# *A Better (Graphical) Benchmark for Monetary Policy? And a Simple Way to Integrate the Dual Goal Objective?*

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***Abstract***

*The stable price goal of central banks is one of the most watched globally. This benchmark for the price index for personal consumption expenditures (PCEPI), currently just "2% p.a.", is "under specified" and allows for a mismatch between what the Federal Reserve (Fed) believes its mandate to be and the impact on markets and citizens they are meant to serve. Instead, the Fed could take a page from the effective benchmarking practices of institutional investors (and learn from their mistakes) to set a simpler and more transparent benchmark that allows for the achievement of longer-term goals (and less examination of "collective dot plots") and better governance at multiple levels. We propose an alternative and more realistic benchmark, which allows for better tracking of not only current inflation experience but also over the "longer run", an unspecified time period in current Fed announcements, publications, press conferences, and minutes, AND of the dual mandate.*

*For one, the current "2% goal" is missing a volatility component (say a +1 or 2 standard deviation band), and for another "longer term" is not specified allowing it to be vague, possibly intentionally, but that does not serve the market and citizens any good. Most importantly, the 2% goal ignores the pernicious effect of compounding – a trivial insight but ignored in the goal statements and press conferences completely, and potentially policy. We show graphically how a new benchmark could be created that achieves a better potential outcome with greater specificity, and a visual representation of the objectives within the benchmark volatility cone, that even non-technical citizens can track. We conclude with a discussion of the application of this idea to other individual goals like GDP, Unemployment, QT and Net Zero, challenges for such goals, but most importantly demonstrate how the Fed could possibly combine targets for goals, as the Fed has a multi-goal objective. We recommend a PEACE (Personal Employment-Adjusted Consumption Expenditure) Price Index that incorporates both goals in a single target/chart. We close with a discussion of ensuring that Fed officials' compensation is made incentive compatible with their goals.*

***Keywords***: *Central Banks; Benchmarking; Inflation Volatility; Price Stability; Dot Plots; Ski Slopes; Quantitative Tightening (QT); Central Bank Officials' Compensation.*

***JEL Classification***: *E02, E31, E52, E58, E61, G23*

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**Resumo**

A meta de preço estável dos bancos centrais é uma das mais observadas globalmente. Essa referência para o índice de preços para despesas de consumo pessoal (PCEPI), atualmente de apenas "2% a.a.", está "subespecificada" e permite uma incompatibilidade entre o que o Federal Reserve (Fed) acredita ser seu mandato e o impacto sobre os mercados e os cidadãos que ele deve servir. Em vez disso, o Fed poderia se inspirar nas práticas eficazes de benchmarking de investidores institucionais (e aprender com seus erros) para definir uma referência mais simples e transparente, que permita o alcance de metas de longo prazo (e menos análise de "gráficos de pontos coletivos") e melhor governança em múltiplos níveis. Propomos uma referência alternativa e mais realista, que permite um melhor acompanhamento não apenas da experiência atual da inflação, mas também no "longo prazo", um período de tempo não especificado nos atuais anúncios, publicações, coletivas de imprensa e atas do Fed, E do mandato duplo.

Por um lado, a atual "meta de 2%" não possui um componente de volatilidade (digamos, uma faixa de desvio padrão de +1 ou 2) e, por outro, "longo prazo" não é especificado, permitindo que seja vago, possivelmente intencionalmente, mas isso não serve ao mercado e aos cidadãos em nada. Mais importante ainda, a meta de 2% ignora o efeito pernicioso da composição — uma percepção trivial, mas ignorada completamente nas declarações de metas e coletivas de imprensa, e potencialmente nas políticas. Mostramos graficamente como um novo benchmark poderia ser criado para atingir um resultado potencial melhor com maior especificidade e uma representação visual dos objetivos dentro do cone de volatilidade do benchmark, que até mesmo cidadãos não técnicos podem acompanhar. Concluímos com uma discussão sobre a aplicação dessa ideia a outras metas individuais, como PIB, desemprego, aperto monetário e zero emissões líquidas de Gases de Efeito Estufa (Net Zero), desafios para tais metas, mas, o mais importante, demonstramos como o Fed poderia combinar objetivos para metas, já que o Fed tem um objetivo multimetas. Recomendamos um Índice de Preços PEACE (*Personal Employment-Adjusted Consumption Expenditure* -Despesa de Consumo Ajustada pelo Emprego Pessoal) que incorpore ambas as metas em uma única meta/gráfico. Encerramos com uma discussão sobre como garantir que a remuneração dos funcionários do Fed seja compatível com seus objetivos em termos de incentivos.

## *Disclosure Statement*

*I have no conflicts or funding issues to disclose.*

1. *I received no financial support from any entities.*
2. *While I serve as co-founder of AlphaEngine Global Investment Solutions LLC and Mcube Investment Technologies LLC, this paper is entirely theoretical and has no apparent value in the performance of my investment functions in this capacity or to the investment and technology firms in the conduct of their business activities.*
3. *There was no third-party review required or conducted of this paper.*
4. *There were no non-disclosure arrangements that had any relevance to this paper.*

*"Inflation is always and everywhere a monetary phenomenon."*

Milton Friedman[1]

1 *https://mfidev.uchicago.edu/about/tribute/mfquotes.shtml#:~:text=%E2%80%9CInflation%20is%20always%20and%20everywhere,chasing%20after%20too%20few%20goods.%E2%80%9D*

> *"I complain that the Federal Reserve does not tell us its target. Why do I complain? Because I have no way of telling if it is doing a good job or not. That's why I want them to tell us what their targets are - and not necessarily money targets. I don't care about money targets. They can do anything with money, as long as they tell us what their real targets are - and as long as they take the blame when they do not hit the real targets."*
>
> Franco Modigliani[2]

## *Introduction – What is Monetary Policy?*

*The late Nobel Laureate Milton Friedman spent his career focusing on inflation and how monetary policy could solve and control rampant inflation, and the late Nobel Laureate Franco Modigliani was a strong believer in the dual mandate of central banks (Modigliani et al, 1998). But this begs the question: "What is monetary policy? It is the Federal Reserve's actions, as a central bank, to achieve three goals specified by Congress: maximum employment, stable prices, and moderate long-term interest rates in the United States" (Fed* Undated*). This is the first sentence of a publication by the US Federal Reserve on Monetary Policy. This translates into a more formal statement; namely, "The Federal Reserve Act states that the Board of Governors and the FOMC should conduct monetary policy 'to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates'…the FOMC also established a numerical longer-run goal for inflation: In the Committee's judgment, an* **annual rate of increase of 2 percent in the price index for personal consumption expenditures**—*an important price measure for consumer spending on goods and services—is most consistent,* **over the longer run**, *with meeting the Federal Reserve's statutory mandate to promote both maximum employment and price stability."[3] While the Fed's mandate is multi-pronged (e.g., it is also concerned about employment and moderate long-term interest rates), the primary focus of this paper will be on the numerical aspects of the "stable prices" goal, with some discussion of more complex, multi-goal considerations, with an attempt to reduce the dual policy mandate to a single metric. However, the principles applied to price stability can be applied easily to the other goals individually, and potentially on a weighted basis (to reflect the priorities of the Fed), using the same technique for the single goal. To distil the dual policy mandate into a single metric, we show how the Fed (or an oversight body like Congress) could create a new index: PEACEPI (Personal Employment-Adjusted Consumption Expenditure Price Index), to measure dual goal achievement with a single target. While we focus on the US, the ideas apply to all central banks globally that have copied or have a variant of the US approach.*

*We try to address the question/frustration that Prof. Franco Modigliani raised 50 years ago, which is currently unaddressed in Fed monetary policy; namely, the lack of accountability given the vagueness in their targets. The stable price goal is one of the most watched goals globally, and any indication that current inflation is different from this level (and expectations of the market) can lead to dramatic market movements in all liquid assets (and potentially valuations of illiquid or private assets).[4] The recent moves in 2024, where the Fed lowered rates, but which led to a backup of long-term rates, demonstrate this confusion and challenges with effective monetary policy. An inordinate amount of ink in the press (digital and hardcopy) and television time is devoted to analyzing and parsing the statements of the central banks, the speeches of individual governors (including videos of the briefcase of Governor Greenspan), the "dot plots," etc.*

2 *SF Fed (1977).*
3 *Emphasis added.*
4 *This is an example of a news story right after inflation data releases, not to mention the non-stop mention on CNBC, Bloomberg etc. https://apnews.com/article/inflation-prices-election-federal-reserve-rates-economy-b45524481of36f459298b92568d22756*

*We argue that this inefficiency could be reduced, and productivity, transparency, and governance improved with two simple enhancements to the benchmark. We argue that this benchmark for the price index for personal consumption expenditures (PCEPI) is "under specified" and allows for a mismatch between what the Federal Reserve (Fed) believes its mandate to be and the impact on markets and citizens they are meant to serve. For example, it appears that an increase in inflation leads to an increase in violent and acquisitive (for monetary gain) crime.[5] Increasing inflation is also being attributed to the risk of potentially pernicious Buy Now Pay Later (BNPL) loans.[6] Instead, the Fed could take a page from the benchmarking practices of effective institutional investors (and learn from the mistakes of the less efficient ones), to set a simpler and more transparent benchmark, that allows for the achievement of longer-term goals, and accountability. Institutional investors, like public pension plans globally, are a good comparator as they too have multiple levels of governance and delegation, with resulting accountability. We use good, bad, and ugly examples of their benchmarking practices to pave the way for the Fed to improve theirs.*

*We propose an alternative and more realistic benchmark, which allows for better tracking of not only current inflation experience, but also over the "longer run", an unspecified time period in current Fed announcements, publications, and minutes. For example, PCEPI as of March 2024 was 2.4% (2.63% on Core), clearly above the target "2%" level, but no mention has been made about the past experience of PCEPI over the "longer term". Moreover, at the March 2024 press conference, Chairman Powell used the word "bumpy" (or "bump") eight times (!!), a non-technical version of "volatility". This can easily be cleaned up with minimal effort, and for example, as we do, "volatility" could refer to the standard deviation of inflation data, much like is done in the finance literature for calculating and articulating the volatility of returns.*

*The primary issues with the current statement are that (i) the current "2% goal" is missing a volatility component, and for another, (ii) "longer run" is not specified, allowing it to be vague, possibly intentionally, but that does the market and citizens no good. The "maximum employment" goal is even less specified, if one could even imagine that from one of the premier economic institutions in the world, with numerous market experts and PhDs working there! Inflation has been running hot in America for a few years, and it proved to be "non-transitory". The longer run impact of hot inflation probably requires the current inflation target to be much lower than 2% to achieve the "longer run" goal, and account for periods of above 2% inflation experience, as we will demonstrate later. After all, if a dinner cost $100 in 2019, and now costs $120 (so a 20% spike in 4 years, and clearly in excess of 2% per intervening year which should have a target price of $108, ignoring compounding), then bringing inflation back to 2% leaves citizens worse off (if they have not experienced commensurate wage gains or employment), even though it may appear that the Fed has met its goal.*

*The paper is structured as follows: Section 1 highlights the historical volatility ("bumpiness") of the PCE Price Index (or PCEPI), Gross Domestic Product (GDP), and Employment/Unemployment, and how the challenge of benchmarking Fed policy relates to the goals of say pension plans and their specification; Section 2 considers various Fed statements about the target and its achievement in minutes, announcements etc., to show how insufficient these reports are that market participants scour, thereby increasing market volatility (especially with "Dot Plots"), and "bumpiness" in the asset markets; Section 3 shows graphically how a new benchmark for PCEPI could be created that achieves a better outcome with greater specificity and a visual representation of the objectives that even non-technical citizens can track. Section 4 applies this to GDP data and discusses the application of this idea to other goals like Unemployment (for the maximum employment goal), and challenges for such goals, while purposely ignoring an Employment measure that is addressed in Section 5. Section 5 shows how the Fed could create an integrated, multi-goal, single target, PEACEPI (Personal, Employment-Adjusted, Consumption Expenditure Price Index), if they genuinely*

5 *https://thehill.com/opinion/congress-blog/3721574-controlling-inflation-is-crime-prevention/.*
6 *https://finance.yahoo.com/news/with-food-inflation-still-hot-consumers-turn-to-buy-now-pay-later-to-buy-groceries-and-takeout-140000942.html?guccounter=1.*

*wanted transparency and accountability across both goals. Section 6 also examines newer goals like Net Zero achievement and even reducing the balance sheet, as these are newer concepts in the broad objectives of central banks. It also examines tying Fed governor compensation to goal achievement, a topic that both Profs. Friedman and Modigliani agreed that it was important. Section 7 concludes.*

*This paper is presented in the hope that some more talented economist at the Fed, Bank for International Settlements, central bank or academia, more conversant with monetary and economic policy, can leverage these ideas to develop a better benchmark. Hence, it is more illustrative than definitive in specifying exact values for the various missing parameters in the Fed's current policy statement.*

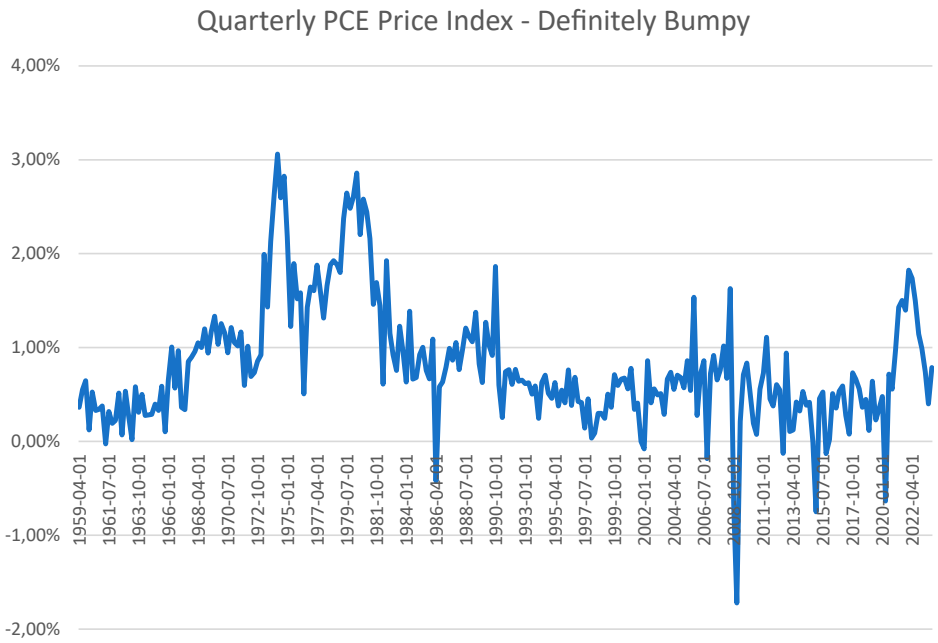
## *Section 1 - PCEPI Volatility and Institutional Benchmarks*

*PCEPI Volatility – Stable, but non-zero. Definitely Bumpy*

*Stated naively, the PCEPI is volatile as shown in Figure 1 (with an annualized volatility or standard deviation of the quarterly data of 1.31%, since inception of the series in 1959, as shown in Table 1)! Hence, to make no mention of a volatility target, for a stochastic variable, fails the most basic Economics 101 or Finance 101 test! While 1.31% pales in comparison to the bumpiness of interest rate or stock markets, it is nevertheless non-zero, and worthy of some mention in central bank objective statements, and meaningful in the context of a "2% per annum" PCEPI target. Not all elements included in PCEPI can be influenced by Fed policy as supply side shocks have shown (San Francisco Federal Reserve 1977). Hence, to state a level without also stating a volatility target, makes little sense. After all the word "stable" precedes the word "price level", so what qualifies as "stable"? What is "bumpy", and where are we in the current bumpy cycle relative to a Fed target level of bumpiness? One simple guide for the target volatility would be to use the historical volatility of the annualized PCE price index (e.g., 1.25% to round off 1.31%), or another might be a dynamic target volatility that the Fed seeks to achieve, as volatility is also dynamic.*

*For example, Table 1 shows the volatility of the annualized volatility of GDP, PCEPI, the Unemployment Rate (UNRATE), and Total Nonfarm Payrolls (PAYEMS), using quarterly data releases, for different time horizons; critically, the volatility and correlation of PCEPI and GDP is also dynamic. The assumption in using this data is that there are no revisions to the data as that adds more complexity, but clearly one of the challenges with economic data is that they are released with a lag and also are subject to multiple revisions. Taking the final value in FRED (Federal Reserve of Economics Databases) as we have done in this paper may not be most appropriate (but can be easily examined and enhanced by Fed economists to account for this quirk). However, over the "longer run" the revisions of the last two data values should have a marginal impact on goal setting or achievement.*

***Figure 1: Quarterly PCE Price Index values***




*Source: FRED Database; Authors calculation*

*As is easily observed, the annualized volatility of PCEPI is relatively stable around 1.25% over different time horizons (and could be shown with say a rolling 10-year or 5-year window chart), as shown by the green highlighted boxes, relative to a data end period of April 2025 (since the data is quarterly). More importantly, while from October 2008 – April 2025, the Fed has hit its 2% target; over the other three periods highlighted in orange, and ostensibly over the last 10 years, which is a reasonable "longer term" period, it has not. Therefore, specificity of the window of examinations is critical to any policy objective. Absence of specificity allows for cherry picking of time horizons with 20-20 hindsight: not the most appropriate method of holding accountable one of the (if not "the") most important economic institutions globally.*

*Table 1: Detailed Annualized Statistics on GDP, PCEPI, Unemployment Rate and Total Nonfarm Employment, All Employees (GDP data from January 1947 – January 2025; PCEPI and Total Nonfarm data from January 1959 – April 2025; Unemployment from January 1948 – April 2025).*

| | Annualized "Return" | Std Deviation | "Sharpe" | Correlation to PCEPI |
|---|---|---|---|---|
| PCEPI - Since Inception | 3.24% | 1.31% | 2.48 | |
| PCEPI - Since 2008 | 2.06% | 1.13% | 1.83 | |
| PCEPI - Since 2020 | 3.48% | 1.11% | 3.15 | |
| PCEPI - Last 10 Years | 2.58% | 1.00% | 2.59 | |
| PCEPI - Last 5 Years | 3.78% | 1.12% | 3.38 | |
| PAYEMS - Since Inception | 0.78% | 2.23% | 0.35 | 0.17 |
| PAYEMS - Since 2008 | 0.24% | 4.07% | 0.06 | 0.38 |
| PAYEMS - Since 2020 | 0.30% | 3.53% | 0.08 | 0.58 |
| PAYEMS - Last 10 Years | 0.34% | 5.12% | 0.07 | 0.46 |
| PAYEMS - Last 5 Years | 0.30% | 7.24% | 0.04 | 0.59 |
| REAL GDP - Since Inception | 3.09% | 2.23% | 1.38 | -0.02 |
| REAL GDP - Since 2008 | 2.18% | 3.04% | 0.72 | 0.34 |
| REAL GDP - Since 2020 | 2.47% | 5.17% | 0.48 | 0.48 |
| REAL GDP - Last 10 Years | 2.28% | 3.72% | 0.61 | 0.34 |
| REAL GDP - Last 5 Years | 2.47% | 5.23% | 0.47 | 0.41 |
| UNEM RATE - Since Inception | 5.69% | 3.49% | 1.63 | 0.04 |
| UNEM RATE - Since 2008 | 6.04% | 4.84% | 1.25 | -0.29 |
| UNEM RATE - Since 2020 | 5.04% | 2.70% | 1.86 | -0.51 |
| UNEM RATE - Last 10 Years | 4.74% | 4.05% | 1.17 | -0.32 |
| UNEM RATE - Last 5 Years | 5.10% | 5.50% | 0.93 | -0.54 |

*Source: FRED Database and Author's calculations.*

*We will address GDP and Unemployment/Employment in Section 4 (for say 3% GDP Growth for 3.5% volatility and 5% Unemployment for say 4% volatility), purposely ignoring the Total Nonfarm Payrolls data, as there are additional complications to deal with. Section 5 takes it up a notch to try to integrate the "price stability" goal with the "maximum employment" goal in a single PEACE price index, which is harder to conceptualize, but shown to be relatively simple to create, if desired. We will demonstrate how this additional specificity of a volatility target of PCEPI allows market participants to gauge the efficacy of the Fed (or any central bank) over longer periods in Section 3. We include the correlation statistic of various economic variable vis-à-vis PCEPI as that might be a secondary goal for the Fed to consider but not addressed in this paper. But as Table 1 demonstrates, the correlation is also a dynamic variable, and for multiple goal objectives could be a critical parameter. To show a contrast of objective statements we show the Bad and Ugly and return to the Good later in this section. We do this because institutions setting their own benchmarks like the Fed can either provide transparency, good governance and accountability or choose to not do so (with resulting consequences in financial performance and impact on citizens), which this paper is attempting to address.*

*Institutional Benchmarks – The Bad and the Ugly (CA Public DB Plans)*

*The corollary to this statement of monetary objectives is the experience public pension plans have had in specifying their return targets – as 2% inflation p.a. is nothing more than a return target. We highlight good and bad examples to show how lack of specificity allows for less-than-optimal governance, transparency and accountability; something, the Fed could learn from these institutions because pension funds and endowments have similar governance structures to the Fed. Principals (Pension Boards vs Congress) hire individuals/ delegated agents (Investment Teams vs the Governors) to oversee a delegated portfolio of decisions. In pension funds and endowments, there is an additional layer of delegation where the investment team (principal) delegates to active managers (agents) who are hopefully skillful (Muralidhar 2024). As a result, to ensure good governance, one would hope that there are clearly specified risk budgets as noted in Muralidhar (2023).*

*For example, the California Public Employees' Retirement System (CalPERS), with over $500bn in assets, and the largest public defined benefit (DB) pension plan in the United States, has a current annual portfolio target expected return of 6.8%.[7] It's sister fund, and the second largest DB fund after CalPERS, California State Teachers' Retirement System (CalSTRS), with over $352bn in assets, has an expected return target of 7% p.a. "Based on various internal and consultant estimates, the actuarial rate of return is currently set at 7.0%, which represents an indicative multi-decade expected average return." (CalSTRS 2024).*

*Ignoring, the specificity of the target, there is no explicit volatility target associated with this goal; however, one can be imputed from the Strategic Asset Allocation (SAA) target and permissible target relative risk permitted. For example, CalSTRS (2024) states, "The reference portfolio is a blend consisting of 70% MSCI ACWI and 30% Bloomberg Aggregate Bond Index. This measure is designed to allow members and the public to compare the portfolio investment performance to a similar* ***risk level portfolio*** *(*emphasis added*) that they could utilize within their personal retirement accounts. This measure will be used in external publications to provide a comparison that is publicly available and clearly defined. The reference portfolio is also the most appropriate* ***performance measurement*** *tool to* ***measure the performance success of the portfolio over long periods****."*

*In other words, one could reasonably assume, since CalSTRS is silent on the volatility of the target expected return, that the 70% MSCI ACWI and 30% Bloomberg Aggregate Bond Index portfolio volatility is a reasonable volatility target. Incredibly, and by contrast, Section 3 on Investment Risk in CalSTRS (2024) is completely silent about any risk value on either strategic or active risk and is absolutely generic in its exposition! As a result, it is beyond third-party assessment of whether they are meeting risk goals. Moreover, CalSTRS (2023a), which is the Chief Investment Officer's Quarterly Report to the Board, doesn't even mention the words "volatility" or "standard deviation"!The Consultant's Report in the Comprehensive Annual Financial Report (CAFR) 2023 doesn't mention risk either, questioning the value of independent consultant oversight, and highlighting how opacity in benchmark specification can lead to poor governance and accountability.*

*Interestingly, in a 2019 disclosure document of a retail fund, one can find an estimate of the volatility of the 70/30 portfolio online from 2015 – 2019 at 8.52%[8], otherwise, the independent observer has to download the benchmark data and calculate this value. The author briefly calculated the volatility from 2000 – 2019 at 11%, which is more reasonable for the target expected return. Strangely, CalSTRS (2023b), which is the portfolio risk report (!!), states that, "The Risk team utilizes the BlackRock Aladdin risk management system for the total plan portfolio," and yet in this 16-page risk report, using a multi-million-dollar software, with plenty of values and charts, there is no measure of total portfolio volatility or Conditional value-at-risk*

7 *https://www.bloomberg.com/news/articles/2022-07-20/calpers-posts-6-1-loss-worst-performance-in-more-than-a-decade*
8 *https://carystreetpartners.com/wp-content/uploads/2019/04/2019-03-Luxon-Global-70-30-Factsheet.pdf*

*(CVAR)*[9] *or that of the 70/30 portfolio! In short, this cannot lead to good governance as one cannot make an assessment of performance without appropriately adjusting for risk (Modigliani-Modigliani 1997).*

*Why is this important? The self-reported funded status (namely, the asset divided by the liabilities and a measure of solvency of the fund or cost to future citizens) for these two pensions are 75% for CalPERS*[10] *(using a 6.8% discount rate for long duration liabilities, when long-term rates are barely around 5%), and a touch higher for CalSTRS. What this means is that there are currently 75 cents for every $1 owed in pensions (again, with very liberal discounting as there would be a lot less if liabilities were discounted at market rates)! Poor objective specification has led to a burden on future generations, much like the Fed not achieving vaguely specified goals could impose on US citizens.*

*Institutional Benchmarks – Better Specificity at LACERA, NMPERA (The Good) and CERN (The Best)*

*In this regard, CalPERS/CalSTRS is lacking relative to say some of their peers in the United States and some sophisticated international pension plans. The Investment Policy Statements (IPS) of the New Mexico Employees' Retirement Association (NMPERA) and the Los Angeles County Employees' Retirement Association (LACERA) have much greater specificity of risk targets and could be a model for the Fed (and CalPERS and CalSTRS). The LACERA IPS states: "The Fund's long-term performance objective is to generate risk-adjusted returns that meet or exceed its defined actuarial target as well as its policy benchmark, net of fees, over the Fund's designated investment time horizon."4 The actuarial target proxies the pension benefit payments (goal). Further, LACERA articulates an explicit relative risk budget. NMPERA's IPS explicitly states that the Board established a* ***10.5% annualized target volatility for the SAA, and a 1.5% annualized tracking error for all delegated decisions****.*[11] *The 10.5% annualized target volatility value is absent in the CalPERS/CalSTRS documents, much like it is lacking for the Fed's 2% inflation target!*

*In the case of the European Organization for Nuclear Research (CERN) pension fund, based in Geneva, Switzerland,*[12] *we quote extensively from Economou et al (2013) as its eloquence and specificity is hard to match. "CERN's implementation of the* ***risk-driven*** *approach gives full flexibility to the investment team in allocating assets, subject to maintaining the fund's total risk under a pre-approved ceiling." Further, from the Statement of Investment Principles (SIP) "*

1. *The board would introduce* ***an absolute quantifiable risk constraint*** *as the sole constraint to the dynamic asset allocation process;*
2. *The fund's natural strategic asset allocation (NSAA) would only serve to indicate the fund's default positioning, consistent with the* ***risk ceiling****, in the absence of other information, at the time that the NSAA is agreed upon;*
3. *Actual asset allocation can dynamically deviate at any time from the NSAA subject solely to maintaining the fund's total risk under a pre-approved ceiling;*
4. *The* ***objective would be to minimize actual estimated risk at all times subject to reaching the actuarial return objective****;*
5. *A* ***continuous risk-control process would ensure compliance****.*

*The SIP further clarifies key processes: 1) the setting of the fund's risk limit, 2) the dynamic asset allocation and risk management processes, 3) the setting of guidelines, and 4) the risk control process." Moreover, "the asset allocation process starts with the definition of the risk limit. In CERN's case, the risk limit is set*

9 *For a definition, see https://www.investopedia.com/terms/c/conditional_value_at_risk.asp.*
10 *https://calpers.ca.gov/docs/board-agendas/202411/financeadmin/item06a-01_a.pdf*
11 *As an aside, the current Chief Investment Officer (CIO), Jon Grabel, was the former CIO of NMPERA so there is some similarity in approaches as a result.*
12 *With a few staff having worked on the Large Hadron Collider (LHC) and with very technical physics backgrounds, including the current CIO, Elena Manola-Bonthold, PhD, and Risk Manager, Alberto Desirelli, PhD, and similarly with Board members.*

***annually**, and it expresses the board's tolerance for maximum annual loss, taking into account the sponsor's ability to make additional recovery contributions. The **limit** is expressed **as the 5-percent CVaR** (Conditional Value-at-Risk) of annual return—**it sets the maximum acceptable loss over the coming twelve months and is expressed in absolute terms (in Swiss francs)**."*[13]

*"From a technical standpoint, the NSAA is calculated on an **annual basis** considering **multiple time horizons**, accounting for, among others, the liabilities of the fund and assumptions related to asset and market risks. The NSAA is calculated by the fund's risk consultant, reviewed with the investment staff, and subsequently approved by the investment committee. The NSAA calculation applies a frequency domain approach for analyzing historical time series and generating scenarios for the future." This process of independent external review by a third-party to ensure risk control is also good governance. In fact, CERN offers an app to its Board members, which is fed electronically and independently, to ensure that the staff are in compliance with these risk limits in all periods, with a breach triggering an alert to staff and the Board – something modern technology affords.*

*We conclude this section by noting that effective risk management and benchmarking require an explicit statement of the goal, the risk target and the time horizon over which these goals will be measured and reviewed. In some cases, it utilizes/requires external parties to provide independent validation of the results, an idea that might make sense for the Fed that wields an enormous amount of economic power and whose governors go on to have lucrative post-retirement careers in the private sector.*

## *Section 2 – The Fed's Goals and Statements*

*In the interest of ensuring transparency, the Fed moved to providing market participants with much more information, more press conferences (and Fed governor speeches) and "dot plots". There has also been a substantial increase in compensation of Fed governors once they retire, post this change, as market participants would like to have the "insider's perspective" in examining likely Fed policy.[14] We examine some key issues around the Fed's price stability (and other goals) based on their own documents and minutes.*

### *Rationale for Inflation Control*

*Fed (Undated) is extremely simple to follow and hence we once again quote extensively from the document: "When the average of prices of a broad collection of goods and services is stable and believed likely to remain so, changes in the prices of individual goods and services serve as clear guides for efficient resource allocation in the U.S. economy. This then contributes to higher standards of living for U.S. citizens…Moreover, stable prices encourage saving and capital formation because when the risks of erosion of **asset values** resulting from inflation—and the need to guard against such losses—are minimized, households are encouraged to save more and businesses are encouraged to invest more."[15]*

*Merton and Muralidhar (2015) argue that the Fed focus on absolute wealth by focusing on just asset values and not relative wealth (i.e., the assets divided by liabilities of each goal of each investor) may have led to shortcomings in achieving other macro-economic goals of increased growth and spending: "the belief that lower long-term rates leads to more investment has led the Federal Reserve, and now the makers for institutional and retail pension funds and insurance companies are not focused on wealth (as in the standard portfolio selection*

13 *Emphasis added.*
14 *https://www.reuters.com/article/idUSBREA2401B/*
15 *Emphasis added.*

*model), but instead on retirement income as measured by funded status, then the outcome desired by central banks might not be realized. By reducing long-term interest rates, the price of the same retirement income level goes up and the price of other assets measured in terms of income units declines — i.e., relative wealth (funded status) declines and investors are actually poorer, thereby experiencing a negative wealth effect." Muralidhar (2024, 2025) demonstrates the alteration of the Q = C+I+G+NX equation and how lower rates in this model could lead to lower output (See Appendix A). We ignore this diversion for now and assume that the Fed's rationale is acceptable.*

*Typical Fed Statements and Press Conferences - (Focused on Short Term)*

*Fed (2024a), the press release after the Fed's January 2024 meeting states: "In considering any adjustments to the target range for the federal funds rate, the Committee will carefully assess incoming data, the evolving outlook, and the balance of risks. The Committee does not expect it will be appropriate to reduce the target range until it has gained greater confidence that inflation is moving sustainably toward 2 percent. In addition, the Committee will continue reducing its holdings of Treasury securities and agency debt and agency mortgage-backed securities, as described in its previously announced plans. The Committee is strongly committed to returning inflation to its 2 percent objective."*

*The Fed minutes of the January 2024 meeting, another document scanned extensively to divine the machinations of the Fed, go further to explain the rationale for the decision. (Fed 2024b). "Pricing of inflation derivatives continued to suggest a near-term path of inflation consistent with a return to 2 percent later this year.… Consumer price inflation had declined markedly over the course of the year, though it remained above 2 percent.…Consumer price inflation continued to slow. The price index for total personal consumption expenditures (PCE) increased 2.6 percent over the 12 months ending in December, while core PCE price inflation—which excludes changes in energy prices and many consumer food prices—was 2.9 percent over the same period. Both total and core PCE price inflation were well below their year-earlier levels.…Total and core PCE price inflation were both projected to step down in 2024 as demand and supply in product and labor markets moved into better alignment. By 2026, total and core PCE price inflation were expected to be close to 2 percent.…In their discussion of inflation, participants observed that inflation had eased over the past year but remained above the Committee's 2 percent inflation objective. They remained concerned that elevated inflation continued to harm households, especially those with limited means to absorb higher prices. While the inflation data had indicated significant disinflation in the second half of last year, participants observed that they would be carefully assessing incoming data in judging whether inflation was moving down sustainably toward 2 percent.…..Although total PCE inflation in December remained above the Committee's 2 percent objective on a 12-month basis, on a 6-month basis, total PCE inflation was near 2 percent at an annual rate, and core PCE inflation was just below 2 percent…Participants generally noted that they did not expect it would be appropriate to reduce the target range for the federal funds rate until they had gained greater confidence that inflation was moving sustainably toward 2 percent."*

*The March 2024 press conference post the Fed March meeting was an example of vagueness and obfuscation, which our benchmark proposal seeks to address.[16] For example, the word "bump" or "bumpy" was used eight times (!!); the Chairman emphasized that the Summary of Economic Projections (SEP) was a "collection", not a "collective" of 19 projections, yet sought to distinguish between the median and average; and then discussed wanting the balance sheet to go to "adequate" as opposed to "abundant" – clearly on the latter, once again missing in specificity on amounts, rate of change and timeline.*

16 *https://www.rev.com/blog/transcripts/fed-chair-jerome-powell-press-conference-transcript-march-17-market-update*

*Why No Specific Target for Growth/Employment*

*The Fed (Undated) clarifies why the goal for maximum employment is less specific: "The goal of maximum employment stands on an* ***equal footing*** *with price stability as an objective of monetary policy. However, policymakers recognize that factors other than monetary policy largely determine the maximum level of employment that can be sustained without leading to higher inflation. These factors include trends in the size and makeup of the population, changes in the types of jobs and skills needed in the workforce, and other policies such as those affecting education and training. Consequently, it would not be appropriate for the FOMC to specify a fixed goal for employment." Barcena and Wessel (2022) demonstrate the challenge of what "maximum employment" is when there is no specificity. The St Louis Fed, in a post on "Fed Policy in Plain English" has this to say: "The concept of maximum employment can be thought of as the highest level of employment that the economy can sustain over time. Of course, measuring this concept is hard because the level of maximum employment varies over time with business conditions, demographics, labor market regulations, and other factors. Rather, the Fed considers a wide range of employment indicators to estimate the shortfalls of employment from its maximum level. In short, the Fed does not have a numerical target for the level of employment; rather, the Fed analyzes economic conditions using a wide range of data to design policies that achieve maximum employment."*

*But Table 1 offers the possibility to lay out such a target given historical data and even the Bureau of Labor Statistics offers this projection: "By 2032, the unemployment rate is expected to recover to 4.3 percent, the NAIRU estimate. Slow projected labor force growth and an increase in the unemployment rate are expected to result in employment growth of 0.3 percent annually over the 2022–32 decade."[17] Again, this value is broadly in line with the historical data provided in Table 1, and could be complemented with a volatility target of say 5% or lower (if we use the data all way back to 1959).*

*Profs. Ben Bernanke and Olivier Blanchard argue that tight labor markets are best measured by the ratio of the number of vacancies to the number of unemployed (Wessel 2023). We examine this in Appendix B. As Section 3 shows, the same techniques and specificity could be used on any or all of the measures they consider for this definition. Profs. Eggertson and Kohn argue that "the Fed should consider an explicit definition of maximum employment as the highest level of employment consistent over time with stable prices" (Wessel 2023), but again, there has been little by way of concrete examples in the public fora.*

*Forward Guidance*

*And in an attempt to improve transparency, Fed (Undated) notes: "In addition to adjusting the target for the federal funds rate, the FOMC also can influence financial conditions by communicating how it intends to adjust policy in the future. Since March 2009, when the federal funds rate was effectively at its lower bound, this form of communication, called 'forward guidance,' has been an important signal to the public of the FOMC's policy intentions. Beginning in late 2007, Federal Reserve policymakers began to publish economic projections, the "Summary of Economic Projections," (SEP) four times each year. Those projections, published along with the FOMC post meeting statement, now provide participants' assessments of the most likely outcomes for real gross domestic product growth, the unemployment rate, inflation, and the federal funds rate over the medium term and over the longer run. Each participant bases his or her projection on his or her assessment of appropriate monetary policy and assumptions about the factors likely to affect economic outcomes."*

*The SEP is operationalized in what is called "dot plots" which demonstrates the "collection", not "collective" of committee members' best guess as to where various economic parameters will be. It is basically a Rorschach*

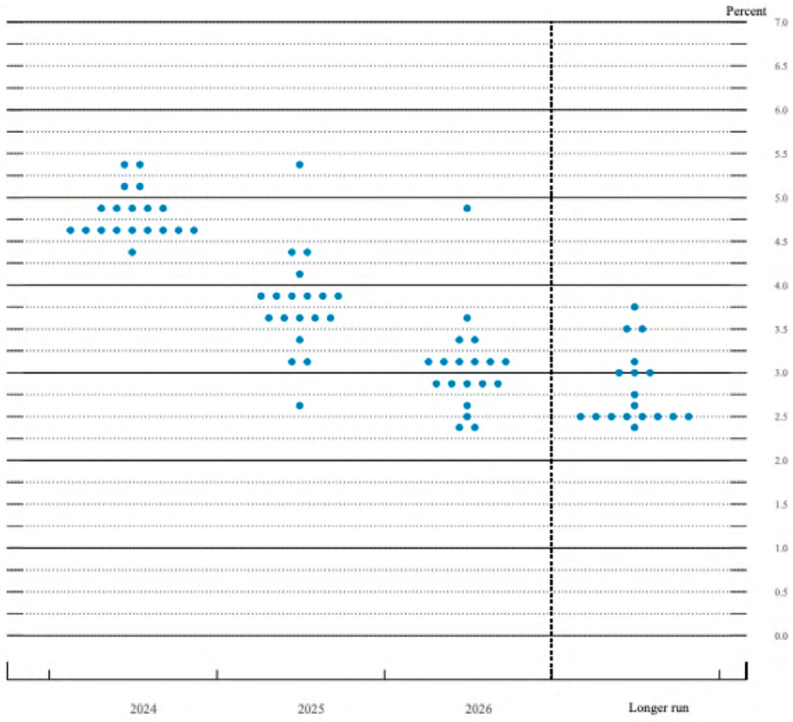
17 *https://www.bls.gov/opub/mlr/2023/article/labor-force-and-macroeconomic-projections.htm*

*Test*[18] *for market pundits! Having worked at The WEFA Group (Wharton Econometrics Forecasting Associates), and having built economic models for countries using the AREMOS software, I can confirm that there is a lot of guesswork in these projections, and the use of "add factors" ensures one can get the output desired to arrive at the value the economic forecaster wants from the model.*

*Figure 2 highlights the Dot Plot*[19] *for the Federal Funds rate and despite the assurance that is a "collection" and not a "collective", market participants were glued to their screens in March 2024 to see if 2 committee members would alter their position; only 1 did. Apparently, if 2 had, the projection would have been for 2 rate cuts in 2024 instead of 3 – a major financial implication for all markets.*

*In summary, Fed minutes, press conferences and statements focus on the short term and not the unspecified long term, recognize that the inflation path is bumpy (e.g., on page 7 of the press conference transcript and again nearly 5 times in responding to the Bloomberg reporter), but put no constraints on what qualifies as bumpy or smooth, and then provides collections of SEP forecasts which the market assumes to be a collective and makes market calls based on these charts. There is clearly room for improvement.*

***Figure 2. FOMC participants' assessments of appropriate monetary policy: Midpoint of target range or target level for the federal funds rate***




## *Section 3 - A Graphical Representation of a "Better" Benchmark – Greater Specificity*

*Franco Modigliani, back in 1977, remarked: "I think that what is really costly about inflation is unexpected deviations of inflation from the anticipated steady state path. This is the problem that I have tried to address." (SF Fed 1977). And this is reflected in his opening comment which has clearly been a pressing issue over 50 years!*

18 *https://en.wikipedia.org/wiki/Rorschach_test#:~:text=The%20Rorschach%20test%20is%20a,personality%20characteristics%20and%20emotional%20functioning.*
19 *https://www.bankrate.com/banking/federal-reserve/how-to-read-fed-dot-plot-explained/#why-you-might-not-want-to-place-too-much-focus-on-the-dot-plot-as-the-fed-fights-inflation*

*Example of a Simple Statement of Price Stability*

*Much like LACERA, NMPERA or CERN, the Fed could easily state that:*

> "Over a 10-year rolling period, updated quarterly, the Fed would like to achieve a 2% target rate of PCEPI with a 1.25% volatility".

*Here we specify, just to be illustrative, the long run is 10 years (but could be reduced to 5)*[20]*, updated quarterly to account for a rolling window, and we have added a volatility target at 1.25%, where somewhat higher volatility would be "bumpy". The Fed or Congress ideally can pick their own values. As Professor Sunghwan Shin (and Bank of Korea board member but commenting in a personal capacity) has noted in private correspondence, the proposed approach invokes a choice between Inflation vs Price Level targeting. As he noted, if you want to take his approach then you will permit output/GDP/employment volatility (and maybe the higher 5% figure, rather than the historical 2.25% experience on Total Nonfarm Employment). One alternative to cushion output volatility would be to widen the bands (i.e., tolerate more inflation volatility), so the economy can take shocks to the Price Level. This has an exact corollary in pension fund management where wider flexibility of contributions = greater portfolio risk = lower average contributions, as wider bands serve as a shock absorber/hedge against asset risk (Muralidhar 2001).*

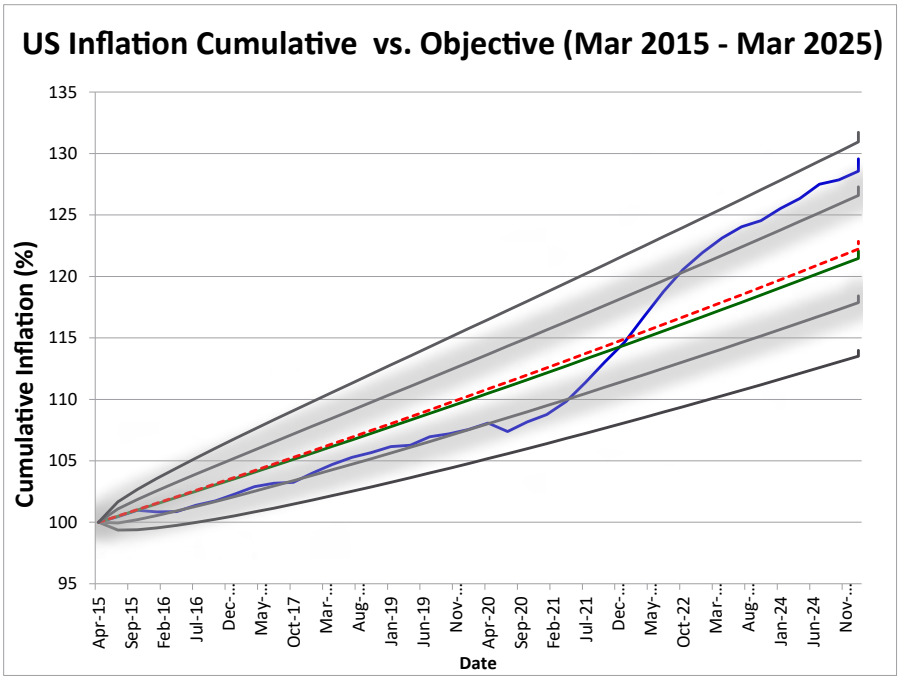
*How would this map out graphically to allow market participants to track where the economy is relative to the Fed target and individuals are not penalized for previous periods of "hot" inflation that affect pocketbooks, even if the rate of PCEPI returns to 2% p.a.? In the case of the rolling 10-year period from October 2013 – 2023, as Figure 3 demonstrates that the Fed should probably be raising rates – not lowering them as they did in 2024. Figure 3 plots the 2% target growing at a quarterly rate of 0.5%, with zero volatility, and then the curves around that line plot the 1 and 2 standard deviation cones around that target based on the 1.25% volatility target. The wiggly line is actual inflation over the 10-year period. For simplicity, we anchor the 1st date on this 10-year rolling period to 100.*

*To improve the transparency of policy, the Fed could easily state that if the blue line approaches the first cone, rates will be adjusted by 25 bps immediately (if above, then raise rate and vice versa), and if it approaches the second cone then the adjustment would be in 50 bps increments/decrements, unless there are exceptional circumstances like the covid drop we see in the chart. However, the current conditions seem to presage more interest rate increases or at least holding the line for a while, rather than the series of cuts in 2024, with Fed governors expressing some trepidation in the run up to the December meeting because inflation is still hot. While 10 years rolling may seem to be a long term, others may define it as 15 years (because policy was altered dramatically in 2008), this could reverse policy, and while not reported here, the blue line is still above the target path, if only marginally, as the extra 1 bps of annualized PCEPI over 15 years has compounded – a key impact the current Fed target ignores!*

*Table 1 highlights the annualized inflation experience over various time periods, and this could be updated in various Fed statements/minutes. Hence the importance of specificity in the details of policy are important for not only the market participants but for Congress to know how the Fed is performing relative to objective measures (and not political ones). For the last 5 years, they are way off target.*

20 *As a referee noted, "Technical challenges to the proposal: standard macro-models (VAR or DSGE) would lack robustness for such long periods as 10-year. Typically, they cover up to 4 years, with forward-looking parameters at max 1-quarter ahead, and increasing uncertainty over time." We thank the anonymous referee for this comment.*

*Figure 3: Path of PCEPI relative to Better Benchmark Specifications (2% annual target; 1.25% volatility; 10-year rolling window with 1 and 2 standard deviation cones). Data from March 2015 – 2025.*




*Source: FRED*

*Price Level Targeting vs Inflation Targeting – The "Temporary" Case*

*While there is a vast literature on this topic, Bernanke (2017) sought to address some issues by proposing an alternative policy measure – a temporary price level target as rates approached the Zero Lower Bound (ZLB). One proposal was to* temporarily *raise the inflation target above 2% but still lacking in clarity about the volatility and time window. The other was price level targeting: "A price-level-targeting central bank tries to keep the* level *of prices on a steady growth path, rising by (say) 2 percent per year; in other words, a price-level-targeting tries to keep the very-long-run average inflation rate at 2 percent." Bernanke (2017). This seems to be in line with our proposal, but clearly with a lot more specificity and permanence versus temporary. He continues: "An inflation-targeter can "look through" a temporary change in the inflation rate so long as inflation returns to target after a time. By ignoring past misses of the target, an inflation targeter lets "bygones be bygones.... A price-level target has at least two advantages over raising the inflation target. The first is that price-level targeting is consistent with low average inflation (say, 2 percent) over time and thus with the price stability mandate. The second advantage is that price-level targeting has the desirable "lower for longer" or "make-up" feature of the theoretical optimal monetary policy." Again, Prof. Bernanke does not clarify what "over time" means, and we are now in a situation of "higher for longer", with a bias to cut rates when it looks like a* permanent *price level targeting as opposite to* temporary *targeting would argue for raising rates.*

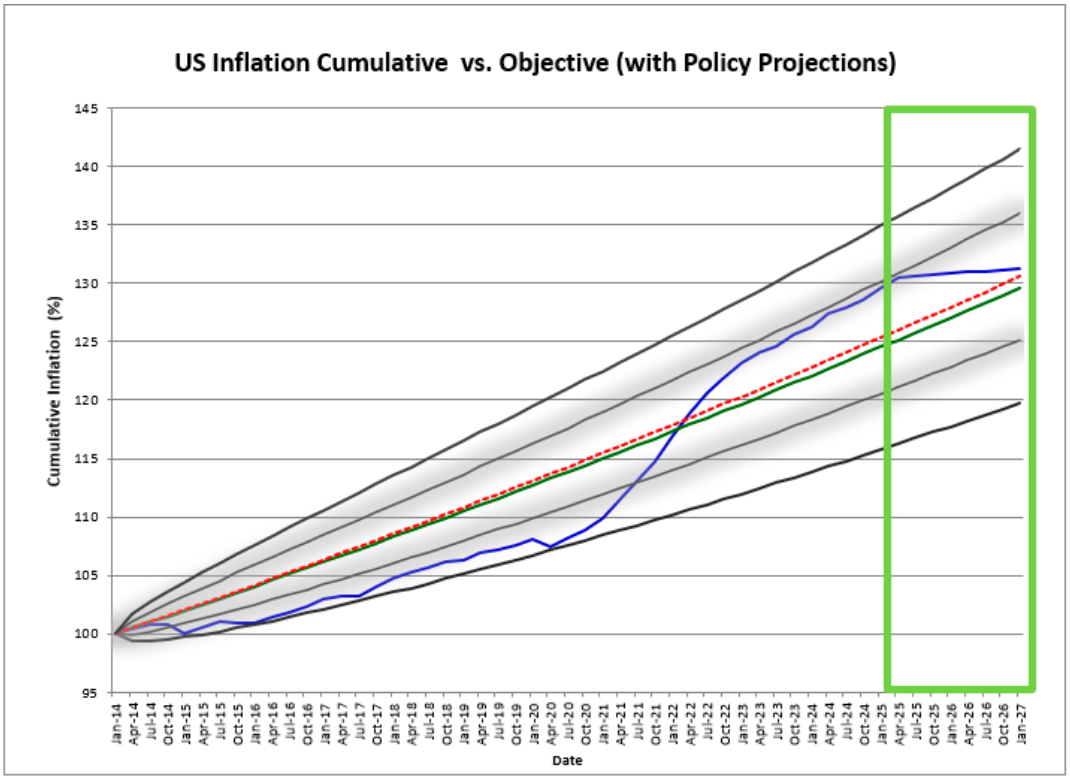
*Bernanke (2017) offers two reasons not to consider this which should be easily overcome given the challenges with the current policy and vagueness of the approach: "For one, it would amount to a significant change in the Fed's policy framework and reaction function, and it is hard to judge how difficult it would be to get the public and markets to understand the new approach. In particular, switching from the inflation concept to the price-level concept might require considerable education and explanation by policymakers. Another drawback is that the "bygones are not bygones" aspect of this approach is a two-edged sword.Under price-*

*level targeting, the central bank cannot "look through" supply shocks that temporarily drive-up inflation, but must commit to tightening to reverse the effects of the shock on the price level." The first is demonstrated to be trivial with the charts compared to the current guess work and "tea leave reading" by market participants; the second is also easily accommodated by accommodation for supply side shocks like the blocking of the Suez Canal, a war in the Middle East, a China supply side shock or even the Baltimore bridge tragedy.*[21]

*Ski Slopes Instead of Dot Plots*

*With these goal charts, adapted coincidentally from the CERN Board reporting package, the Fed governors or collective/collection could also show the public how they plan to bring the inflation back to the target line and over what period. We demonstrate this in Figure 4 where the Fed gets to project how they plan to bring inflation down to the target path over, say, a 2-year window (so in this case from May 2025 – December 2026), and not some arbitrary SEPs, with no consequences if they are completely off target.*

***Figure 4: Projected Path of PCEPI to Better Benchmark Specifications (2% annual target; 1.25% volatility; 10-year rolling window with 1 and 2 standard deviation cones). Data from January 2014 – March 2025 + Forecast of 2 years.***




*Source: FRED + Author's Calculations*

*This degree of specificity will hold governors accountable as they will not be able to claim that inflation was "transitory" and bear no consequence, while the population suffers from an overhang of compounded past "hot" inflation. This alignment of interest in this principal-agent relationship could also be tied to the compensation of the governors but that will be discussed in future research (and touched upon briefly in Section 6). To be fair to the governors, the achievement of these goals is not at all simple, especially since we do not truly understand the performance of the global economy, all the macroeconomics papers and models*

21 *I am grateful to Prof. Sunghwan Shin for pointing me to this research.*

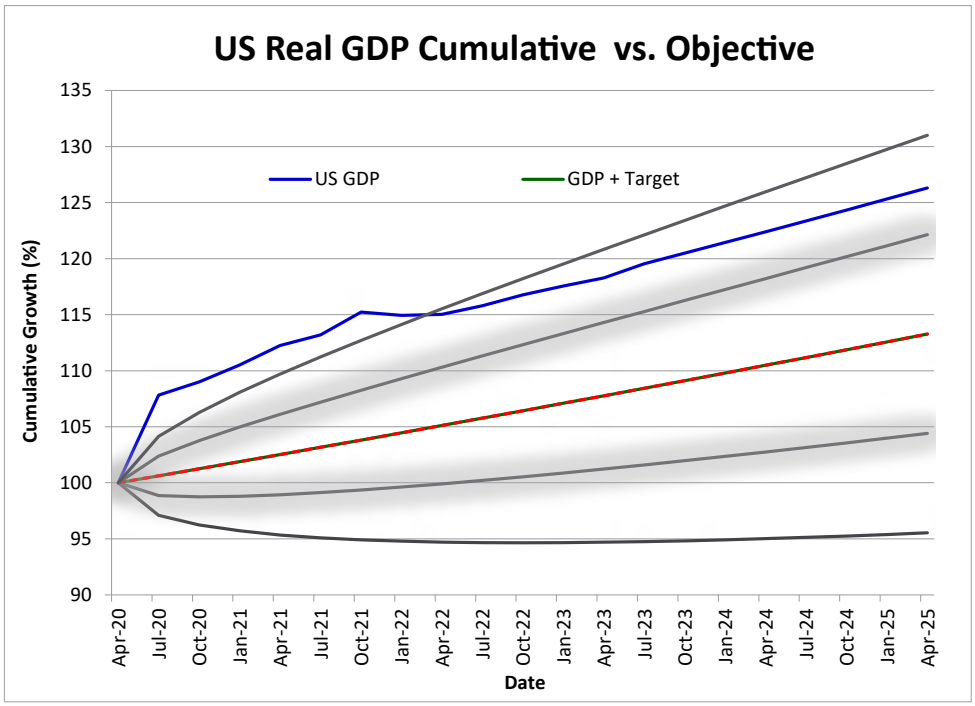
*notwithstanding. Merton and Muralidhar (2015) even suggest that the absolute model of monetary policy should be made relative and Muralidhar (2024, 2025) shows how the relative perspective upends all we have been taught in finance theory based on Expected Utility Theory (a model of absolute wealth).And if the model in Appendix A is even remotely correct, then the Fed has been misled by current academic theory and using the wrong approach to achieve their price stability goal!*

## *Section 4 – Application to Maximum Employment Goals*

*Application to Maximum Employment – GDP, GDP Now and Unemployment Rate*

*We purposely ignore the Total Nonfarm, All Employees series in this section as we use it in the next. The goal of this section is to just show how the same concepts for the single price stability goal could be applied to a single "maximum employment" proxy. As noted earlier, GDP and Unemployment are tough variables to influence as a proxy for maximum employment, but given the data in Table 1, we could draw similar cone charts to track overall progress of these variables over relevant time windows and reasonable volatility, and hold them less accountable to the achievement of these goals as long as they stay in say the 1 standard deviation of the cones. We suggested, based on the various data windows in Table 1, that for Real GDP Growth say a long-term target of 3%, with 3.5% volatility, over a rolling 5-year window. We show this in Figure 5. The impact of the covid shock on economic activity is obvious and may allow for a longer-term window to bring the economy back to the long-term path and clearly there will be some base effect distortions when these values drop out of the rolling window.*

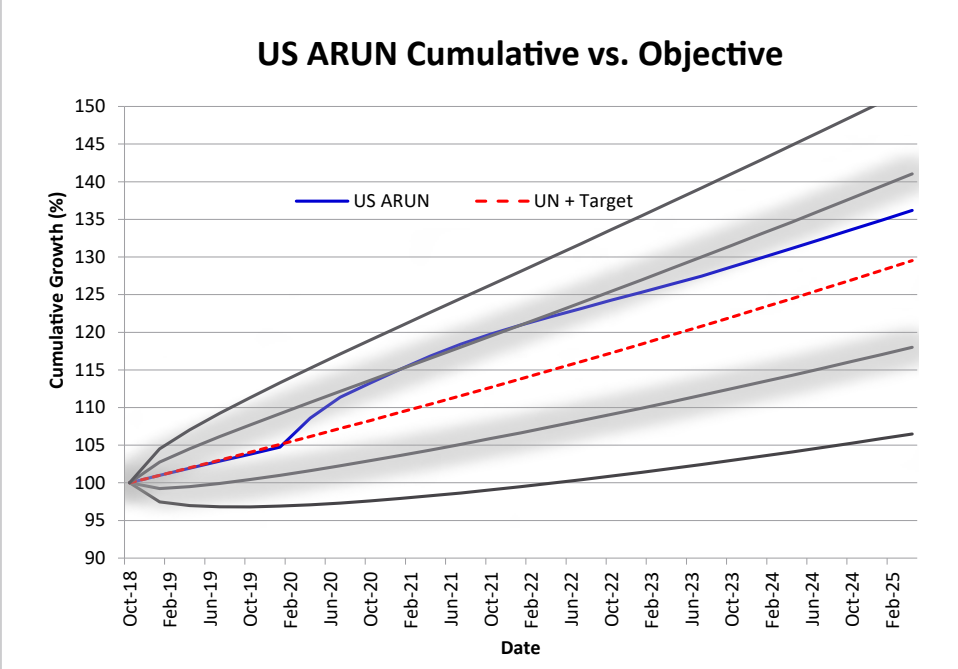
***Figure 5: Path of Real GDP Relative to Better Benchmark Specifications (3% annual target; 3.5% volatility; 5 year rolling window). Data from December 10/2018 – March 2025.***




*Source: FRED + Author's Calculations*

*In the case of Unemployment, again using Table 1, which is more closely tied to maximum employment and the concept of NAIRU noted in the BLS comment earlier, we could suggest that the Actual Realization of Unemployment (ARUN) - a 5% Unemployment, with say 4% volatility, over a rolling 5-year window (as Unemployment is more impactful on the economy as it hits the wallet directly) – be the target. This is shown in Figure 6 and much like Real GDP, shows the impact of covid, but also demonstrates that government policy helped keep this rate in the 1-standard deviation cone. Interestingly, the GDP Now forecasts from the Atlanta Fed can be layered onto this chart, rather than arbitrary and opaque "dot plots".[22] After all, that is produced by the Fed and rather than 19 collective guesses maybe the Fed picks just one? The ARUN is tricky as with current employment below 4%, stimulating employment to get the blue line back to the red line could be problematic.*

***Figure 6: Path of Unemployment Relative to ARUN (5% annual target; 5.5% volatility; 5 year rolling window). Data from December 10/2018 – April 2025.***




*Source: FRED + Author's Calculations*

*Alternative Indicators of Maximum Employment*

*As Barcana and Wessel (2022) list, there can be many indicators to show that the maximum employment is broad-based and inclusive; these could include the Labor Force Participation Rate, employment to population ratio, quits etc. As long as the variable is measurable with some degree of certainty, it is a candidate for this approach. Given the multiple indicators, one can imagine the governors being given a dashboard on a cell phone (along with folks at Treasury), so these can all be monitored in real time and they can be held accountable. While we will not cover more complex variations, one can see Fed economists potentially creating a weighted indicator much like various Economic Surprise indices.*

22 *https://www.atlantafed.org/cqer/research/gdpnow*

## *Section 5. Integrating Price Stability and Maximum Employment into a Single Goal = PEACE!*

*The challenge with two stochastic goals is how does one rank one versus the other or consider trade-offs between them. The Fed monetary statement seems to suggest that they have equal importance, but the employment goal lacks ANY specificity. In this section, we introduce a new index, the PEACE Price Index.*

*The two matrices below demonstrate the challenge of using either an employment or unemployment measure versus PCEPI. We need a target, stochastic index, which can be clearly identified as "high" (and hence either "good" or "bad") or "low". We will argue that in order to create a multi-goal measure, integrated into a single measure, we need to create a price index that is adjusted for "maximum employment", and hence this must be a ratio of the form shown in equation (1).*

$$\text{PEACEPI} = \frac{\text{PCEPI}}{\text{Measure of Maximum Employment}} \qquad (1)$$

*As Figure 7A demonstrates, using PCEPI against say "Total Nonfarm, All Employees" (PAYEMS) creates an index that is easier to interpret than say using "Unemployment Rate" in the denominator in equation (1).*

*Figure 7A: PEACE Price Index using Employment to Normalize*

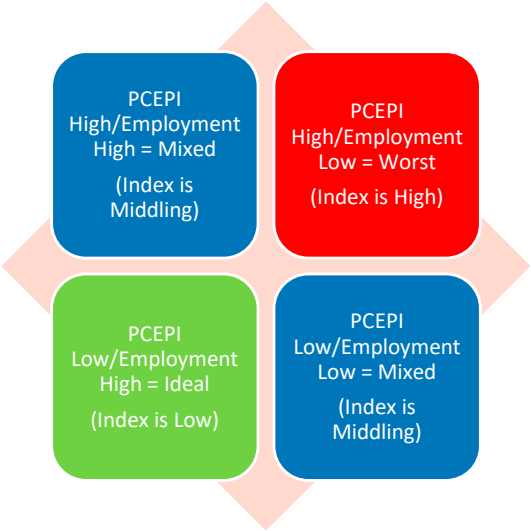
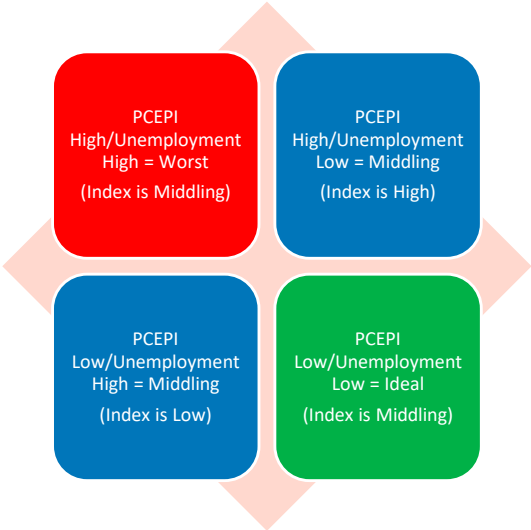



*Figure 7B: PEACE Price Index using Unemployment to Normalize*



*What Figures 7A vs 7B show is that if our chosen denominator is say the PAYEMS series from FRED, then when the Index is high, that means the Fed is probably failing on both goals and vice-versa, whereas when the index is middling, then they are doing okay on one or the other. With Unemployment in the denominator, the extremes of the index indicate middling behavior, which makes it harder to have accountability.*

*So, following Ambarish-Seigel (1996), we can summarize that we have two stochastic variables, say P and E, then the following must hold (with the derivation shown in Appendix C).*

$$\text{If } R(t) = \frac{P(t)}{E(t)} \tag{2}$$

*Then the corresponding risk measure for the PEACEPI Index for our cones is in equation (3) and referred to as Tracking Error in the institutional asset management business.*

$$\sigma_R^2 = \sigma_P^2 - \sigma_E^2 - 2 * \sigma_P * \sigma_E * \rho_{P,E} \tag{3}$$

### *i. Modeling PEACEPI Cones*

*In order to demonstrate how this would work, we provide some high-level statistics on the PEACEPI, in comparison to other variables in Table 2.*

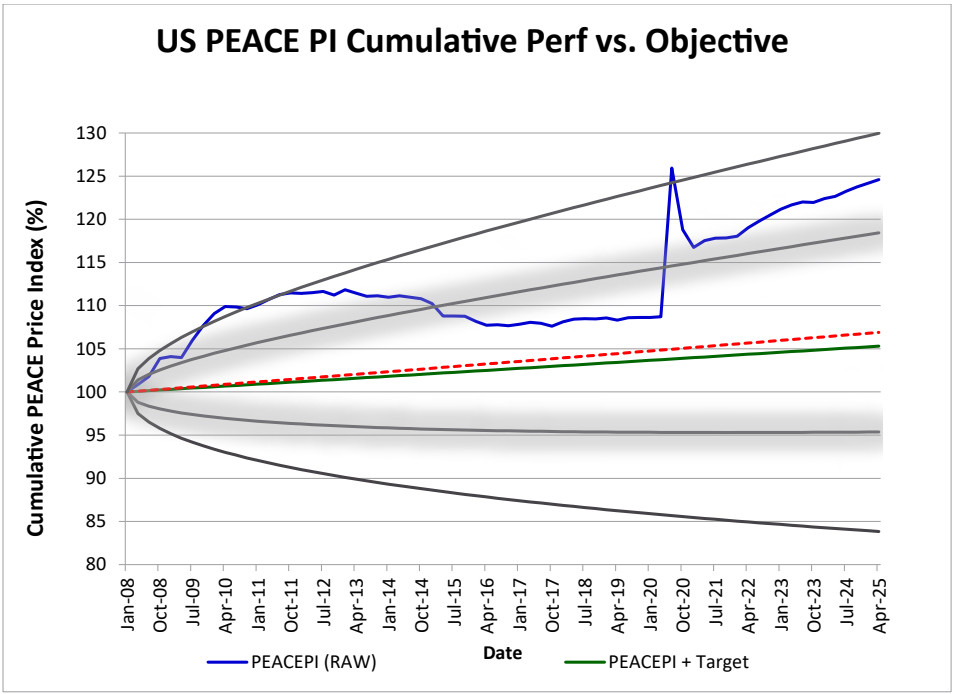
***Table 2: Historical Data on PEACEPI, PAYEMS and PCEPI over Different Time Windows.***

| | Since Inception | | | From 2008 | | | From 2020 | | | Last 10 Years | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PEACE % | PAYEMS (%) | PCEPI % | PEACE % | PAYEMS (%) | PCEPI % | PEACE % | PAYEMS (%) | PCEPI % | PEACE % | PAYEMS (%) | PCEPI % |
| Annual Return | 0.39% | 1.69% | 3.24% | 0.34% | 0.81% | 2.06% | 0.70% | 0.88% | 3.48% | 0.37% | 1.20% | 5.98% |
| Std Deviation | 2.60% | 2.26% | 1.31% | 4.17% | 3.99% | 1.14% | 7.29% | 7.06% | 1.11% | 5.34% | 5.12% | 1.00% |
| "Sharpe" | 0.15 | 0.75 | 2.48 | 0.08 | 0.20 | 1.81 | 0.10 | 0.12 | 3.14 | 0.07 | 0.23 | 5.98 |
| Correlation to PCEPI | 0.34 | 0.17 | | -0.10 | 0.36 | | -0.49 | 0.58 | | -0.31 | 0.46 | |

*Source: FRED and Author's Calculations.*

*Interestingly, the PEACEPI long-term and short-term levels hover around 0.3% and the tracking error ranges from a low of 2.60% over the long-term (since 1959 through April 2025), to more than 7% (from 2020)! Hence, the Fed governors can choose a level commensurate with their preferences, but this will also establish the horizon over which they can be measured – very simply, the greater the tracking error targeted, the longer the horizon to have confidence that they have achieved their goals (using a variant of the Ambarish-Seigel 1996 formula, adjusted in this context in Appendix C). For simplicity, assume the Since Inception values to draw out the cones just to highlight whether the Fed is successful in their dual mandate as shown in Figure 8.*

*Figure 8: PEACEPI Actual vs a Target of 0.39% p.a. and Tracking Error Cones of 2.6% (Using Since Inception inputs)*




*What Figure 8 shows is that even if the cones were widened, inflation, adjusted for employment (using our measure), has been running hotter relative to our definition of employment, and hence the Fed should be thinking about appropriate policies to bring this into check. As we noted, if the blue line is above the green, as shown in Figure 7A, that is a bad situation, and the Fed is NOT achieving its goals!*

*In Appendix D, we assume that the Fed sets a PEACEPI target of 0.3% and a tracking error of 4% and ask if we can have some confidence that they have achieved these goals with some confidence over varying time periods – the answer does not appear to be so. Again, this is just meant to be illustrative so that the Fed or some other independent body can utilize to develop more appropriate and refined measures.*

## *Section 6. Net Zero Goals, Balance Sheet Reduction and Fed Compensation*

*Other Goals – Balance Sheet Reduction and Net Zero.*

*The balance sheets of the central banks have ballooned post the Global Financial Crisis (GFC) and central banks acquired many Treasury securities and Mortgage-Backed Securities (MBS).*[23] *As with the other goals, the Fed and European Central Bank (ECB) SHOULD indicate how much of that balance sheet they will allow to run-off or sell periodically (Quantitative Tightening or QT – which is at odds with lowering interest rates), but again without giving ranges to allow market participants to see how this may also be bumpy has participants guessing. There may be some benefit to not specifying these sales as the central banks have taken substantial and record losses on holding these securities as interest rates have risen at their behest – which is a tax on citizens.*[24, 25] *Hence, they could be conflicted to lower interest rates to minimize these losses and hence this could also be measured.*

23 *https://data.bis.org/topics/CBTA/tables-and-dashboards.*
24 *https://www.reuters.com/markets/europe/bundesbank-posts-big-loss-predicts-more-2024-02-23/*
25 *https://www.reuters.com/markets/europe/ecb-reports-record-loss-2023-rate-hikes-bite-2024-02-22/*

*The Net Zero goal gets a bit more complicated as the ECB has committed to a 55% reduction in emissions by 2030 and Net Zero by 2050.*[26] *Muralidhar and Muralidhar (2024) examine the difficulties in measuring these "financed emissions" for the largest US public pension funds and endowments multi-asset portfolios and how these goals could potentially lead to non-obvious investment decisions in those portfolios; similarly for the ECB. Again, the Muralidhar-Muralidhar approach could be used to lay out intermediate targes (i.e., between today and 2030 and then again through 2050) as these policies are silent on intermediate points, not to mention volatility. However, the specificity of the end dates is useful.*

*Compensation of Fed Officials*

*In the opening quote, Prof. Modigliani expresses his frustration back in 1977 that if we do not know what the targets are, how can we hold Fed officials accountable. As we saw in the case of CalSTRS, the absence of any definition of risk makes it hard to know how they are doing relative to their goals.*[27] *The one point of agreement during the famous Friedman-Modigliani monetarist-New Keynesian debates was on Fed compensation (the other was on rational expectations). Their dialog has this exchange:*

*"Modigliani: I. think· they would have an interest in the country; and I am quite willing to say that they should be paid a wage which is escalated on real national income. It could go up one point for each one-point rise in real income and then go down three points each time the inflation goes up. So, you see, I have a very one-sided bias against inflation.*

*Friedman: Franco, I agree that they should; but tell me, what chance do you think there is that such a method of payment would ever be adopted? And why not? It is such a sensible method; why should we deprive ourselves of such a sensible rule for compensating our servants?"*

*To the comment we made earlier on the "Ski Slopes" section, there is a case to be made for typing compensation to performance relative to these goals, on a risk-adjusted basis. However, to a comment/poll I ran on LinkedIn, given the wealth of governors is also influenced by stock market performance (favoring low rates over high as many were/are millionaires), should the compensation be adjusted in their salaries or wealth, as the former is trivial compared to the latter? This is being addressed in future research.*

## *Section 7 - Conclusions*

*The stable price goal of central banks is one of the most watched globally, and any indication that current inflation is different from this level (and expectations of the market) can lead to dramatic market movements in all liquid assets (and potentially valuations of illiquid or private assets). This goal consumes immense volumes of ink in the press and occupies the bulk of business television. We demonstrated how this benchmark is "under specified" and allows for a mismatch between what the Fed believes its mandate to be and the impact on markets and citizens they are meant to serve. We demonstrated how the Fed could take a page from the effective benchmarking practices of institutional investors, to set a simpler and more transparent benchmark, that allows for the achievement of longer-term goals (and less examination of "collective dot plots") and in turn, better governance, transparency and accountability.*

26 *https://www.ecb.europa.eu/ecb/climate/green_transition/html/index.en.html.*

27 *Totally unplanned, but my undergraduate students at Georgetown University (in "Asset Management") were asked to evaluate the efficacy of the CIO of CalSTRS – the longest serving public official. While he has received numerous awards, the question for the students is whether he achieved his various goals on an absolute and risk-adjusted basis. Most specifically, what has happened to the funded status during his tenure, because ultimately, the only goal that matters is whether CalSTRS can pay its beneficiaries and any worsening of the funded status is a wealth transfer from future generations to the current one – a typically unpleasant outcome.*

*We propose an alternative and more realistic benchmark, which allows for better tracking of not only current inflation experience but also over the "longer run", an unspecified time period in current Fed announcements, publications, and minutes. We suggest adding a volatility component, and a specific time period over which they will be measured for various goals. Most importantly, the 2% goal ignores the pernicious effect of compounding – a trivial insight but ignored in the goal statements and press conferences completely. We show graphically how a new benchmark could be created that achieves a better potential outcome with greater specificity and a visual representation of the objectives that even non-technical citizens can track. More importantly, from these charts it is hard to see why the Fed would want to cut assuming that our time window of a rolling 10-year is a reasonable one. More importantly, we also demonstrated how the Fed could specify clearly the path of inflation they anticipate relative to the long-term path and also what they will do should actual inflation over long periods track above the 1 and 2 standard deviation cones.*

*We conclude with a discussion of the application of this idea to other goals including GDP, unemployment, QT and Net Zero, challenges for such goals, and the possibility of combining targets for goals, as the Fed has a multi-goal objective. For GDP we suggested that the Fed could use GDP Now forecasts instead of confusing and potentially arbitrary dot plots and for maximum unemployment we suggest ARUN – a dashboard to integrate the many employment variables the Fed tracks. These could be pushed onto an app or even a cell phone of governors and Treasury officials to ensure that they can monitor the economy and also be held accountable to higher officials, thereby improving governance. Finally, we integrated the dual mandate of price stability and maximum employment to suggest the creation of a new PEACE Price Index, which can be used to set a single target for an integrated goal and again the Fed seems to be behind the 8-ball even with this definition of "price stability".*

*To bring this full circle, we quote Franco Modigliani, who helped develop some of the earliest Fed macro-economic models and also developed the M-square risk-adjusted performance measure (Modigliani-Modigliani 1997), to ensure effective governance of agents (asset managers) relative to a benchmark. The Fed governors have a governance role (over the economy) as their titles suggest and Congress has a governance role relative to the Fed and Treasury. To paraphrase Franco Modigliani slightly and to tie his comments on lack of clarity on goals, risk-adjusted returns and Fed officials' compensation: "Yes – you can eat risk-adjusted price stability."*

## *Appendix A – The Relative Macro Economics Model*

*We quote extensively from Muralidhar (2025). We were all taught that a country's GDP is easily specified by equation A.1:*

$$GDP\ (Q) = C + I + G + NX \qquad (A.1)$$

*Where* Q *is Output,* C *is Private consumption,* I *is Investment by private companies,* G *is Government spending, net and* NX *is Net Exports. In the simple traditional model,* C *and* I *are negatively related to interest rates (i.e., the first derivative of* C *and* I *to* r *are negative and hence lower rates = higher* C *and* I*), and* G *and* NX *are relatively unaffected by interest rates (except in highly unusual circumstances). Usually, we are taught that the causality is the other way around: higher government spending leads to higher interest rates, and this crowds out private investment. Moreover, in the traditional model, a lowering of corporate and personal tax rates leads to a nearly unambiguous increase in GDP.*

*One will recognize immediately that this naïve description of the economy ignores pension funds and relative wealth investors – especially the impact on liabilities! Each of the first three components of the GDP equation have a connection to pension funds, because each of them effectively sponsors a pension fund and seeks to ensure that there are sufficient funds to meet the target liability.*

*Aizenman, Cheung and Ito (2017) note that, "Conventional logic suggests that lowering the policy interest rate will stimulate consumption and investment while discouraging people from saving, but low interest rates may also prompt people to increase their saving to compensate for the low rate of return. Using data on 135 countries from 1995 to 2014, this paper shows that a low-interest rate environment can yield different effects on private saving across country groups under different economic environments." Individual consumers save through some form of defined contribution (DC) plans. While 401(K) plans are employer-sponsored, the risk and the decisions to ensure adequate retirement rests entirely with individuals, and there is a global trend to pass retirement risk onto individuals. Therefore, in the Merton-Muralidhar world, the traditional private consumption variable is replaced with a new variable,* $C_p$*, which is the traditional private consumption, with an adjustment for the outstanding pension liability (target retirement income) of all individuals. While in some poor countries this may be a small number, it should be evaluated nonetheless. The World Economic Forum's estimate of the pension liability of this segment, assuming each individual has a reasonable target retirement income, would meaningfully exceed US GDP! Now, the impact of lower interest rates is not as clear as in the conventional model because lower rates also lower the funded status of DC plans because of the increased liabilities expected to be funded by DC plans. This forces individuals to save more and could offset the ability of lower rates to raise consumption (through a simple wealth effect). Aizenmen, Cheung and Ito (2017) examine the effect of rates on savings in 135 countries from 1995-2014 and conclude that, "Among developing countries, when the nominal interest rate is not too low, we detect the substitution effect of the real interest rate on private saving. However, among industrial and emerging economies, the substitution effect is detected only when the nominal interest rate is lower than 2.5%." The income effect is defined as follows: a higher interest rates leads to higher consumption and lower savings (i.e., negative); and the substitution effect as higher interest rate leads to lower consumption and higher savings (i.e., positive).*

*Similarly, private companies, in addition to investing to grow their business, also sponsor defined benefit (DB) pension plans. According to Milliman, the aggregate funded status of the top 100 companies' DB pension plans is approximately 91 percent, and total liabilities would exceed $2 Trillion. Once again, one should replace the private company investment variable with* $I_p$*, which is the traditional investment variable with an adjustment for outstanding pension liabilities of all private companies. Lower rates clearly pushed the funded status of DB plans lower globally and forced many companies to contribute more. This trend was*

*reversed once rates started to rise. But how did tax reform play out? Interestingly, the reform of 2017 gave many companies the incentive to contribute more to their pension funds, claiming a deduction at the higher 2017 tax rate. So, rather than stimulating investment as would be expected in conventional theory, the tax cut stimulated contributions to the pension funds (a form of savings) and also share buybacks, flowing into asset markets with no new investments taking place. This is another example of the distortion created by pension funds/pension liabilities, especially underfunded plans, on the economy and macro-economic policy. Hence, you cannot unequivocally say that lower rates lead to higher investment; the first derivative of* $I_p$ *to interest rates could be positive.*

*The third aspect, completely neglected by the academic community in the conventional model, is the fact that federal, state and local governments offer a range of DB plans to their employees. Milliman's index of the funded status of the 100 largest public pension plans stands at approximately 71% and total liabilities would exceed $5 Trillion. This estimate excludes the potential deficit of the Pension Benefit Guarantee Corporation (PBGC), which is also similarly impacted by interest rates, and a burden of the government, and excludes Social Security which will soon revert to being financed entirely by taxes. While the traditional GDP formula pretty much ignores the impact of interest rates on G, in the MM world,* $G_P$*, is the original government spending variable enhanced to incorporate the impact of the public DB plans on government spending. Succinctly, the lower the interest rates, the lower the ability of governments to stimulate the economy. This follows because the lower funded status of public pension funds forces them to contribute more to the pension funds, impinging on federal, state and local government budgets. Recent data from the Society of Actuaries shows how contributions rose dramatically from 2005-2016, while liabilities also increased dramatically.*[28] *The pressure on public funds in the low-rate environment had been acute; while many pension funds have lowered their expected returns, many public fund sponsors have battled with the pension fund boards because a lower expected return places enormous pressure on their budgets.*

*In other words, the correct formula for GDP in the real world, which incorporates the potentially distorting effects of liabilities of the pension funds of the three key sectors of the economy, individuals, companies and government entities is as in equation A.2:*

$$GDP = C_P + I_P + G_P + NX \qquad (A.2)$$

*This formula has markedly different reactions to various policy variables like interest rates and tax rates than the traditional formula as summarized in Table A.1. Policy makers that adopt conventional economic solutions to challenges of a weak economy run the risk of experiencing the unintended consequences of the pension plan impact. Lower rates could lower GDP depending on how each segment of the economy reacts to lower rates – if the overwhelming impact of the increase (decrease) in liabilities is to save more (less), one could explain the savings glut (reduction) by this distortion. Similarly, if lower taxes in the future lead companies and individuals to attempt to save more to fund their pensions, once again, the impact on GDP could be muted, reflecting Einstein's quote: "The hardest thing in the world to understand is the income tax." Stated differently, in this relative world (relative to pension liabilities), one has to bend their perspective on economic activity and economic actors, much like Einstein noted that light is bent by gravitational fields of large objects.*

28 *https://www.pionline.com/article/20190212/ONLINE/190219955/public-pension-contributions-grow-but-so-do-liabilities-8212-soa-analysis*

***Table A.1: Comparing traditional macro model and relative macro model forecasts for fiscal and monetary policy***

| *Macro Policy Tool* | *Traditional Economics* | *"Relativity" Focused* |
|---|---|---|
| Lower short- and long-term interest rates | *Increase Q through C and I (G unaffected). Should lead to economic growth and some increase in core inflation* | *Depending on the state of the relative economy (demography, funded status etc.), could lower C, I and G, leading to lower Q. Does not stimulate economic growth but leads to asset inflation (and less likely core inflation)* |
| Lower taxes | *Ostensibly raise C (after-tax income) and I (stimulates economy)* | *Encourages additional savings in pension schemes and hence C and I could decline* |

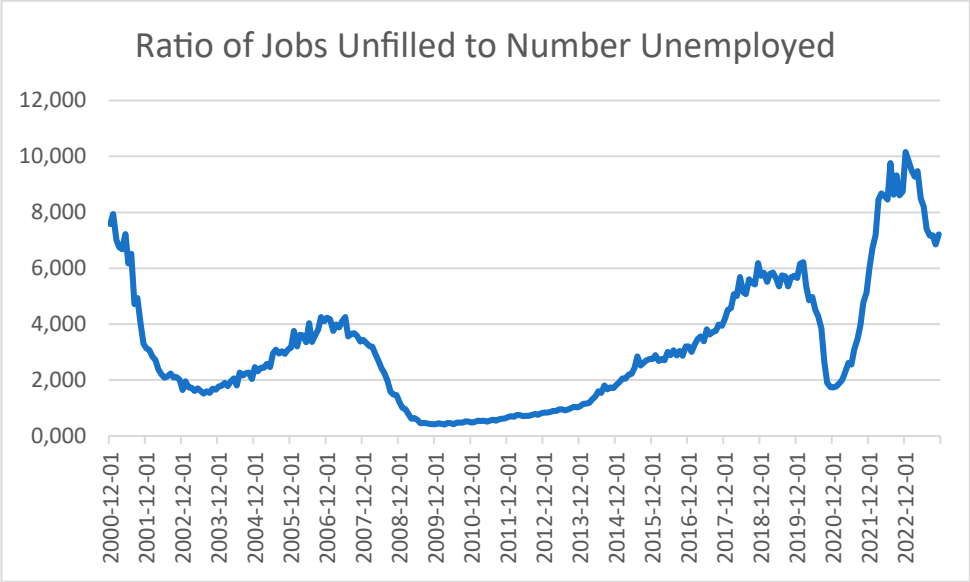
## *Appendix B: The Bernanke-Blanchard Measure of Full Employment Profs.*

*Ben Bernanke and Olivier Blanchard argue that tight labor markets are best measured by the ratio of the number of vacancies to the number of unemployed (Wessel 2023). Since this data is not provided by FRED, we calculated our best estimate of the same using the two following data series from FRED:*

1. *Other Labor Market Measures: Job Vacancies: Total: Unfilled Vacancies (Stock) for United States, Number, Monthly, Seasonally Adjusted*
2. *Number Unemployed for 27 Weeks & over, Thousands of Persons, Monthly, Seasonally Adjusted*

*The ratio is plotted in Figure B.1*

***Figure B.1: Ratio of Jobs Unfilled versus Number Unemployed: 12/2000 – 12/2022***




*Source: FRED and Author's Calculations.*

*The summary data over the entire period is provided in Table B.1.*

***Table B.1: Summary Statistics Ratio of Jobs Unfilled versus Number Unemployed: 12/2000 – 12/2022***

| Since Inception | BB Ratio |
|---|---|
| Annual Return | 3.21 |
| Std Deviation | 4.72 |
| "Sharpe" | 0.68 |
| Correlation | -0.657 |
| Max (Qtrly) | 9.84 |
| Min (Qtrly) | 0.43 |
| Median (Qtrly) | 2.78 |

*Source: FRED and Author's Calculations.*

*This index could also be used with the method discussed in Sections 2 and 3.*

## *Appendix C – Stochastic Dynamics of a Ratio of Two Stochastic Variables*

*Ambarish and Seigel (1996) derive useful equations which can help us understand the dynamics of the ratio of PCEPI to PAYEMS, both stochastic, and how it can be used in a dynamic multi-period world.*

*Assume that PCEPI (*P*) and the PAYEMS (*E*) are the two stochastic variables under consideration, and*

$$R = \frac{P}{E}. \quad \text{(A.C.1)}$$

*In finance it is typical to think of risk as variance or the squared standard deviation of returns from the mean return. Therefore, in a relative comparison, one would want to define the variance of the relative return per unit of time as the difference of the numerator and the denominator. In other words, one would want the following condition to hold:*

$$\sigma_R^2 = \text{variance per unit of time of } \left(\frac{dP}{P} - \frac{dE}{E}\right) \quad \text{(A.C.2)}$$

*And that* P *and* E *follow the generalized Weiner process so that*

$$\frac{dP}{P} = \mu_p dt + \sigma_P dz \quad \text{(A.C.3)}$$

$$\frac{dE}{E} = \mu_E dt + \sigma_E dz \quad \text{(A.C.4)}$$

*Where* $(\mu_P, \sigma_P)$ *and* $(\mu_E, \sigma_E)$ *are the instantaneous mean and volatility parameters of the PCEPI and PAYMES, respectively, and reported in Table 1 for different time horizons. Define* $\rho_{P,E}$ *as the correlation between* P *and* E *and define the ratio of the portfolio and benchmark as* R(t) *such that*

$$R(t) = \frac{P(t)}{E(t)} \quad \text{(A.C.1)}$$

*The dynamics of* R(t) *can be extracted using Ito's Lemma such that*

$$\frac{dR}{R} = \left(\mu_p - \mu_E + \sigma_E^2 - \sigma_P \sigma_E \rho_{P,E}\right) dt + \sigma_P dz_p - \sigma_E dz_E \quad \text{(A.C.5)}$$

*As noted in the original article, "the variance of the stochastic terms in (A.C.5) are identical to those in equation (A.C.2), completing the intuitive appeal of using* R(t) *as measure of relative performance." Equation A.C.2 is the square of the "tracking error" – which is a very important relative risk term, especially in institutional investing (as noted in Section 1), and used to determine whether agents are lucky or skillful.*

*Since we are interested in the time development of* R(t), *define* dz *such that*

$$\sigma_R dz = \sigma_P dz_p - \sigma_E dz_E \quad \text{(A.C.6)}$$

*Squaring both sides and reducing since* $dz^2 = dt$ *and* $dz_P * dz_E = \rho_{P,E} dt$

$$\sigma_R^2 = \sigma_P^2 - \sigma_E^2 - 2 * \sigma_P * \sigma_E * \rho_{P,E} \quad \text{(A.C.7)}$$

*Equation (A.C.7) is very interesting as it is exactly the square of the tracking error. This validates the use of this formulation for the relative risk measure that need to use for PEACEPI.*

*One can go a step further and derive a simple geometric Brownian motion from (A.C.5) for* R *(much like is used for the derivation of stocks) such that*

$$R(t) = R(0) * exp^{\sigma_R \epsilon \sqrt{t}} * exp\left[\left\{\left(\mu_P - \frac{\sigma_P^2}{2}\right) - \left(\mu_E - \frac{\sigma_E^2}{2}\right)\right\} t\right] \quad \text{(A.C.8)}$$

*Where ∈ is the standard normal variable, and exp is the exponent. The first exponential factor in equation (A.C.8) is the noise component and the second exponent is the whether the goal dominates noise. Therefore, for the goal to dominate noise, a minimum number of data points,* T, *are needed or alternatively,*

$$T > \frac{K^2 * (\sigma_P^2 - \sigma_E^2 - 2 * \sigma_P * \sigma_E * \rho_{P,E})}{\left\{\left(\mu_P - \frac{\sigma_P^2}{2}\right) - \left(\mu_E - \frac{\sigma_E^2}{2}\right)\right\}^2} \qquad \text{(A.C.9)}$$

*Where* K *(Kappa) is the number of standard deviations for a given confidence interval. For example, when* K *=1, then one desires an 84% confidence in the skill of the Fed in achieving its goals and so on. Through cross multiplication, and taking the square root of both sides, we can now establish the time horizon for the Fed to be measured based on our desired confidence that they are skillful. Hence, the horizon in their monetary policy statement, need not be an arbitrary number, but rather tied to the stochastic processes of PCEPI and PAYEMS.*

$$\sqrt{T} * \left[\frac{\left\{\left(\mu_P - \frac{\sigma_P^2}{2}\right) - \left(\mu_E - \frac{\sigma_E^2}{2}\right)\right\}}{\sqrt{(\sigma_P^2 - \sigma_E^2 - 2 * \sigma_P * \sigma_E * \rho_{P,E})}}\right] > K \qquad \text{(A.C.10)}$$

## *Appendix D. Using Ambarish-Seigel (1996) to Establish Confidence in Fed*

*Ambarish and Seigel (1996) derive useful equations which can help us tell how confident we can be that the Fed is achieving a stochastic goal versus a stochastic benchmark. We provide some high-level numbers over different time windows, and even with a generous assumption that the actual PEACEPI tracks a benchmark with a correlation 0.99, the confidence we have in their skill over different time windows is poor. Over the last 10 years, even on the assumption that they ran PEACEPI at 0.24%, less than a target of 0.3%, given the high tracking error, the confidence we have is less than a coin-toss. The other periods are no better. This is purely hypothetical but is meant to illustrate how a stochastic benchmark can be used to measure the efficacy of the Fed over various time horizon.*

*Table A.D.1: Confidence in the Skill of the Fed in Achieving Personal Employment Adjusted Consumption Expenditure Price Inflation Stability*

| Fed Goal =PEACEPI (1) | PEACEPI ACTUAL (2) | PEACEPI TARGET (3) | Correlation (4) | PEACEPI ACTUAL Volatility (5) | PEACEPI TARGET Volatility (6) | Excess (7) = (2) - (3) | Tracking Error (8) | Ratio (9) = (7)/(8) | K (# Std Deviations of a Unit Normal) (10) | Confidence in Skill (11) derived from (10) | Time in years (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 YEARS | 0.24% | 0.30% | 0.990 | 5.38% | 4.00% | 0.06% | 1.53% | 0.04 | -0.02 | 49% | 10.00 |
| SINCE 2008 | 0.31% | 0.30% | 0.990 | 4.28% | 4.00% | -0.01% | 0.647% | -0.01 | -0.10 | 46% | 15.00 |
| SINCE 2020 | 0.64% | 0.30% | 0.990 | 8.61% | 4.00% | -0.34% | 4.680% | -0.07 | -0.25 | 40% | 3.50 |

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