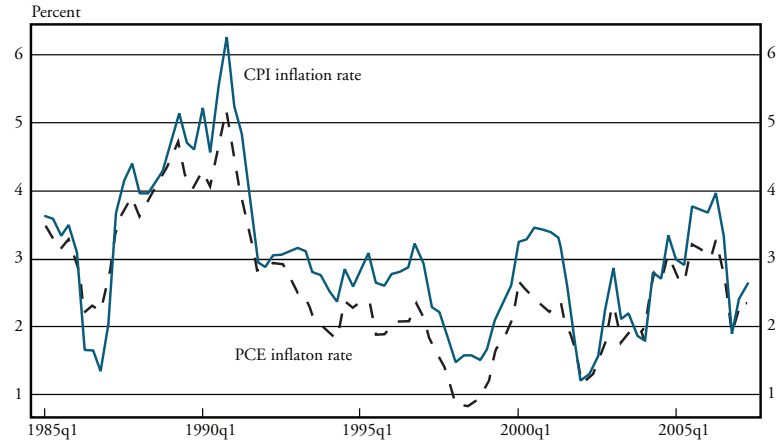
The overall and core inflation differentials fluctuate significantly around a moving trend. Chart 3 (panel A) plots the changes in the overall inflation differential since 1985, along with a five-year moving average of the quarter-over-quarter differentials. Since 1985, the overall inflation differential has ranged from 2.0 to -2.2 percentage points. Panel B plots the changes in the core differential and its five-year moving average of quarter-over-quarter differentials. Since 1985, the core inflation differential has ranged from 2.0 to -0.7 percentage points.

The five-year moving average is a simple way to illustrate the trend (or underlying) inflation differential by abstracting from the short-run movements in the differential. The chart clearly shows the average differential changing over time. For example, the average overall differential ranges from -0.2 to 0.8 percentage point, while the core differential ranges from 0.0 to 0.8 percentage point. Since 2002, the average overall differential has been 0.34 percentage point, while the average core differential has been 0.05 percentage point.

Just as the differentials for actual and moving-average inflation fluctuate, so do forecasts of the differentials. Two organizations report forecasts for both CPI and PCE inflation: the Survey of Professional

Chart 1

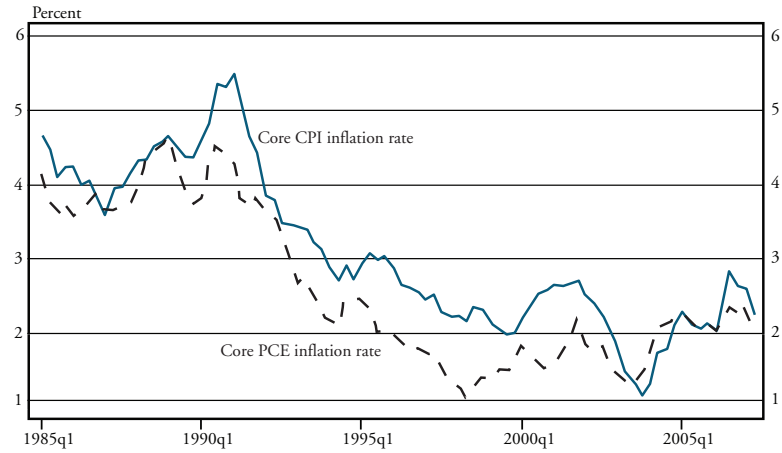
CPI AND PCE INFLATION RATES



Sources: Bureau of Labor Statistics (CPI), Bureau of Economic Analysis (PCE)

Chart 2

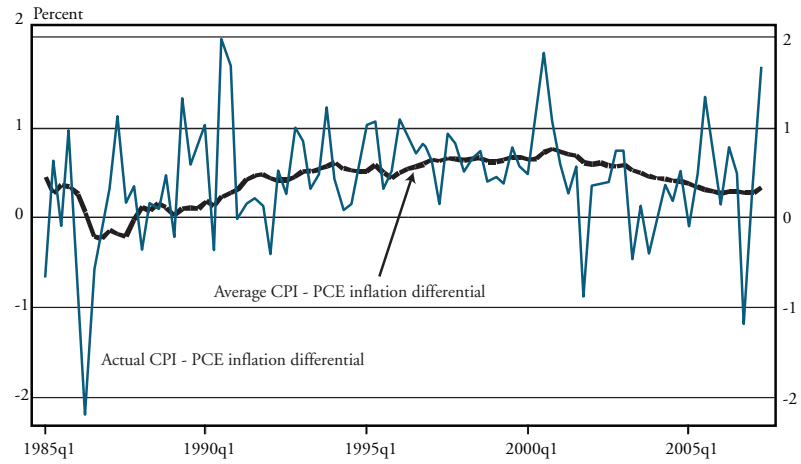
CORE CPI AND CORE PCE INFLATION RATES



Sources: Bureau of Labor Statistics (CPI), Bureau of Economic Analysis (PCE)

Chart 3A

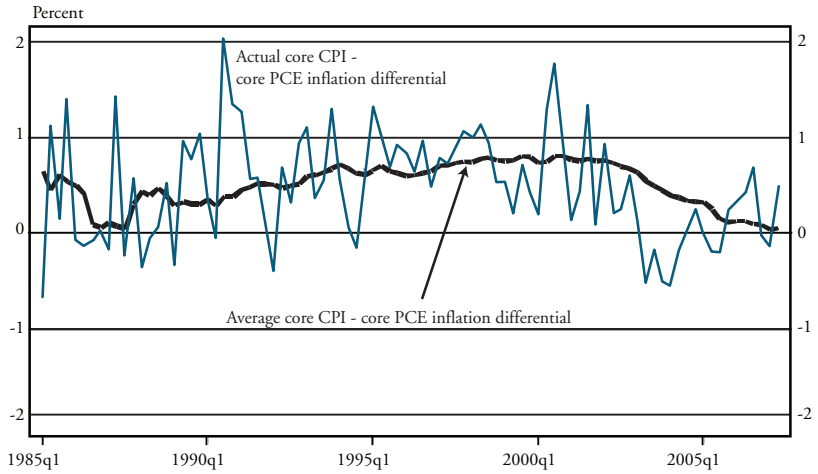
CPI-PCE INFLATION DIFFERENTIAL



Sources: Bureau of Labor Statistics (CPI), Bureau of Economic Analysis (PCE), author's calculations

Chart 3B

CORE CPI-CORE PCE INFLATION DIFFERENTIAL



Sources: Bureau of Labor Statistics (CPI), Bureau of Economic Analysis (PCE), author's calculations

Forecasters (SPF) and the Congressional Budget Office (CBO).[2] Chart 4 shows the differentials for these inflation forecasts for various time periods. Not only do the differentials for the forecasts change over time, but, more important, the differentials for the forecasts by the CBO and the SPF can be very different. For example, the differential for the SPF forecasts for overall CPI and PCE inflation in 2009 is 0.2 percentage point, while the differential for the CBO forecasts is 0.4 percentage point. The differentials for forecasts of core CPI-core PCE inflation in 2009 are also very different: 0.3 percentage point for the SPF and 0.5 percentage point for the CBO.

Given the differences in the overall and core inflation differentials, it is clearly difficult to convert from one measure of inflation to the other. Before describing a procedure for making the conversion, though, a closer look at the differences between the measures is required.

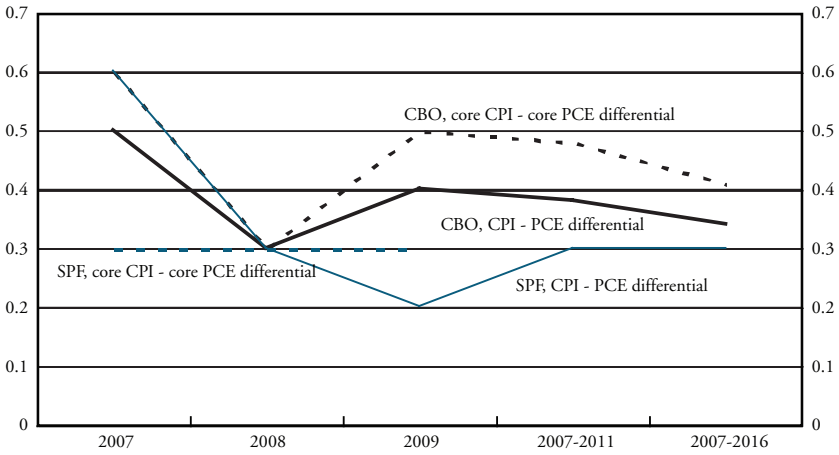
II. CHALLENGES TO CONVERTING INFLATION RATES

Determining how to convert between CPI and PCE inflation rates first requires examining the empirical evidence to establish why calculations of CPI and PCE inflation differ in the first place. The key differences between the two measures stem from four basic effects: formula, weight, scope, and other factors.[3]

The *formula effect* relates to the different ways the price indexes are calculated. Put simply, the CPI uses a fixed-weight average of prices for the individual components, with the weights updated every two years. In contrast, the PCE index's weights change every quarter.[4] Many analysts prefer the PCE price index to the CPI because its weights are updated more frequently. The more frequent updates, they argue, better account for substitution between different components of the index as the relative prices for those components change.

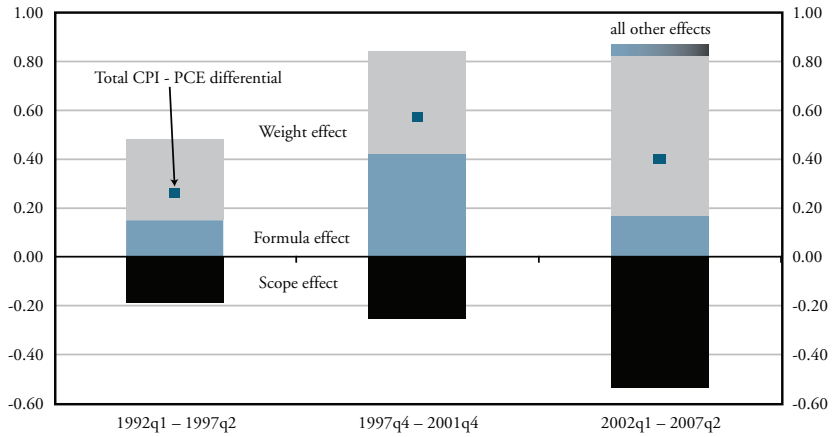
The magnitude of the formula effect changes over time. In Chart 5, each bar represents a decomposition of the inflation differential for one of three different sample periods. The square in the middle of each bar shows the actual CPI-PCE overall inflation differential. For example, the average differential from 2002 to mid-2007 was 0.4 percentage point. The size of the formula effect is indicated by the blue portion of each bar. For example, the formula effect was 0.17 percentage point during the last period, amounting to almost half of the overall

Chart 4
INFLATION DIFFERENTIAL, CBO AND SPF



Sources: Bureau of Labor Statistics (CPI), Bureau of Economic Analysis (PCE), Congressional Budget Office, Survey of Professional Forecasters, author's calculations

Chart 5
DECOMPOSING THE CPI-PCE INFLATION DIFFERENTIAL



Notes: McCully, Moyer, and Stewart, Tables 1, 2, and 5. Results for 1992q1 – 1997q2 and 1997q4 – 2001q4 are converted to average annual rates. The results for the first two sample periods combine the price and weight effects while the results for the last sample period put the price effects into "other effects." However, the authors (footnote 14, page 11) state that the "the price effect is small."

Sources: McCully, Moyer, and Stewart; author's calculations

inflation differential. As the chart shows, the size of the formula effect during the 1985-2007 period ranged from as large as 0.4 percentage point (1997q4-2001q4) to as small as 0.16 percentage point (1992q1-1997q2).

The *weight effect* arises because the weight applied to a CPI component may differ from the weight applied to the same component in the PCE, for two reasons. First, CPI weights rely on household surveys, while PCE weights rely on business surveys. Second, and more important, the weights reflect how much consumers spend on each component. Since the CPI reflects out-of-pocket spending by urban households, while the PCE reflects spending by or *on behalf of* households and operating expenses of nonprofit institutions, the weights for any specific component may differ significantly.

Housing provides a striking example of how weights can differ.[5] In the PCE price index, the weight for housing is about 15 percent, less than half the 32 percent weight for housing in the CPI. In addition to reflecting the use of different surveys to measure total expenditures, the different weights reflect the differing measurement concepts used by the two indexes. In 2005, housing prices rose 2.6 percent (fourth quarter over fourth quarter) according to the PCE index and 2.5 percent according to the CPI. Thus, the 17-point difference in the housing weights accounted for about 0.4 percentage point of the overall 2005 inflation differential.[6]

Chart 5 also shows the changes in the size of the weight effect (the grey shaded area of each bar). In the last period, the weight effect accounted for 0.66 percentage point, more than the entire overall inflation differential. (This reflects the fact that the scope effect, which is discussed next, subtracts from the formula and weight effects.) As with the formula effect, the size of the weight effect from 1985 to mid-2007 ranged from 0.32 to 0.66 percentage point.

The *scope effect* reflects the fact that certain components in the CPI are not included in the PCE price index, and vice versa. For example, CPI medical care is limited to out-of-pocket expenses by consumers, while PCE medical care includes direct purchases by consumers and spending *on behalf of* consumers, such as employer-provided health insurance plans, Medicare, and Medicaid.

The impact of medical care in explaining the overall inflation differential reflects a weight effect as well as a scope effect. In December 2005, the weight of medical care was 6.2 percent in the CPI and 20.5 percent in the PCE index. Part of the difference reflects a weight effect. For the parts of medical care common to both indexes, the medical care weight is 5.9 percent in the PCE and 2.6 percent in the CPI. However, a larger effect comes from the fact that, in addition to direct consumer spending, PCE medical care also includes third-party payments, which account for most of medical care. The medical care components that are only in the CPI have a weight of 3.6 percent, while the medical care components only in the PCE have a weight of 14.6 percent.

As it turns out, the scope effect from medical care inflation operates in the opposite direction. From 2002 to mid-2007, CPI inflation averaged 2.9 percent and PCE inflation averaged 2.5 percent. By itself, the much larger weight on medical care in the PCE would tend to cause PCE inflation to be larger than CPI inflation, not smaller. In fact, the net scope effect from medical care is -0.22 percentage point.[7]

Chart 5 also shows changes in the scope effect (the black area of the bars). Notice that the scope effect is negative, lying below the zero axis. As with the scope effect of medical care, the scope effect by itself would suggest that PCE inflation would be greater than CPI inflation. For example, the scope effect in the last period was -0.53 percentage point. As with the formula and weight effects, the size of the scope effect from 1985 to mid-2007 varied significantly, from -0.18 percentage point to -0.53 percentage point.

Finally, *other factors* include remaining effects that must be taken into account when comparing the PCE index and the CPI. These effects include seasonal-adjustment differences, price differences, and residual differences

The many conceptual and empirical differences between CPI and PCE inflation help explain why the inflation differential between the two measures exists and why the differential changes over time.[8] The inflation differential can be decomposed into four effects. It turns out that the size of the effects changes over three different historical time periods. In addition, the four effects are applied to over 300 components of the price indexes, making the decomposition computationally burdensome and time consuming. As a result, decomposition is

unlikely to help analysts forecast future differentials as doing so would require forecasts for each of the scope, formula, and weight effects.

III. CONVERTING BETWEEN CPI AND PCE INFLATION FORECASTS

Converting between CPI and PCE inflation forecasts is a challenge for several reasons. First, lacking an analytical explanation or a simple statistical regularity, a simple equation cannot be used to make the conversion. Second, with the key factors used to decompose the historical differential changing over time, any equation used to explain—and then forecast—the inflation differential is likely to be unstable. Third, as the structure of the economy changes over time, or as the size and nature of the shocks hitting the economy change, the underlying inflation differentials will change in unknown ways at unknown times.

To address these challenges, it is necessary to estimate multiple models to explain and then forecast the CPI-PCE and core CPI-core PCE inflation differentials. This section briefly describes 14 forecasts of the overall inflation differential based on statistical models.[9,10] Analogous forecasts were generated for the core CPI-core PCE inflation differential.

The models used in this analysis are conventional, widely used, time-series models that often help forecast economic variables. In most cases, the models assume that the inflation differential depends on lagged values of the inflation differential. In addition, as suggested earlier, it is likely that the model parameters used to explain and then forecast the inflation differential change over time. So, the estimated models allow the parameters to change in different ways. One way to allow the parameters to change over time is to simply estimate the model over different sample periods. Another way is to explicitly model the changes in the parameters.

Forecasts 1, 2, and 3 are simply the average inflation differential over three different sample periods: 1995q1-2007q2, 2000q1-2007q2, and 2002q3-2007q2. Estimating the model over shorter and shorter sample periods may be helpful because it reduces the likelihood of parameter change. But even though a model estimated over a longer sample period is misspecified if the parameters change, the use of a longer sample period may be helpful because it may reduce the variance of the parameter estimates.[11] Thus, there is a case for using several alternative sample

periods. The average inflation differential used in Chart 3 (panels A and B) is an example of this model. The model forecasts simply equal the average over the sample period. Thus, it is assumed that fluctuations around the average are random and can be ignored in forecasting.

Forecasts 4, 5, and 6 are based on conventional autoregressive (AR) models estimated over the same three sample periods. In an AR model, the inflation differential depends on a constant and lags of the inflation differential. The lag length and parameters are allowed to change over the three sample periods. By allowing the current inflation differential to depend on past values of the inflation differential, the forecasts of the future inflation differential will tend to vary over time but revert to the mean. That is, if the current inflation differential is large, then it is likely that future deviations will be smaller, so that the forecast differential approaches a long-run differential over time. While the models allow for this variation over time, the forecast values generally converge to their long-run equilibrium values within one to two years.

Forecasts 7, 8, and 9 are produced with vector autoregressive (VAR) models for CPI and PCE inflation estimated over the three sample periods. In a VAR model, *each* inflation rate is separately regressed against lagged values of *both* inflation rates. This is the only model that forecasts CPI and PCE inflation separately; all the other models forecast the inflation differentials directly. The VAR model forecasts the inflation differential by calculating the difference between the CPI and PCE inflation forecasts.[12] As with the AR model, the lag length and parameters are allowed to change over the sample periods.

Forecast 10 relies on the approach that recent data are more informative about current parameters than data from the distant past. While using shorter sample periods is one method to account for changes in model parameters, it is extreme in that it gives equal weight to all observations within the sample period and zero weight to observations outside the sample period. This model is estimated over a single sample period using "discounted least squares," in which all data are used but later observations get more weight than earlier observations.

Forecasts 11 and 12 are produced by exponential smoothing, a statistical technique that allows the *underlying* inflation differential to change over time. This is an easily applied approach to allowing an unobserved mean differential to change over time. With exponential

smoothing, today's mean equals last quarter's mean plus a correction for the difference between today's actual inflation differential and last quarter's (unobserved) mean differential. It is easy to forecast future mean differentials.[13] Exponential smoothing requires one parameter. Forecast 11 is produced with the parameter estimated over the period from the first quarter of 1985 to the second quarter of 2007, while forecast 12 is produced by setting the parameter to a specific predetermined value[14]

Forecast 13 is produced by a technique that explicitly models the changes in the parameters of the statistical model. It does so by estimating a regime-switching model for the inflation differential. This approach assumes that two regimes characterize the inflation differential. The model allows the inflation differential to switch between a high mean and a low mean. The model also allows the variance of the inflation differential to switch between a high variance and a low variance.[15]

Forecast 14 is derived from a different model of parameter changes. In contrast to the regime-switching model, this extension allows the parameters of the model to change each quarter. As with forecasts 4-6, the underlying model is autoregressive, in that the inflation differential depends on one lagged inflation differential. Unlike forecasts 4-6, though, the parameters are assumed to follow a random walk.

IV. THE INFLATION DIFFERENTIAL FORECASTS

Using multiple models to estimate the inflation differential is the statistical equivalent of the old adage, "don't put all your eggs in one basket"—in other words, don't rely on one model. But when converting from one measure of inflation to another, one wants a single inflation differential, not 14 differentials. Averaging the results of all of the models not only yields a single differential, but it also prevents one model from dominating the results.

Once a single estimate of the inflation differential is obtained, it is relatively easy to convert between PCE and CPI inflation projections. For example, adding an overall inflation differential to an overall PCE inflation projection gives the corresponding overall CPI inflation projection. Similarly, subtracting a core inflation differential from a core CPI inflation projection gives the corresponding core PCE inflation projection. By allowing the models' forecast horizon to extend from

one to ten years, it is possible to convert a near-term PCE inflation projection into a near-term CPI inflation projection, or to convert a ten-year CPI inflation projection into a ten-year PCE inflation projection.

This section summarizes the inflation differential forecasts for 2007-17. For the overall inflation differential, each of the 14 forecasts gets a weight of 7 percent, or one-fourteenth of the total forecast, to produce the average projected inflation differential. In addition, two measures of the dispersion of results are reported: the *range* of results and the *central tendency*. The range reports the highest and lowest forecasts of the 14 differentials estimated. The central tendency is simply the range after dropping the three highest and three lowest forecasts. Analogous summary statistics are presented for the core inflation differential.[16]

The average, central tendency, and range of the ten-year forecasts are shown in Charts 6 and 7.[17] The average is plotted on the charts with a large square, the central tendency is shown with a line, and the range (minimum and maximum) is plotted with an asterisk (*).

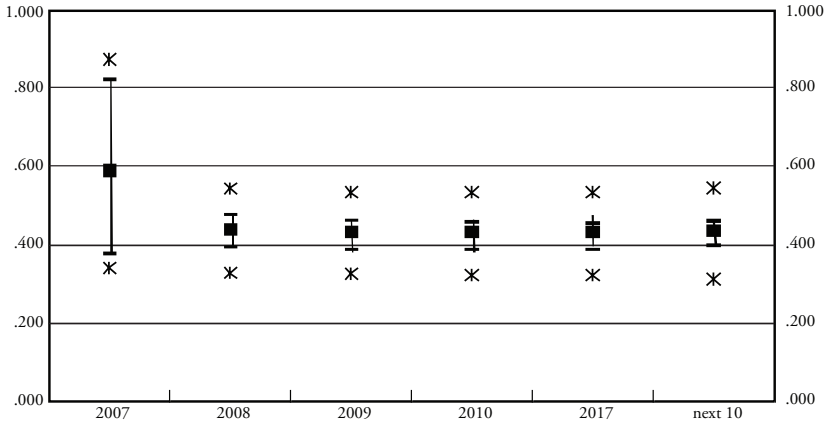
The forecast for the *overall inflation differential* is close to 0.4 percentage point. (The 2007 average includes two quarters of actual data, so is closer to 0.6 percentage point.) In addition, the central tendency is fairly narrow, generally about 0.4-0.5 percentage point.

The results for the *core inflation differential* are somewhat less precise. The average is generally close to 0.25 percentage point. However, unlike the overall inflation differential, the central tendency is much wider.[18] For 2008-17, the central tendency is between 0.1 and 0.4 percentage point.

An example may help in illustrating how these results can actually be applied. The FOMC recently announced a central tendency for overall and core PCE inflation for 2007-10. The central tendency forecast for core PCE inflation in 2008 is 1.7-1.9 percent. The results in this analysis can be used to convert this forecast into a comparable core CPI inflation forecast for 2008. Adding the average forecast for the core inflation differential in 2008 (0.242 percentage point) to the midpoint of the FOMC's central tendency for core PCE inflation (1.8 percent) yields a core CPI inflation projection of 2.0 percent. Using the central tendency for the inflation differential forecasts reported in this analysis, the comparable CPI inflation projection would be 1.9–2.2 percent.

Chart 6

TOTAL INFLATION DIFFERENTIAL FORECASTS

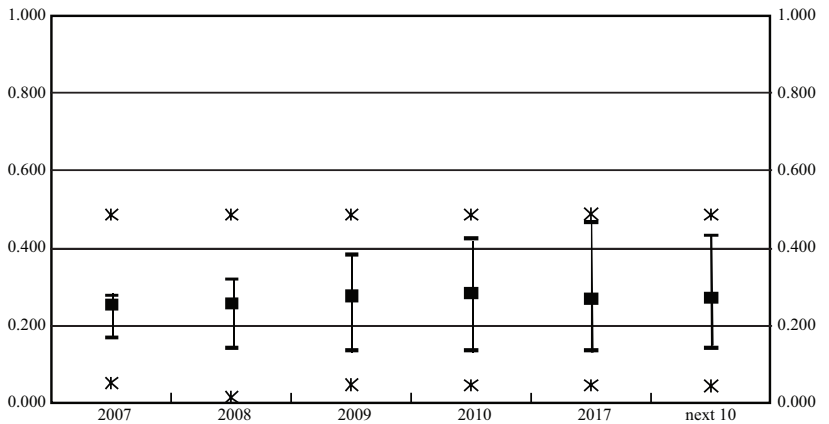


Addendum: The CBO forecast for 2007-"next 10" is 0.5, 0.3, 0.4, 0.4, 0.3, and 0.32. The SPF forecast for 2007-09 and "next 10" is 0.6, 0.3, 0.2, and 0.3.

Source: Author's calculations

Chart 7

CORE INFLATION DIFFERENTIAL FORECASTS



Addendum: The CBO inflation differential forecast for 2007-"next 10" is 0.6, 0.3, 0.5, 0.6, 0.3, and 0.38. The SPF forecast for 2007-09 is 0.3, 0.3, and 0.3.

Source: Author's calculations

V. SUMMARY

CPI inflation and PCE inflation are the two most common measures of consumer price inflation. However, conceptual differences in the two measures lead to empirical differences. While they generally track each other over time, CPI inflation tends to be higher than PCE inflation. In addition, the differential changes over time. Not only does the actual differential change, but so do the underlying trends in the differential. These changes likely reflect changes in the economy's underlying structure, along with changes in the nature of the shocks to the economy.

For these reasons, it is likely that any model that might be used to convert between the two inflation rates will exhibit some instability. Since the nature and timing of the instability cannot be known in advance, 14 different models are used to forecast the inflation differential. Then, the average across the 14 models is used as "the" inflation differential. Once a CPI-PCE inflation differential is determined, adding the projected differential to a PCE inflation projection gives a comparable CPI inflation projection, or subtracting the differential from a CPI inflation projection gives a comparable PCE inflation projection. The range and central tendency from the 14 model forecasts provides some evidence about the possible values for the differential forecast.

According to the analysis in this article, on average the overall CPI inflation forecast is 0.4 percentage point greater than the PCE inflation forecast, and the core CPI inflation forecast is 0.25 percentage point greater than the core PCE inflation forecast. Recognizing the uncertainty of any forecast, and using the central tendency as a measure of dispersion, the overall CPI inflation forecast is generally between 0.4 and 0.5 percentage point of the overall PCE inflation forecast. Analogously, the core CPI inflation forecast is generally between 0.1 and 0.4 percentage point of the core PCE inflation forecast.

The results in this article may change over time as new models are added or new data become available. Any new model can be easily added to the set of models used in this analysis. Moreover, as additional quarterly data become available, the models could be re-estimated and used to make updated forecasts of the overall and core inflation differentials. While the current differentials are unlikely to change significantly with the addition of one more piece of data, the specific results may change somewhat.

ENDNOTES

[1]See Clark (1999) for an in-depth discussion of the differences between the CPI and PCE price indexes.

[2]Both sets of forecasts are briefly described in the ***Model Specifications***, which appears with this article on the bank's website.

[3]See Clark (1999) and McCully, Moyer, and Stewart (MMS, 2007). Much of the material in this section draws on MMS, who provide a detailed accounting of how each factor explains the quarterly differences between 2002q1 and 2007q2.

[4]Technically, the CPI uses a fixed-weight Laspeyres price index while the PCE index uses a Fisher-Ideal chain-type price index.

[5]"Rent of shelter" is the component of the CPI that is comparable to "housing" in the PCE. In the CPI, "rent of shelter" includes owners' equivalent rent of primary residence (73.5 percent); rent of primary residence (18.3 percent); housing at school, excluding board (0.5 percent); and other lodging away from home, including hotels and motels (7.7 percent). See appendix Table A, MMS.

[6]The weight effect for a particular component is the difference in the weight times the inflation rate of the specific component. In this case, the weight effect = 0.17*(2.5 percent) = 0.44 percentage point. In addition, see Table 3 of MMS.

[7]Table 4 (MMS, page 23) reports that the scope effect (PCE items out-of-scope of the CPI) is 0.37 percentage point and the scope effect (CPI items out-of-scope of the PCE) is 0.16 percentage point. Since the two terms enter with different signs, the net effect is 0.22 percentage point.

[8]McCully, Moyer, and Stewart (2007) provide a complete historical decomposition of the inflation differential. As MMS state (page 8): "It is important to keep in mind that there is no 'best' set of effects. Likewise, there is no best way of estimating a particular effect and no best order in which to estimate the separate effects. These choices require weighing a variety of factors, including accuracy, transparency, and computational simplicity."

[9]More detailed descriptions of the models and actual model estimations are included in the ***Model Specifications***.

[10]Two other forecasts were considered, but eventually not included in the analysis. As noted earlier, the CBO and SPF provide forecasts for CPI and PCE inflation. Unfortunately, the CBO does not provide the forecasts on a regular basis, and the SPF does not provide forecasts for all of the years used in this analysis. However, since they provide useful outside information that could be used for converting between CPI and PCE inflation forecasts, the results are reported in the ***Model Specifications***.

[11]Clark and McCracken (2005) show that using a longer sample period (and ignoring potential structural change) may lead to more accurate forecasts.

[12]Specifically, a forecast of CPI inflation given an outside projection of PCE inflation is given by $F_t\pi^c_{t+k} = P_t\pi^P_{t+k} + (F^{VAR}_{t+k}\pi^c_{t+k} - F^{VAR}_{t+k}\pi^P_{t+k})$, where F^{VAR} denotes the VAR forecast.

[13]Exponential smoothing has been used by Cogley (2002) to estimate an unobserved measure of core inflation.

[14]Exponential smoothing is discussed in the ***Model Specifications***.

[15]In addition, the two regimes for the mean and the two regimes for the variance are not constrained to coincide.

[16]The results for all 14 forecasts of the overall inflation differential and all 14 forecasts of the core inflation differential are presented in the ***Model Specifications***. It is important to note that the forecasts estimated by models in this analysis are not guaranteed to be completely accurate. In addition, future research may develop even better forecasting models. It is also worth noting that although the term "central tendency" is used to summarize FOMC forecasts, the central tendencies in this article are not official projections by the Federal Reserve System or the Federal Reserve Bank of Kansas City.

[17]Specific numerical forecasts are given in appendix Tables A1 and A2 of the ***Model Specifications***.

[18]The reason for the wider central tendency and range of forecasts is discussed in the ***Model Specifications***.

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