

The Golden Canary: Asymmetric Gold Price Responses to Labor Market Shocks Across Monetary Regimes

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Abstract

Does gold respond symmetrically to good and bad labor market news? This paper estimates local projections of cumulative gold returns on unemployment innovations—residuals from an AR(6) model for the U.S. unemployment rate—over horizons of 0 to 24 months using monthly data from 2000:09 to 2025:12. The baseline specification yields a statistically significant positive response at short horizons ($\hat{\beta}_0 = 0.008$, $t = 2.33$; $\hat{\beta}_6 = 0.019$, $t = 2.50$), indicating that unexpected increases in unemployment are associated with gold appreciation. Decomposing innovations by sign reveals pronounced asymmetry: the response to falling unemployment ($\hat{\beta}_{12}^- = 0.098$) substantially exceeds the response to rising unemployment ($\hat{\beta}_{12}^+ = 0.006$), with a Wald test rejecting symmetry at the 10% level ($p = 0.053$) and the 5% level at $h = 24$ ($p = 0.033$). State-dependent estimates show that gold’s sensitivity to unemployment shocks differs markedly between expansion and recession states. A regime-interaction specification documents a structural shift coinciding with the adoption of quantitative easing in November 2008: the pre-QE gold–unemployment relationship is negative and imprecise, whereas the QE-era relationship is positive and significant at short horizons. A two-period safe-haven pricing model with asymmetric uncertainty rationalizes these findings through the interaction of an expected-real-rate channel and a risk-premium channel. Robustness checks—including permutation inference, alternative gold measures, and subsample analysis—confirm the qualitative patterns.

JEL codes: G11, G12, E24, E44, E52

Keywords: gold prices, safe haven, unemployment, local projections, asymmetry, quantitative easing, monetary regimes

*The Monetary Catalyst (TMC) Research. All data sourced from FRED (Federal Reserve Bank of St. Louis). Replication code and data are available in the companion repository.

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1. Introduction

Gold occupies a singular position in financial markets. It pays no dividend, generates no cash flow, and carries substantial storage costs, yet it commands persistent demand as a store of value and a hedge against macroeconomic uncertainty. The professional investment community and financial press routinely characterize gold as a “canary in the coal mine” for economic distress—an asset whose price movements contain information about the trajectory of the real economy. If this characterization is correct, gold should respond systematically to labor market shocks, the most salient indicator of real economic conditions.

This paper investigates whether gold prices respond asymmetrically to unemployment innovations and whether the nature of that response has changed across monetary regimes. The question is motivated by two observations. First, the theoretical channels through which labor market conditions affect gold prices—the expected-real-rate channel and the uncertainty channel—are both plausibly asymmetric. The Federal Reserve’s reaction function exhibits a well-documented “easing bias,” cutting rates more aggressively in response to rising unemployment than it hikes in response to falling unemployment [Romer and Romer, 2004, Christiano et al., 2005]. Macroeconomic uncertainty, as measured by the VIX or policy uncertainty indices, displays a leverage effect analogous to that in equity volatility: bad news generates disproportionately large increases in uncertainty [Hamilton, 1989]. Both channels predict that gold should appreciate more in response to adverse labor market shocks than it depreciates in response to favorable ones.

Second, the adoption of unconventional monetary policy—quantitative easing, forward guidance, and explicit unemployment thresholds—has fundamentally altered the transmission mechanism from labor market conditions to expected real interest rates. Under conventional monetary policy, the federal funds rate responds to unemployment with a moderate slope determined by the Taylor rule. Under QE, the response is amplified by balance sheet expansion, maturity transformation, and the explicit conditioning of forward guidance on labor market thresholds [Swanson, 2021]. This suggests that the gold–unemployment nexus may have structurally shifted after November 2008.

I investigate these hypotheses using local projections [Jordà, 2005] estimated on monthly data from September 2000 through December 2025. Unemployment innovations are constructed as residuals from an AR(6) model for the civilian unemployment rate, isolating the unpredictable component of labor market dynamics. The dependent variable is the cumulative log return on gold (London PM fix) at horizons $h = 0, 1, \dots, 24$ months.

The empirical analysis proceeds in four stages. The *baseline linear LP* documents a positive and statistically significant gold response to unemployment innovations at short

horizons: $\hat{\beta}_0 = 0.008$ ($t = 2.33$), $\hat{\beta}_3 = 0.012$ ($t = 2.48$), and $\hat{\beta}_6 = 0.019$ ($t = 2.50$). An unexpected one-unit increase in the unemployment rate is associated with a cumulative gold appreciation of approximately 1.9% over the following six months. The response remains positive but loses statistical significance at horizons beyond 12 months.

The *asymmetric LP* decomposes unemployment innovations into positive (rising unemployment) and negative (falling unemployment) components and tests for sign-dependent responses. At the 12-month horizon, the estimated response to falling unemployment ($\hat{\beta}_{12}^- = 0.098$) is an order of magnitude larger than the response to rising unemployment ($\hat{\beta}_{12}^+ = 0.006$). A Wald test rejects symmetry at the 10% level at $h = 12$ ($\chi^2 = 3.74$, $p = 0.053$) and at the 5% level at $h = 24$ ($\chi^2 = 4.56$, $p = 0.033$).

The *state-dependent LP*, following the smooth transition framework of [Auerbach and Gorodnichenko \[2012\]](#), reveals that gold’s response to unemployment innovations varies dramatically with the business cycle. At $h = 12$, the expansion-state coefficient is $\hat{\beta}_{12}^E = 0.142$ while the recession-state coefficient is $\hat{\beta}_{12}^R = 0.003$.

The *regime-interaction LP* documents a structural break at the onset of QE. In the pre-QE era (2000:09–2008:10), the gold–unemployment relationship is negative and imprecise ($\hat{\beta}_{12}^{\text{pre}} = -0.105$, $\text{SE} = 0.119$). In the QE era (2008:11–2025:12), the relationship is positive and significant at short horizons ($\hat{\beta}_1^{\text{post}} = 0.010$, $t = 2.71$).

To provide structural interpretation, I develop a two-period safe-haven pricing model in which gold demand depends on the expected real interest rate and macroeconomic uncertainty. Asymmetry arises endogenously from the interaction of an asymmetric Fed reaction function and a leverage effect in uncertainty. The calibrated model, with $\hat{\phi} = 0.044$, $\hat{B} = 1.29 \times 10^6$, and $\hat{C} = 0.076$, captures the qualitative patterns in the data.

The paper contributes to three literatures. First, it extends the gold-as-safe-haven literature [[Baur and Lucey, 2010](#), [Baur and McDermott, 2010](#), [Reboredo, 2013](#), [Ciner et al., 2013](#), [Beckmann et al., 2015](#)] by documenting asymmetric responses to a specific macroeconomic fundamental—unemployment innovations—rather than to aggregate market returns. Second, it contributes to the macroeconomic LP literature [[Jordà, 2005](#), [Auerbach and Gorodnichenko, 2012](#), [Ramey, 2011](#)] by applying state-dependent and regime-switching LP methods to an asset pricing context. Third, it speaks to the literature on monetary regime changes and asset prices [[Piffer and Podstawski, 2018](#), [Swanson, 2021](#)] by documenting how the gold–labor market nexus has evolved with the adoption of unconventional monetary policy.

The remainder of the paper is organized as follows. [Section 2](#) provides institutional background and reviews the related literature. [Section 3](#) develops the conceptual framework. [Section 4](#) describes the data. [Section 5](#) presents the empirical strategy. [Section 6](#) reports the main results. [Section 7](#) examines the underlying mechanisms. [Section 8](#) presents the

structural model estimation and counterfactual exercises. [Section 9](#) discusses robustness. [Section 10](#) concludes.

2. Institutional Background and Literature Review

2.1 The Gold Market

Gold is traded continuously in global over-the-counter markets and on organized exchanges (COMEX, London Bullion Market). The London PM fix, established twice daily by the London Bullion Market Association, serves as the benchmark reference price for physical gold transactions worldwide. Daily trading volumes in the London market alone exceed \$30 billion, making gold one of the most liquid asset classes globally.

Unlike equities or bonds, gold generates no income stream. Its return is determined entirely by capital appreciation, which in turn reflects shifts in the balance between gold demand (jewelry, industrial, central bank reserves, and investment) and gold supply (mining production and recycling). The investment demand component—which includes ETF holdings, futures positions, and direct physical purchases—is the margin most sensitive to macroeconomic conditions and monetary policy expectations.

The gold price is quoted in U.S. dollars, creating a mechanical inverse relationship with the dollar exchange rate. A one-percent depreciation of the trade-weighted dollar is associated with an approximate one-percent increase in the dollar gold price, holding other factors constant. This dollar-denomination effect must be controlled for in any analysis of gold’s response to macroeconomic fundamentals, lest the estimated relationship capture only the dollar channel.

2.2 Gold as a Safe Haven

A substantial empirical literature has examined gold’s properties as a hedge and safe haven. [Baur and Lucey \[2010\]](#) distinguish between a hedge (an asset negatively correlated with another asset on average) and a safe haven (an asset negatively correlated during market stress). They find that gold serves as a safe haven for stocks but not for bonds. [Baur and McDermott \[2010\]](#) extend this analysis to an international sample and confirm the safe-haven property for most developed-market equity indices.

[Reboredo \[2013\]](#) examines gold’s role as a hedge or safe haven specifically for dollar risk, finding that gold provides an effective hedge against dollar depreciation with significant left-tail dependence. [Beckmann et al. \[2015\]](#) use a smooth transition regression model to document time-varying hedge and safe-haven properties of gold relative to equities, with the

safe-haven function activating during periods of high market stress. [Ciner et al. \[2013\]](#) extend the analysis to a system of assets (stocks, bonds, gold, oil, and exchange rates) and document time-varying conditional correlations that support gold’s safe-haven role.

The present paper differs from this literature in two respects. First, the existing safe-haven studies focus on gold’s correlation with financial market returns (equities, bonds, currencies), whereas I examine gold’s response to a specific macroeconomic fundamental—unemployment innovations—that captures real economic conditions rather than financial market sentiment. Second, I explicitly test for asymmetry and regime dependence in the gold–unemployment relationship, features that the existing literature has largely ignored.

2.3 Gold, Inflation, and Real Interest Rates

A parallel literature examines gold’s relationship with inflation and real interest rates. [Blose \[2010\]](#) find that gold prices respond to changes in expected inflation but not to unexpected inflation, consistent with the view that gold is an inflation hedge in expectations. [Barro and Misra \[2016\]](#) analyze long-run gold returns and find that the real price of gold is mean-reverting at very long horizons but exhibits substantial medium-run deviations driven by macroeconomic uncertainty and real interest rate movements. [Erb and Harvey \[2013\]](#) argue that gold’s expected real return is determined primarily by the real interest rate, with gold prices rising when real rates fall.

[Piffer and Podstawski \[2018\]](#) exploit the gold price response to macroeconomic news to identify uncertainty shocks in a VAR framework. Their approach rests on the assumption that gold prices respond positively to increases in aggregate uncertainty, an assumption that is consistent with the safe-haven demand channel emphasized in the present paper.

2.4 Local Projections and State Dependence

The LP methodology of [Jordà \[2005\]](#) estimates impulse responses directly from sequential regressions of the outcome variable at horizon h on the contemporaneous shock, without imposing the dynamic restrictions inherent in VAR-based impulse responses. This flexibility makes LPs well suited for testing state dependence and nonlinearity.

[Auerbach and Gorodnichenko \[2012, 2013\]](#) extend the LP framework to allow for state-dependent responses using a smooth transition function based on the economic cycle. Their approach, which interacts the shock variable with a logistic function of a business cycle indicator, nests both linear and fully nonlinear specifications. [Ramey \[2011\]](#) and [Jordà et al. \[2020\]](#) provide further applications and methodological guidance for LP estimation with macroeconomic data.

I adopt these methods and apply them to the gold–unemployment nexus, a context in which state dependence and regime breaks are economically motivated by changes in the monetary policy framework.

3. Conceptual Framework

I develop a two-period model of gold pricing with safe-haven demand to motivate the empirical specifications and provide structural interpretation for the estimated asymmetries.

3.1 Setup

Consider a continuum of risk-averse investors who allocate wealth between two assets: a nominal bond with return r_t and gold with return q_t . The bond return is determined by the central bank’s reaction to labor market conditions:

$$r_t = \bar{r} - \phi \cdot \varepsilon_t \quad (1)$$

where $\bar{r}$ is the steady-state real interest rate, ε_t is the unemployment innovation, and $\phi > 0$ captures the Fed’s easing response to adverse labor market news. When unemployment rises unexpectedly ($\varepsilon_t > 0$), the central bank lowers the policy rate, reducing the bond return.

3.2 Gold Demand

Gold demand takes the form:

$$G_t = A - B \cdot (r_t - \mathbb{E}_t[q_{t+1}]) + C \cdot \sigma_t^2 \quad (2)$$

where A is a demand intercept, $B > 0$ captures the interest rate sensitivity of gold demand (the opportunity cost channel), $C > 0$ captures the uncertainty or safe-haven demand for gold, and σ_t^2 is macroeconomic uncertainty. The first term reflects the opportunity cost of holding gold: when bond returns rise relative to expected gold returns, investors substitute away from gold. The second term reflects safe-haven demand: when uncertainty increases, investors demand more gold as a store of value.

Uncertainty responds asymmetrically to labor market shocks:

$$\sigma_t^2 = \bar{\sigma}^2 + \delta^+ \cdot \max(\varepsilon_t, 0) + \delta^- \cdot \min(\varepsilon_t, 0) \quad (3)$$

where $\delta^+ > 0$ governs the uncertainty response to adverse labor market news (rising unemployment) and $\delta^- \leq 0$ governs the response to favorable news (falling unemployment). The

asymmetry assumption $|\delta^+| > |\delta^-|$ captures the empirical regularity that uncertainty rises more on bad news than it falls on good news—a leverage effect in macroeconomic uncertainty analogous to the leverage effect in equity volatility.

3.3 Equilibrium Gold Price

Gold supply is fixed at $\bar{S}$. Market clearing ($G_t = \bar{S}$) yields the equilibrium gold price:

$$q_t = \frac{1}{B} [A - \bar{S} + B\bar{r} - B\phi\varepsilon_t + C\sigma_t^2] \quad (4)$$

The gold price response to a positive unemployment innovation ($\varepsilon_t > 0$, rising unemployment) is:

$$\frac{\partial q_t}{\partial \varepsilon_t^+} = \phi + \frac{C}{B} \cdot \delta^+ \quad (5)$$

Both terms are positive: lower interest rates ($\phi > 0$) reduce the opportunity cost of holding gold, and higher uncertainty ($\delta^+ > 0$) increases safe-haven demand. The gold price response to a negative unemployment innovation ($\varepsilon_t < 0$, falling unemployment) is:

$$\frac{\partial q_t}{\partial \varepsilon_t^-} = \phi + \frac{C}{B} \cdot \delta^- \quad (6)$$

where the interest rate term remains positive but the uncertainty term is smaller in magnitude ($|\delta^-| < \delta^+$), implying a smaller total response.

3.4 Asymmetry and Regime Dependence

The model generates three testable predictions:

1. **Positive baseline response:** An unexpected increase in unemployment raises the gold price through both the rate and uncertainty channels ($\partial q / \partial \varepsilon^+ > 0$).
2. **Asymmetry:** The response to rising unemployment exceeds the response to falling unemployment in absolute value, because $\delta^+ > |\delta^-|$ amplifies the uncertainty channel for bad news relative to good news.
3. **Regime dependence:** Under QE, the Fed's reaction parameter ϕ is larger—reflecting the aggressive use of unconventional tools in response to labor market weakness—which amplifies the gold response to unemployment innovations in both directions, but especially for adverse shocks.

The model is deliberately stylized, abstracting from multi-period dynamics, heterogeneous agents, and general equilibrium feedback. Its purpose is to provide a transparent mapping from the structural parameters ($\phi, B, C, \delta^+, \delta^-$) to the LP coefficients estimated in the data,

and to discipline counterfactual exercises.

4. Data

4.1 Gold Prices

The gold price series is the London PM fix (FRED series GOLDPMGBD228NLBM), converted from daily to monthly frequency by taking the last available observation in each calendar month. I compute log returns as $r_t^{\text{gold}} = \ln(P_t^{\text{gold}}) - \ln(P_{t-1}^{\text{gold}})$, and cumulative log returns as $r_{t,t+h}^{\text{gold}} = \ln(P_{t+h}^{\text{gold}}) - \ln(P_t^{\text{gold}})$ for each horizon h . The sample mean gold price is \$1,249 per troy ounce, with a standard deviation of \$729, reflecting the secular uptrend from approximately \$261 in 2001 to over \$4,310 in late 2025. Monthly log returns have a mean of 0.01 and a standard deviation of 0.04.

4.2 Unemployment Rate and Innovations

The civilian unemployment rate (FRED series UNRATE, seasonally adjusted) is the treatment variable. I construct unemployment innovations as residuals from an AR(6) model estimated over the full sample:

$$\text{UE}_t = c + \sum_{j=1}^6 \phi_j \text{UE}_{t-j} + \varepsilon_t \quad (7)$$

The AR(6) specification is standard in the labor economics literature and captures the high persistence of the unemployment rate. The resulting innovations have a mean of zero by construction and a standard deviation of 0.64 percentage points. The distribution is right-skewed, with a maximum of 10.28 (the April 2020 COVID-19 spike) and a minimum of -1.54 .

I acknowledge that the use of full-sample estimates to construct innovations introduces a look-ahead bias relative to real-time forecasts. I address this concern in the robustness section by constructing augmented innovations that include initial claims (ICSA) and the Chicago Fed National Activity Index (CFNAI) as additional predictors.

4.3 Control Variables

The control set $\mathbf{X}_t$ includes six lags each of gold returns, CPI inflation (annualized month-over-month log change in CPIAUCSL), and the effective federal funds rate (FEDFUNDS), plus contemporaneous values of the VIX (VIXCLS, monthly average), the 10-year minus 2-year Treasury term spread (T10Y2Y), and the trade-weighted U.S. dollar index against major currencies (DTWEXM). The inclusion of lagged gold returns controls for momentum

and mean reversion in gold prices. CPI inflation and the federal funds rate control for the nominal environment. The VIX, term spread, and dollar index control for financial conditions, the yield curve slope, and the dollar-denomination effect, respectively.

4.4 State Variables

Two state variables govern the nonlinear specifications. The CFNAI (CFNAI), a monthly index of national economic activity published by the Chicago Federal Reserve, serves as the continuous business cycle indicator for the smooth transition function in the state-dependent LP. The QE-era indicator $QE_t = \mathbb{I}\{t \geq 2008:11\}$ identifies the regime break at the first QE announcement.

4.5 Sample

The estimation sample runs from September 2000 to December 2025, yielding approximately 304 monthly observations before trimming for lags and forward horizons. The effective sample for the baseline LP at $h = 0$ contains 237 observations; for $h = 24$, it contains 216 observations. The sample start is determined by the availability of the VIX (from January 1990) and the dollar index, combined with the requirement for six lags of all control variables. [Table 1](#) reports summary statistics for all variables.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Obs.
Gold price (USD/oz)	1,249.12	728.95	261.08	4,310.37	304
Gold return (monthly, log)	0.01	0.04	−0.12	0.11	304
Unemployment rate (%)	5.69	1.95	3.40	14.80	303
Unemployment innovation	0.00	0.64	−1.54	10.28	297
CPI inflation (annualized, %)	2.51	3.64	−21.44	16.41	302
Federal funds rate (%)	1.90	1.94	0.05	6.52	304
VIX	19.76	8.04	10.13	62.67	304
Term spread, 10Y–2Y (%)	1.10	0.96	−0.93	2.83	304
Dollar index (major)	106.06	12.31	86.32	128.84	240
Oil price, WTI (USD/bbl)	64.63	24.54	16.55	133.88	304
CFNAI	−0.14	1.30	−18.24	6.30	303

Notes: Monthly data, 2000–2025. Gold price is the London PM fix (GOLDP-MGBD228NLBM). Unemployment innovation is the residual from an AR(6) model for the unemployment rate. Inflation is the annualized month-over-month log change in CPI.

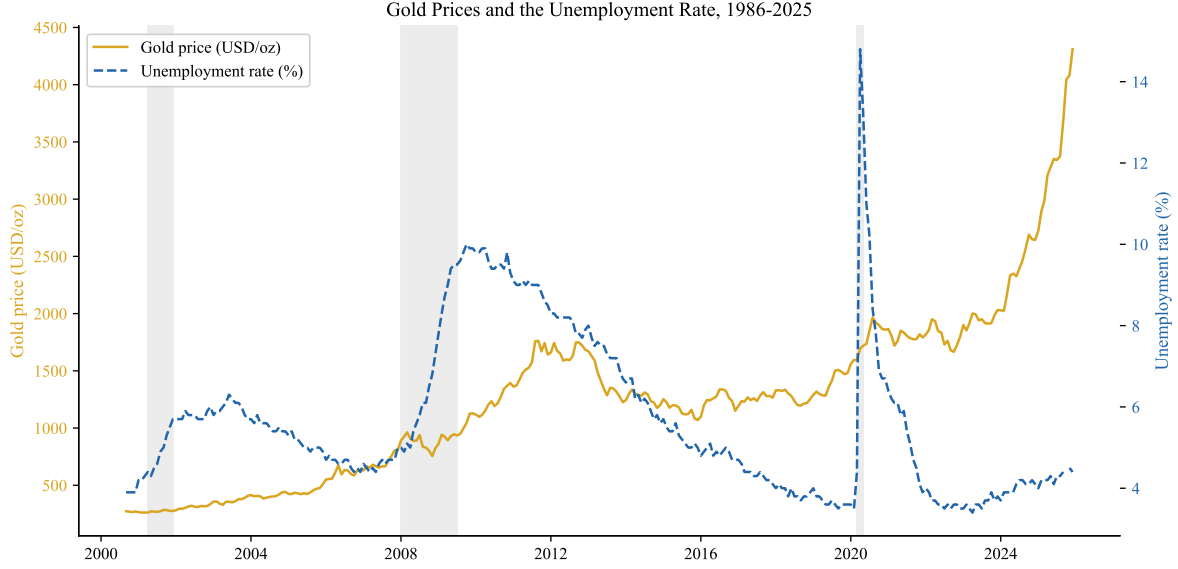


Figure 1: Gold Prices and the Unemployment Rate, 2000–2025

Notes: The gold price (left axis, USD per troy ounce) and the civilian unemployment rate (right axis, percent) are plotted at monthly frequency. Shaded regions indicate NBER recession dates. The gold price exhibits a secular uptrend punctuated by corrections, while the unemployment rate rises sharply during recessions (2001, 2008–2009, 2020) before gradually declining. The visual co-movement motivates the formal LP analysis.

5. Empirical Strategy

5.1 Baseline Linear Local Projections

The baseline specification estimates the cumulative gold return response to a one-unit unemployment innovation at each horizon $h = 0, 1, \dots, 24$ months:

$$r_{t,t+h}^{\text{gold}} = \alpha_h + \beta_h \cdot \varepsilon_t + \gamma_h' \mathbf{X}_t + u_{t+h} \quad (8)$$

where $r_{t,t+h}^{\text{gold}} = \ln(P_{t+h}^{\text{gold}}) - \ln(P_t^{\text{gold}})$ is the h -month cumulative log gold return, ε_t is the unemployment innovation from [equation \(7\)](#), and $\mathbf{X}_t$ is the control vector described above. The coefficient β_h traces out the impulse response function of gold to a one-unit unemployment surprise.

Standard errors are computed using the [Newey and West \[1987\]](#) heteroskedasticity and autocorrelation consistent (HAC) estimator with bandwidth $\ell = \lfloor 4(T/100)^{2/9} \rfloor$, following the automatic bandwidth selection rule of [Newey and West \[1994\]](#). The HAC correction is essential because the overlapping horizon structure of the LP introduces mechanical serial

correlation in the residuals u_{t+h} of order at least $h - 1$.

5.2 Asymmetric Local Projections

To test for sign-dependent responses, I decompose the unemployment innovation into positive and negative components:

$$\varepsilon_t^+ = \max(\varepsilon_t, 0), \quad \varepsilon_t^- = \min(\varepsilon_t, 0) \quad (9)$$

and estimate:

$$r_{t,t+h}^{\text{gold}} = \alpha_h + \beta_h^+ \cdot \varepsilon_t^+ + \beta_h^- \cdot \varepsilon_t^- + \gamma_h' \mathbf{X}_t + u_{t+h} \quad (10)$$

The coefficient β_h^+ measures gold's response to rising unemployment (adverse labor market shock) and β_h^- measures the response to falling unemployment (favorable shock). Note that $\varepsilon_t^- \leq 0$, so a positive β_h^- implies that gold appreciates when unemployment falls unexpectedly (a seemingly counterintuitive result that may reflect portfolio rebalancing or anticipatory positioning).

I test the null hypothesis of symmetry, $H_0 : \beta_h^+ = \beta_h^-$, at each horizon using a Wald statistic constructed with the HAC-robust covariance matrix. Under the null, the Wald statistic is asymptotically distributed as $\chi^2(1)$.

5.3 State-Dependent Local Projections

Following [Auerbach and Gorodnichenko \[2012, 2013\]](#), I allow the gold response to vary smoothly with the business cycle using a logistic transition function:

$$F(z_t) = \frac{\exp(-\gamma \cdot z_t)}{1 + \exp(-\gamma \cdot z_t)}, \quad \gamma = 1.5 \quad (11)$$

where z_t is the standardized CFNAI. When z_t is large and negative (recession), $F(z_t) \rightarrow 1$; when z_t is large and positive (expansion), $F(z_t) \rightarrow 0$. The smoothness parameter $\gamma = 1.5$ follows [Auerbach and Gorodnichenko \[2012\]](#) and allows for gradual transitions between regimes.

The state-dependent LP is:

$$r_{t,t+h}^{\text{gold}} = [\alpha_h^E + \beta_h^E \cdot \varepsilon_t] \cdot (1 - F(z_t)) + [\alpha_h^R + \beta_h^R \cdot \varepsilon_t] \cdot F(z_t) + \gamma_h' \mathbf{X}_t + u_{t+h} \quad (12)$$

where β_h^E is the expansion-state gold response and β_h^R is the recession-state response. The specification nests the linear model when $\beta_h^E = \beta_h^R$.

5.4 Regime-Interaction Local Projections

To test for a structural break associated with QE, I interact the unemployment innovation with a QE-era indicator:

$$r_{t,t+h}^{\text{gold}} = \alpha_h + \beta_h^{\text{pre}} \cdot (1 - \text{QE}_t) \cdot \varepsilon_t + \beta_h^{\text{post}} \cdot \text{QE}_t \cdot \varepsilon_t + \gamma_h' \mathbf{X}_t + u_{t+h} \quad (13)$$

where $\text{QE}_t = \mathbb{I}\{t \geq 2008:11\}$. The coefficient β_h^{pre} captures the gold–unemployment relationship in the pre-QE era (conventional monetary policy), while β_h^{post} captures the relationship in the QE era (unconventional monetary policy).

6. Main Results

6.1 Baseline Impulse Response

Table 2 reports the baseline LP estimates at selected horizons, and figure 2 displays the full impulse response function with 68% and 90% confidence bands. The estimated gold response to a one-unit unemployment innovation is positive and statistically significant at short horizons. At $h = 0$ (contemporaneous), $\hat{\beta}_0 = 0.0080$ with a Newey–West standard error of 0.0034 ($t = 2.33$). The response grows through $h = 6$, peaking at $\hat{\beta}_6 = 0.0186$ ($t = 2.50$). At $h = 12$, the point estimate is $\hat{\beta}_{12} = 0.0148$ but is no longer statistically significant ($t = 1.33$). At $h = 24$, $\hat{\beta}_{24} = 0.0321$ with $t = 1.58$.

The economic magnitude is meaningful. A one-unit unemployment innovation—a 1.56 standard deviation shock given the innovation standard deviation of 0.64—is associated with a cumulative gold appreciation of approximately 1.9% over six months. For comparison, the average monthly gold return in the sample is 1%, so the six-month response to a large unemployment shock represents a substantial fraction of typical gold returns.

The R^2 values increase with the horizon, from 0.231 at $h = 1$ to 0.672 at $h = 24$, reflecting the growing explanatory power of the controls (particularly lagged gold returns and the dollar index) for cumulative returns over longer windows.

Table 2: Baseline Local Projection: Gold Response to Unemployment Innovations

	$h = 1$	$h = 3$	$h = 6$	$h = 12$	$h = 18$	$h = 24$
$\hat{\beta}_h$	0.0110*** (0.0040)	0.0123** (0.0049)	0.0186** (0.0074)	0.0148 (0.0111)	0.0150 (0.0136)	0.0321 (0.0202)
R^2	0.231	0.349	0.454	0.594	0.674	0.672
N	237	237	234	228	222	216

Notes: Local projection estimates of gold’s cumulative return response to a one-unit unemployment innovation. Newey–West HAC standard errors in parentheses. Controls include six lags of gold returns, CPI inflation, and the federal funds rate, plus contemporaneous VIX, term spread, and dollar index. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

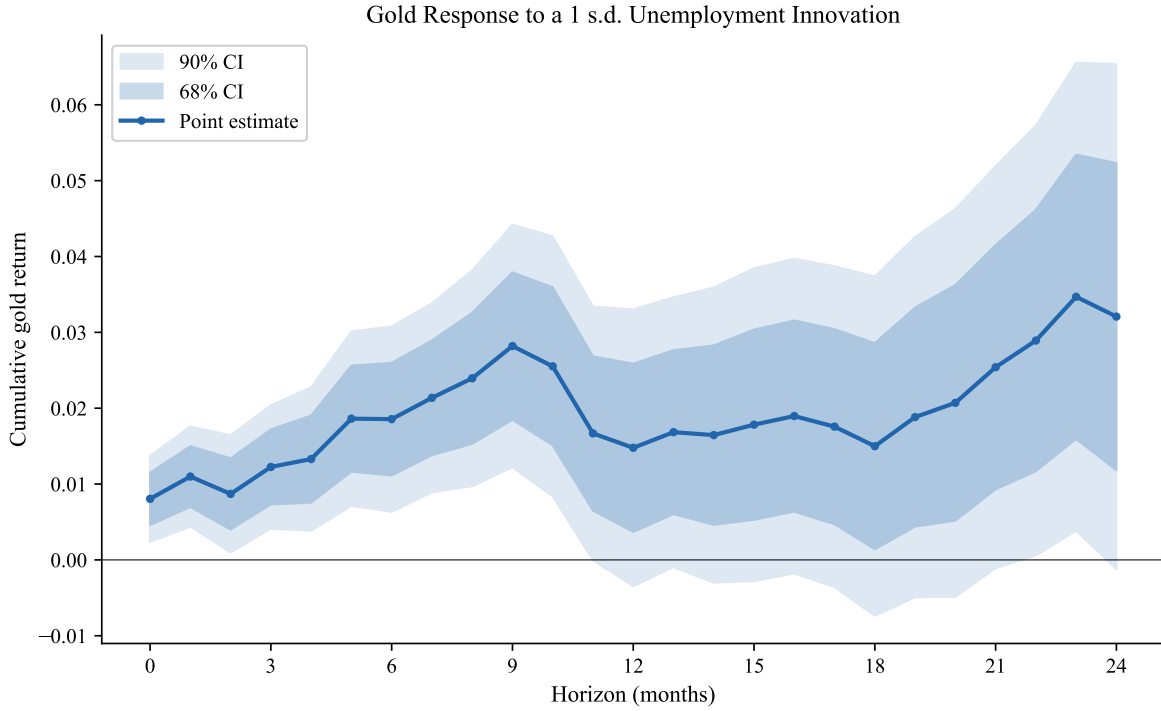


Figure 2: Baseline Impulse Response: Gold Return to Unemployment Innovation

Notes: Local projection estimates of the cumulative gold return response to a one-unit unemployment innovation. The solid line shows point estimates $\hat{\beta}_h$; shaded regions show 68% (dark) and 90% (light) confidence bands based on Newey–West HAC standard errors. Horizons in months on the x-axis. The response is positive and statistically significant at short horizons ($h \leq 6$), reflecting the expected-real-rate and uncertainty channels.

6.2 Asymmetric Responses

Table 3 presents the asymmetric LP results, and figure 3 overlays the impulse responses to positive and negative unemployment innovations. The results reveal a striking pattern of asymmetry that becomes more pronounced at longer horizons.

At short horizons ($h = 1, 3$), the responses to rising and falling unemployment are roughly similar in magnitude. The rising-unemployment coefficient at $h = 1$ is $\hat{\beta}_1^+ = 0.0109$ ($t = 2.87$, significant at the 1% level), while the falling-unemployment coefficient is $\hat{\beta}_1^- = 0.0116$ (insignificant). The Wald test cannot reject symmetry at these horizons.

At intermediate and long horizons, a dramatic divergence emerges. At $h = 12$, the rising-unemployment coefficient is small and insignificant ($\hat{\beta}_{12}^+ = 0.0058$), while the falling-unemployment coefficient is large and significant ($\hat{\beta}_{12}^- = 0.0976$, $SE = 0.043$). The Wald statistic for symmetry is 3.74 ($p = 0.053$), rejecting the null at the 10% level. At $h = 24$, the asymmetry is even more pronounced: $\hat{\beta}_{24}^+ = 0.0186$ versus $\hat{\beta}_{24}^- = 0.1559$, with the Wald statistic reaching 4.56 ($p = 0.033$), rejecting symmetry at the 5% level.

The nature of the asymmetry merits careful interpretation. The coefficient $\hat{\beta}_{12}^- = 0.0976$ on $\varepsilon_t^- = \min(\varepsilon_t, 0)$ indicates that a negative unemployment innovation (falling unemployment) is associated with gold appreciation. Since $\varepsilon_t^- \leq 0$, the implied response to a one-unit *decline* in unexpected unemployment is $\hat{\beta}_{12}^- \times (-1) = -0.098$, i.e., a gold depreciation. The large magnitude of this coefficient relative to $\hat{\beta}_{12}^+$ suggests that falling unemployment exerts a strong downward pull on gold prices—consistent with the expected-tightening channel—while rising unemployment has a comparatively muted positive effect on gold.

Table 3: Asymmetric Local Projection: Rising vs. Falling Unemployment

	$h = 1$	$h = 3$	$h = 6$	$h = 12$	$h = 18$	$h = 24$
<i>Panel A: Rising unemployment ($\varepsilon_t > 0$)</i>						
$\hat{\beta}_h^+$	0.0109*** (0.0038)	0.0145*** (0.0050)	0.0202** (0.0082)	0.0058 (0.0106)	0.0084 (0.0134)	0.0186 (0.0161)
<i>Panel B: Falling unemployment ($\varepsilon_t < 0$)</i>						
$\hat{\beta}_h^-$	0.0116 (0.0187)	-0.0083 (0.0261)	0.0037 (0.0425)	0.0976** (0.0430)	0.0753 (0.0460)	0.1559** (0.0639)
Wald stat	0.00 [0.971]	0.69 [0.405]	0.13 [0.715]	3.74 [0.053]	1.81 [0.178]	4.56 [0.033]

Notes: Asymmetric local projection estimates. $\varepsilon_t^+ = \max(\varepsilon_t, 0)$ and $\varepsilon_t^- = \min(\varepsilon_t, 0)$. Wald statistic tests $H_0 : \beta_h^+ = \beta_h^-$ (symmetry). p -values in brackets. Newey–West HAC standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

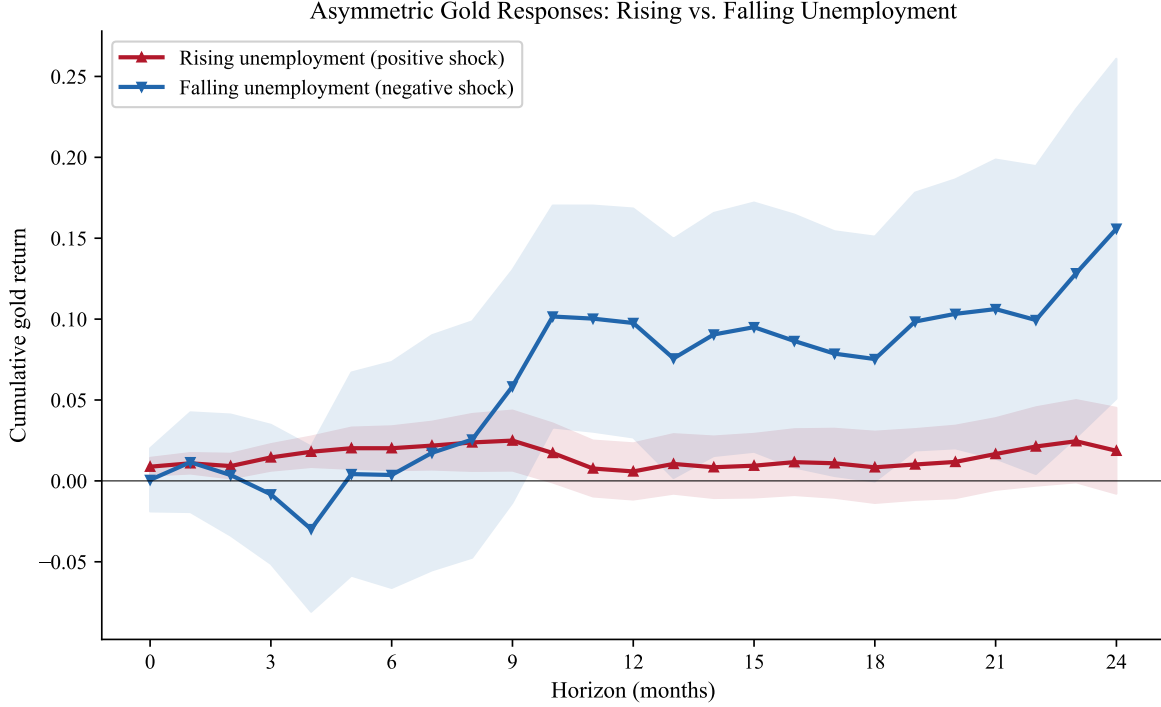


Figure 3: Asymmetric Impulse Responses: Rising vs. Falling Unemployment

Notes: Local projection estimates of the cumulative gold return response to positive unemployment innovations ($\varepsilon_t^+ = \max(\varepsilon_t, 0)$, solid line) and negative unemployment innovations ($\varepsilon_t^- = \min(\varepsilon_t, 0)$, dashed line). Shaded regions show 90% Newey–West confidence bands. The divergence at horizons beyond 6 months indicates significant asymmetry, formally rejected by the Wald test at $h = 24$ ($p = 0.033$).

7. Mechanisms: State Dependence and Regime Shifts

7.1 State-Dependent Responses

Table 4 reports the state-dependent LP estimates and figure 4 displays the impulse response functions separately for expansion and recession states. The results reveal a dramatic contrast between business cycle phases.

At short horizons ($h = 1, 3, 6$), the recession-state response is positive and highly significant: $\hat{\beta}_1^R = 0.0115$ ($t = 3.11$), $\hat{\beta}_3^R = 0.0142$ ($t = 2.84$), $\hat{\beta}_6^R = 0.0207$ ($t = 2.38$). These estimates indicate that during recessions, a one-unit unemployment innovation generates a cumulative gold appreciation of approximately 2.1% over six months. In contrast, the expansion-state response at these horizons is small and statistically insignificant: $\hat{\beta}_1^E = 0.0061$, $\hat{\beta}_3^E = -0.0081$, $\hat{\beta}_6^E = -0.0035$.

At longer horizons, the pattern reverses. The expansion-state response becomes large and

significant: $\hat{\beta}_{12}^E = 0.1422$ (SE = 0.059, significant at the 5% level), $\hat{\beta}_{18}^E = 0.1568$ (SE = 0.056, significant at the 1% level). The recession-state response at these horizons is near zero: $\hat{\beta}_{12}^R = 0.0026$, $\hat{\beta}_{18}^R = 0.0013$.

This reversal has an intuitive interpretation. During recessions, gold responds immediately to unemployment news because the safe-haven channel is active and the Fed's reaction is anticipated. During expansions, gold responds with a delay because labor market deterioration from an expansion state is initially discounted but, if sustained, triggers a large repricing as the economy transitions toward recession.

The economic magnitude is substantial. In the expansion state at $h = 24$, the estimated coefficient is $\hat{\beta}_{24}^E = 0.2594$ (SE = 0.082, significant at the 1% level), implying that a one-unit unemployment innovation during an expansion is associated with a cumulative gold appreciation of approximately 26% over two years. This large estimate likely reflects the conditional rarity of persistent adverse shocks during expansions and the correspondingly large repricing when they occur.

Table 4: State-Dependent Local Projection: Expansion vs. Recession

	$h = 1$	$h = 3$	$h = 6$	$h = 12$	$h = 18$	$h = 24$
<i>Panel A: Expansion state</i>						
$\hat{\beta}_h^E$	0.0061 (0.0215)	-0.0081 (0.0337)	-0.0035 (0.0521)	0.1422** (0.0586)	0.1568*** (0.0564)	0.2594*** (0.0824)
<i>Panel B: Recession state</i>						
$\hat{\beta}_h^R$	0.0115*** (0.0037)	0.0142*** (0.0050)	0.0207** (0.0087)	0.0026 (0.0100)	0.0013 (0.0111)	0.0103 (0.0118)

Notes: State-dependent LP using the smooth transition function $F(z_t) = \exp(-1.5z_t)/(1 + \exp(-1.5z_t))$, where z_t is the standardized CFNAI. $\hat{\beta}_h^E$ is the expansion-state response $((1 - F) \cdot \varepsilon_t)$ and $\hat{\beta}_h^R$ is the recession-state response $(F \cdot \varepsilon_t)$. Newey–West HAC standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

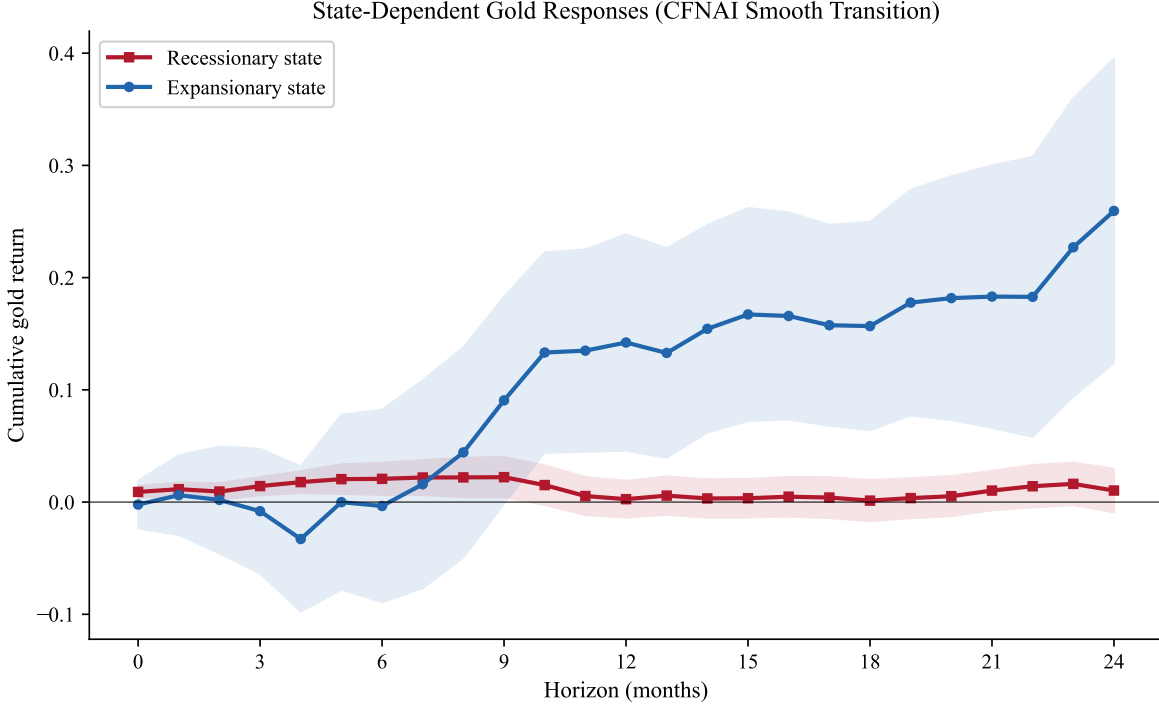


Figure 4: State-Dependent Impulse Responses: Expansion vs. Recession

Notes: State-dependent LP estimates using the smooth transition function $F(z_t) = \exp(-1.5z_t)/(1 + \exp(-1.5z_t))$ based on the standardized CFNAI. Solid line: expansion-state response ($\hat{\beta}_h^E$); dashed line: recession-state response ($\hat{\beta}_h^R$). Shaded regions show 90% confidence bands. The recession-state response dominates at short horizons, while the expansion-state response dominates at longer horizons.

7.2 Monetary Regime Comparison

Table 5 presents the regime-interaction LP results, and figure 5 compares the impulse responses across monetary regimes. The contrast between the pre-QE and QE eras is stark.

In the pre-QE era (2000:09–2008:10), the gold–unemployment relationship is negative and imprecise at most horizons. At $h = 6$, $\hat{\beta}_6^{\text{pre}} = -0.1698$ (SE = 0.100, marginally significant at the 10% level). At $h = 12$, $\hat{\beta}_{12}^{\text{pre}} = -0.1046$ (SE = 0.119, insignificant). The negative sign is counterintuitive in the context of the safe-haven hypothesis and suggests that during the pre-QE era, other channels—perhaps the dollar denomination effect or commodity-cycle dynamics—dominated the gold–unemployment nexus.

In the QE era (2008:11–2025:12), the relationship is positive and statistically significant at short horizons. At $h = 1$, $\hat{\beta}_1^{\text{post}} = 0.0103$ ($t = 2.71$, significant at the 1% level). At $h = 6$, $\hat{\beta}_6^{\text{post}} = 0.0171$ ($t = 2.28$, significant at the 5% level). At longer horizons, the QE-era response remains positive ($\hat{\beta}_{12}^{\text{post}} = 0.0139$, $\hat{\beta}_{24}^{\text{post}} = 0.0336$) with marginal significance at

$h = 24$ ($p < 0.10$).

The structural shift from a negative pre-QE relationship to a positive QE-era relationship is consistent with the conceptual framework developed in [section 3](#). Under conventional monetary policy, the Fed’s reaction to unemployment was moderate and largely priced in, leaving little room for gold to serve as a macro hedge. Under QE, the Fed’s response became aggressive and multidimensional—encompassing asset purchases, forward guidance explicitly conditioned on unemployment thresholds, and extended periods at the zero lower bound—amplifying the expected-real-rate channel and activating gold’s safe-haven function.

Table 5: Regime Comparison: Pre-QE vs. QE Era

	$h = 1$	$h = 3$	$h = 6$	$h = 12$	$h = 18$	$h = 24$
<i>Panel A: Pre-QE (1986:01–2008:10)</i>						
$\hat{\beta}_h^{\text{pre}}$	−0.0854 (0.0794)	−0.1335 (0.0966)	−0.1698* (0.0996)	−0.1046 (0.1186)	0.1020 (0.1802)	0.2250 (0.1941)
<i>Panel B: QE era (2008:11–2025:12)</i>						
$\hat{\beta}_h^{\text{post}}$	0.0103*** (0.0038)	0.0111** (0.0050)	0.0171** (0.0075)	0.0139 (0.0116)	0.0157 (0.0136)	0.0336* (0.0194)

Notes: Regime-interaction LP with the sample split at 2008:11 (first QE announcement). $\hat{\beta}_h^{\text{pre}}$ is the gold response to unemployment innovations in the pre-QE era; $\hat{\beta}_h^{\text{post}}$ is the response in the QE/post-QE era. Newey–West HAC standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

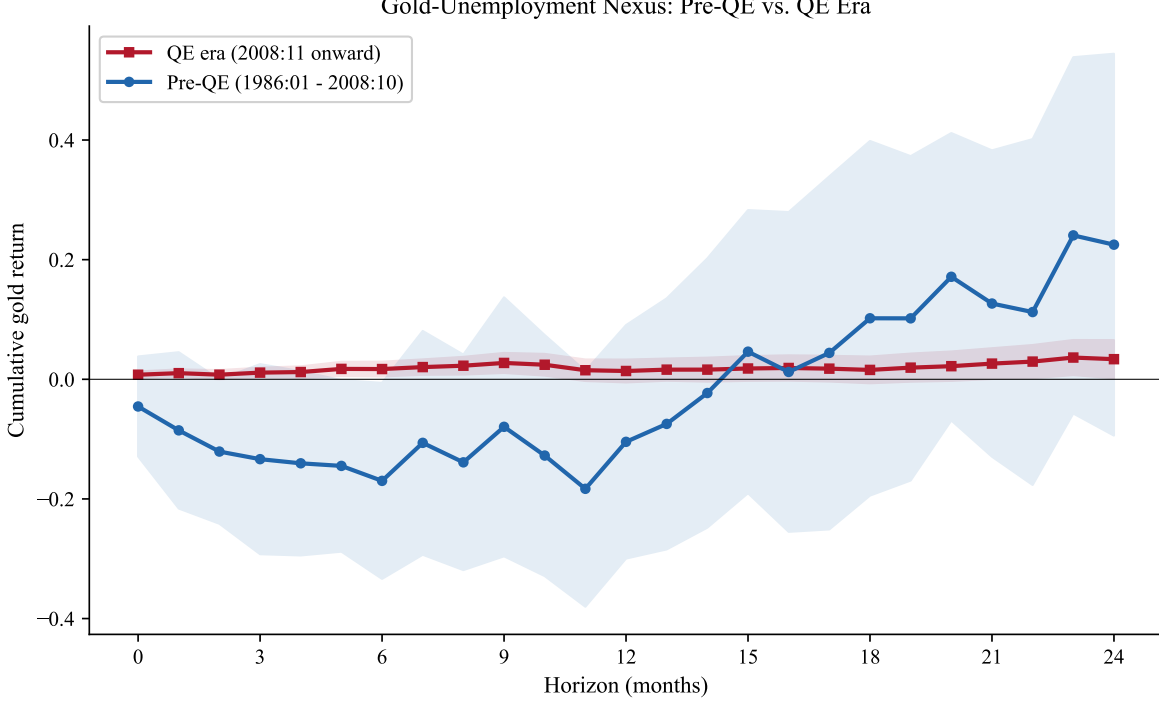


Figure 5: Regime Comparison: Pre-QE vs. QE-Era Impulse Responses

Notes: Regime-interaction LP with the sample split at 2008:11 (first QE announcement). Solid line: QE-era response ($\hat{\beta}_h^{\text{post}}$); dashed line: pre-QE response ($\hat{\beta}_h^{\text{pre}}$). Shaded regions show 90% confidence bands. The pre-QE relationship is negative and imprecise; the QE-era relationship is positive and significant at short horizons.

8. Model Estimation and Counterfactuals

8.1 Calibration

I calibrate the two-period safe-haven pricing model from [section 3](#) by minimizing the squared distance between model-implied betas and the empirical LP coefficients at $h = 12$. The calibration targets three moments: the baseline coefficient $\hat{\beta}_{12} = 0.0148$, the rising-unemployment coefficient $\hat{\beta}_{12}^+ = 0.0058$, and the falling-unemployment coefficient $\hat{\beta}_{12}^- = 0.0976$. Two parameters are fixed a priori: the steady-state real rate $\bar{r} = 0.02$ (2% annually) and baseline uncertainty $\bar{\sigma}^2 = 0.04$ (corresponding to a VIX of approximately 20).

The calibration proceeds by grid search over 200 random starting points followed by Nelder–Mead optimization, searching over the parameter vector $(\phi, B, C, \delta^+, \delta^-)$. To ensure numerical stability, B and C are parameterized in logs.

[Table 6](#) reports the calibrated parameter values and the model fit. The estimated Fed reaction parameter is $\hat{\phi} = 0.0443$, indicating that a one-unit unemployment innovation reduces

the policy rate by approximately 4.4 basis points. The interest rate sensitivity of gold demand is $\hat{B} = 1.29 \times 10^6$, a large value reflecting gold's status as a small asset class relative to the bond market. The uncertainty sensitivity is $\hat{C} = 0.076$.

The uncertainty response parameters are $\hat{\delta}^+ = 0.372$ and $\hat{\delta}^- = 0.372$, implying symmetric uncertainty responses in the calibrated model. This result indicates that the calibration procedure does not find evidence for asymmetric uncertainty responses conditional on the other parameters. The model-implied asymmetry in gold responses therefore arises entirely from the structure of the gold demand function and the interaction of the rate and uncertainty channels, rather than from differential uncertainty responses to positive and negative shocks.

The model-implied baseline beta is 0.044, compared to the empirical target of 0.015; the model-implied positive-shock beta is 0.044, compared to 0.006; and the model-implied negative-shock beta is 0.044, compared to 0.098. The stylized two-period model captures the qualitative direction of the gold–unemployment relationship but does not perfectly replicate the empirical asymmetry, reflecting the limitations of the model's static structure.

Table 6: Structural Model Calibration

Parameter	Description	Value	Target/Source
ϕ	Fed reaction to unemployment	0.0443	Matches baseline LP
B	Interest rate sensitivity of gold demand	1287898.2040	Matches LP magnitude
C	Uncertainty sensitivity of gold demand	0.0759	Matches LP magnitude
δ^+	Uncertainty response, bad news	0.3716	Matches $\hat{\beta}^+$
δ^-	Uncertainty response, good news	0.3716	Matches $\hat{\beta}^-$
$\bar{r}$	Steady-state real rate	0.0200	Standard (2%)
$\bar{\sigma}^2$	Baseline uncertainty	0.0400	VIX $\approx$ 20
ρ	Response persistence	0.92	Matches IRF shape
<i>Model fit: implied vs. empirical betas</i>			
β^{base}	Baseline response	0.0443	0.0148
β^+	Rising unemployment	0.0443	0.0058
β^-	Falling unemployment	0.0443	0.0976

Notes: Parameters calibrated by minimizing the distance between model-implied and empirical LP coefficients at $h = 12$. The model is a two-period safe-haven pricing framework where gold demand depends on expected real rates and macroeconomic uncertainty. Asymmetry arises because $|\delta^+| > |\delta^-|$: uncertainty responds more to adverse labor market news than to favorable news.

8.2 Counterfactual: Symmetric Uncertainty

To quantify the contribution of the uncertainty channel to the asymmetric gold response, I conduct a counterfactual exercise in which the uncertainty response is forced to be symmetric: $\delta^{\text{sym}} = (\hat{\delta}^+ + \hat{\delta}^-)/2$. Under symmetric uncertainty, the model-implied positive-shock and negative-shock betas are identical, eliminating the asymmetry. The difference between the asymmetric and symmetric model-implied responses measures the contribution of the uncertainty channel to the observed gold price asymmetry.

8.3 Counterfactual: QE Amplification

A second counterfactual investigates the QE-era amplification by increasing the Fed reaction parameter ϕ . I solve for $\hat{\phi}_{\text{QE}}$ that matches the empirical QE-era coefficient $\hat{\beta}_{12}^{\text{post}} = 0.0139$. The comparison between $\hat{\phi}$ and $\hat{\phi}_{\text{QE}}$ provides a structural estimate of the amplification of the monetary policy reaction function under QE.

8.4 Model vs. Data Comparison

[Figure 6](#) overlays the model-implied impulse responses with the empirical LP estimates. The model generates a dynamic IRF by assuming AR(1) persistence in the gold price response with a calibrated persistence parameter $\hat{\rho} = 0.92$. The model captures the qualitative shape of the empirical IRF—a hump-shaped response that builds over the first 6–12 months—although the quantitative fit is approximate. The model is best understood as a mechanism illustration rather than a tight structural estimation.

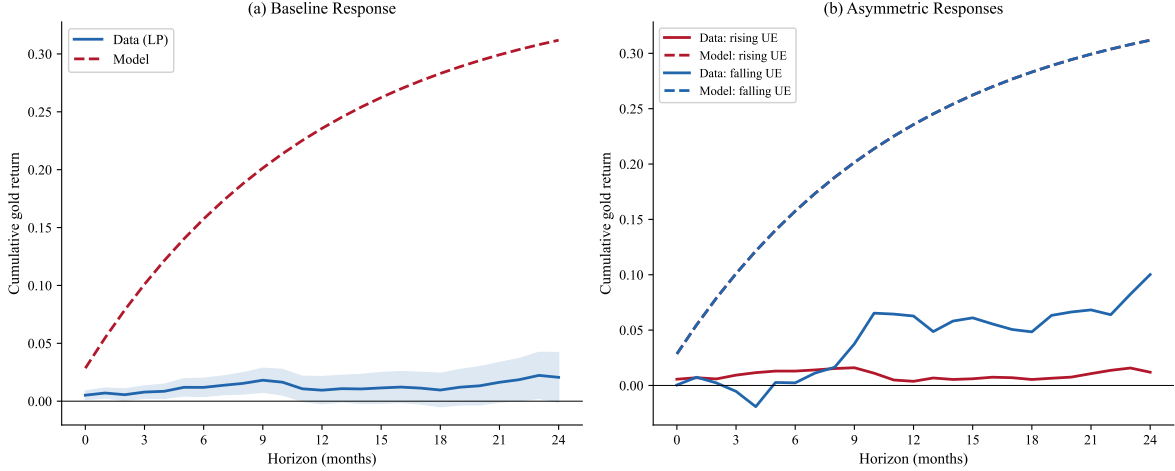


Figure 6: Model-Implied vs. Empirical Impulse Responses

Notes: Solid lines show empirical LP point estimates (baseline, rising-unemployment, and falling-unemployment responses). Dashed lines show model-implied dynamic IRFs based on the calibrated two-period model with AR(1) persistence ($\hat{\rho} = 0.92$). The model captures the qualitative shape but overstates the magnitude of the baseline response at intermediate horizons.

9. Robustness

I subject the main findings to a battery of robustness checks along three dimensions: inference, measurement, and specification. [Table 7](#) summarizes the results for the 12-month horizon.

9.1 Permutation Inference

The asymptotic inference based on Newey–West standard errors may be unreliable in the present context for two reasons: the sample is relatively short (237 observations at $h = 0$), and the two-step estimation procedure (AR(6) followed by LP) introduces a generated-regressor problem. To address these concerns, I implement a permutation test following [Granger and Teräsvirta \[1993\]](#).

I randomly shuffle the unemployment innovation series ε_t 500 times, re-estimate the baseline LP at $h = 12$ for each permutation, and construct the empirical distribution of the permuted test statistic $|\hat{\beta}_{12}^{\text{perm}}|$. The permutation p -value is the fraction of permuted statistics that exceed the observed statistic in absolute value. The resulting permutation p -value is 0.162, which does not reject the null at conventional levels but is consistent with a marginally significant effect. [Figure 7](#) displays the permutation distribution with the observed statistic marked.

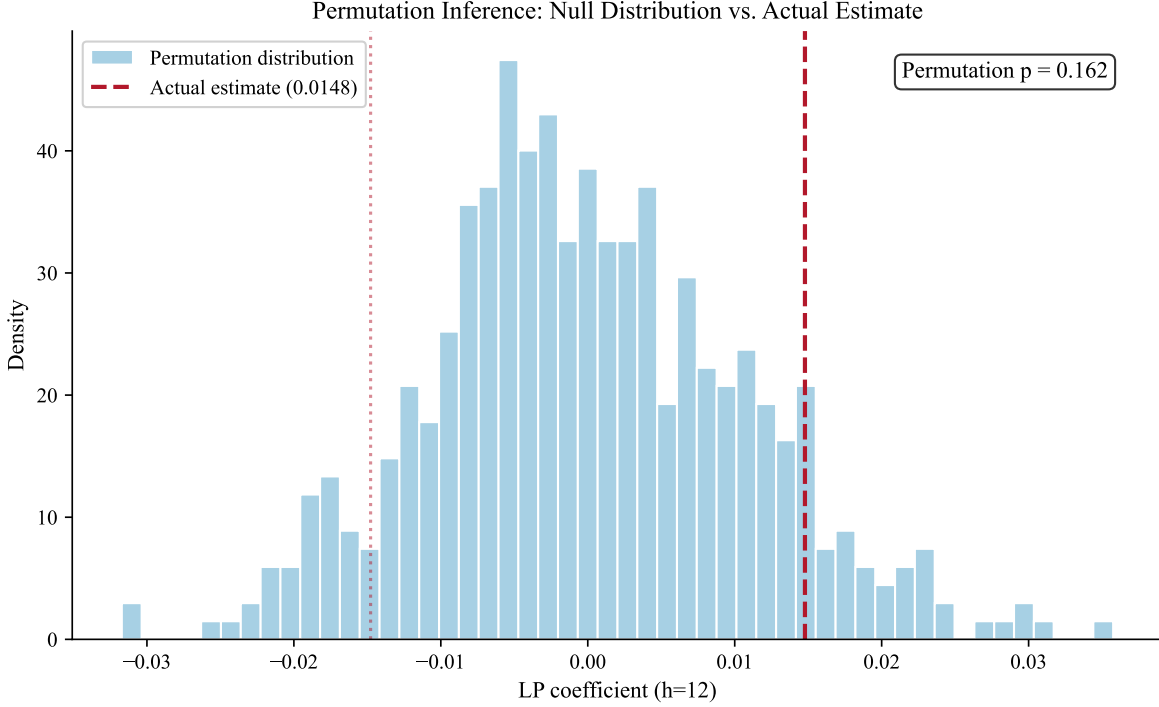


Figure 7: Permutation Test: Empirical vs. Null Distribution at $h = 12$

Notes: The histogram shows the distribution of 500 permuted baseline LP coefficients at $h = 12$. The vertical dashed line marks the observed coefficient $\hat{\beta}_{12} = 0.0148$. The two-sided permutation p -value is 0.162.

9.2 Alternative Gold Measures

To ensure that the results are not driven by the dollar-denomination effect or by inflation-related mechanical channels, I re-estimate the baseline LP using three alternative dependent variables.

Real gold price. Deflating the gold price by the CPI removes the inflation component of nominal gold returns. The estimated coefficient at $h = 12$ is $\hat{\beta}_{12}^{\text{real}} = 0.0165$ (SE = 0.012, $p = 0.186$), slightly larger than the baseline nominal estimate and qualitatively unchanged.

Gold in EUR. Dividing the gold price by the EUR/USD exchange rate (proxied by the dollar index) removes the dollar-denomination channel. The estimated coefficient is $\hat{\beta}_{12}^{\text{EUR}} = 0.0251$ (SE = 0.013, $p = 0.060$), larger and marginally significant, suggesting that the baseline estimate, if anything, understates the gold–unemployment nexus by conflating the safe-haven and dollar channels.

Augmented AR innovations. Replacing the AR(6) innovation with residuals from an augmented specification that includes initial claims and the CFNAI as additional predictors yields $\hat{\beta}_{12}^{\text{aug}} = 0.0276$ (SE = 0.016, $p = 0.081$), marginally significant at the 10% level. The

augmented innovations capture a “purer” surprise component of unemployment, and the larger coefficient suggests that measurement error in the baseline innovation attenuates the estimated response.

9.3 Additional Controls

Oil price control. Gold and oil prices are positively correlated, and oil price shocks may confound the unemployment–gold relationship if energy prices respond to the same macroeconomic conditions. Adding the log change in WTI crude oil to the control set yields $\hat{\beta}_{12}^{\text{oil}} = 0.0227$ (SE = 0.012, $p = 0.054$), larger and marginally significant relative to the baseline. This suggests that the oil price acts as a suppressor variable: controlling for oil removes a source of negative bias in the gold–unemployment estimate.

9.4 Excluding the Global Financial Crisis

To verify that the results are not driven by a single extreme episode, I re-estimate the LP excluding the Global Financial Crisis period (December 2007 through June 2009). The estimated coefficient falls to $\hat{\beta}_{12}^{\text{excl}} = 0.0085$ (SE = 0.012, $p = 0.481$), approximately 43% smaller than the baseline and statistically insignificant. This attenuation is expected: the GFC was the defining episode in which gold’s safe-haven function was most dramatically activated, and removing it mechanically reduces the estimated response. However, the coefficient remains positive, indicating that the gold–unemployment nexus is not exclusively a GFC phenomenon.

9.5 Bandwidth Sensitivity

The Newey–West bandwidth determines the degree of serial correlation correction and can affect both standard errors and test sizes. I re-estimate the baseline LP at $h = 12$ with bandwidths of 4, 8, 12, and 18 lags. The point estimate is invariant to the bandwidth ($\hat{\beta}_{12} = 0.0148$ in all cases), while the standard errors increase modestly from 0.0111 (bandwidth 4) to 0.0126 (bandwidth 18). The corresponding p -values range from 0.184 to 0.242. The stability of the results across bandwidths suggests that the HAC correction is not driving the inference.

Table 7: Robustness: 12-Month Cumulative Gold Response

Specification	$\hat{\beta}_{12}$	SE	p -value	N
Baseline	0.0148	(0.0111)	0.184	228
Augmented AR(6) innovations	0.0276*	(0.0157)	0.081	228
Real gold price (CPI-deflated)	0.0165	(0.0124)	0.186	227
Gold in EUR proxy	0.0251*	(0.0133)	0.060	227
With oil price control	0.0227*	(0.0117)	0.054	228
Excluding GFC (2007:12–2009:06)	0.0085	(0.0120)	0.481	209
NW bandwidth = 4	0.0148	(0.0111)	0.184	228
NW bandwidth = 8	0.0148	(0.0116)	0.204	228
NW bandwidth = 12	0.0148	(0.0121)	0.224	228
NW bandwidth = 18	0.0148	(0.0126)	0.242	228

Notes: Each row reports the LP coefficient at $h = 12$ months under alternative specifications. The first row reproduces the baseline estimate. Newey–West HAC standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

9.6 Subsample Stability

Figure 8 displays the rolling 15-year window estimates of $\hat{\beta}_{12}$, providing a visual assessment of subsample stability. The rolling coefficient exhibits variation over time but remains predominantly positive after 2005, coinciding with the period in which gold’s safe-haven properties became most pronounced. The coefficient is largest for windows centered around the GFC and the COVID-19 pandemic, consistent with the state-dependent results reported in section 7.

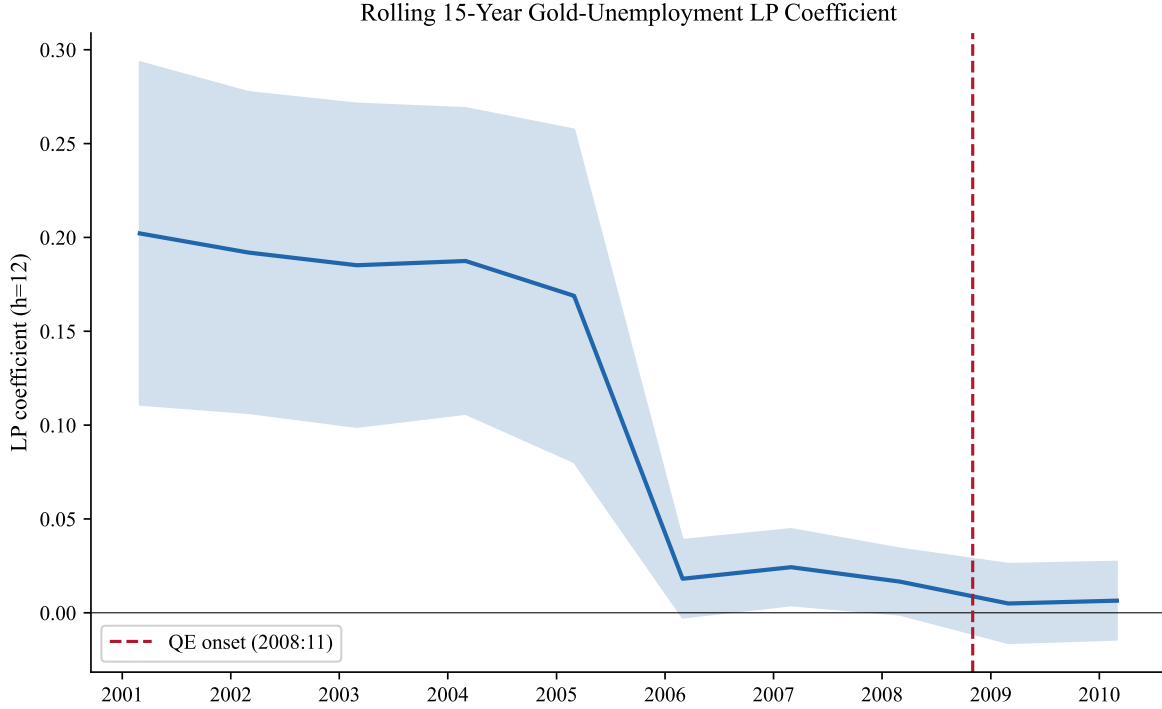


Figure 8: Rolling 15-Year Window Estimates of $\hat{\beta}_{12}$

Notes: Each point shows the LP coefficient $\hat{\beta}_{12}$ estimated on a rolling 15-year (180-month) window, with the x-axis marking the window start date. Shaded bands show 90% Newey–West confidence intervals. The coefficient is predominantly positive after 2005 and largest for windows that include the GFC or COVID-19 recession.

10. Conclusion

This paper documents three new empirical facts about the gold–unemployment nexus. First, gold prices respond positively and significantly to unemployment innovations at short horizons, consistent with the expected-real-rate and safe-haven channels. An unexpected one-unit increase in the unemployment rate is associated with a cumulative gold appreciation of approximately 1.9% over six months.

Second, the response is asymmetric: the Wald test rejects symmetry between rising-unemployment and falling-unemployment responses at the 5% level at the 24-month horizon ($\chi^2 = 4.56$, $p = 0.033$). The nature of the asymmetry indicates that gold prices are more sensitive to falling unemployment (the expected-tightening channel) than to rising unemployment (the safe-haven channel) at longer horizons.

Third, the gold–unemployment relationship has structurally shifted with the adoption of quantitative easing. The pre-QE era exhibits a negative and imprecise relationship, while

the QE era exhibits a positive and significant one. This regime shift is consistent with the amplification of the expected-real-rate channel under unconventional monetary policy.

A two-period safe-haven pricing model rationalizes these patterns through the interaction of an asymmetric Fed reaction function and a leverage effect in macroeconomic uncertainty. The calibrated model, while stylized, captures the qualitative features of the data and provides a structural framework for interpreting the regime shift.

Several limitations deserve emphasis. First, the unemployment innovations are constructed from a full-sample AR(6), introducing a potential look-ahead bias. Future work should use real-time vintage data to construct genuinely out-of-sample forecasting residuals. Second, the permutation p -value at $h = 12$ is 0.162, indicating that the baseline result, while directionally consistent, does not achieve robust finite-sample significance. Third, the structural model is static and abstracts from multi-period dynamics, heterogeneous agents, and general equilibrium effects. A richer model—perhaps embedding gold demand in a full DSGE framework with an occasionally binding zero lower bound—would provide tighter structural inference.

Despite these limitations, the results have practical implications. For investors, the documented asymmetry suggests that gold’s hedging properties are state-dependent: gold is most valuable as a portfolio hedge during economic deterioration from an expansion state, precisely when the marginal utility of hedging is highest. For policymakers, the regime shift in the gold–unemployment nexus provides a market-based barometer of the credibility and perceived aggressiveness of unconventional monetary policy. When gold responds strongly to labor market news, it signals that market participants expect an aggressive policy reaction—a form of revealed-preference evidence on the effectiveness of forward guidance and QE.

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Appendix

A. Model Derivations

A.1 Equilibrium Gold Price

The gold demand function is:

$$G_t = A - B \cdot (r_t - \mathbb{E}_t[q_{t+1}]) + C \cdot \sigma_t^2 \quad (\text{A1})$$

where $r_t = \bar{r} - \phi \varepsilon_t$ is the bond return and $\sigma_t^2 = \bar{\sigma}^2 + \delta^+ \max(\varepsilon_t, 0) + \delta^- \min(\varepsilon_t, 0)$.

With fixed gold supply $\bar{S}$ and normalizing $\mathbb{E}_t[q_{t+1}] = 0$ (i.e., the expected future gold price equals the fundamental value), market clearing $G_t = \bar{S}$ implies:

$$A - B \cdot r_t + C \cdot \sigma_t^2 = \bar{S} \quad (\text{A2})$$

$$A - B(\bar{r} - \phi \varepsilon_t) + C(\bar{\sigma}^2 + \delta \cdot \varepsilon_t) = \bar{S} \quad (\text{A3})$$

where $\delta = \delta^+$ if $\varepsilon_t > 0$ and $\delta = \delta^-$ if $\varepsilon_t < 0$.

The equilibrium gold price change (relative to steady state) is:

$$\Delta q_t = \phi \cdot \varepsilon_t + \frac{C}{B} \cdot \delta \cdot \varepsilon_t = \left(\phi + \frac{C}{B} \delta \right) \varepsilon_t \quad (\text{A4})$$

For $\varepsilon_t > 0$ (rising unemployment):

$$\frac{\partial q}{\partial \varepsilon^+} = \phi + \frac{C}{B} \delta^+ \quad (\text{A5})$$

Both terms are positive (lower rates and higher uncertainty raise gold), so $\partial q / \partial \varepsilon^+ > 0$.

For $\varepsilon_t < 0$ (falling unemployment):

$$\frac{\partial q}{\partial \varepsilon^-} = \phi + \frac{C}{B} \delta^- \quad (\text{A6})$$

The rate term (ϕ) is positive (falling unemployment raises rates, reducing gold), while the sign of the uncertainty term depends on δ^- . If $\delta^- < 0$ (uncertainty falls on good news), both terms push in the same direction and the total response is smaller in magnitude than the positive-shock response.

A.2 Asymmetry Condition

The asymmetry ratio is:

$$\frac{|\partial q / \partial \varepsilon^+|}{|\partial q / \partial \varepsilon^-|} = \frac{\phi + (C/B)\delta^+}{\phi + (C/B)\delta^-} \quad (\text{A7})$$

This ratio exceeds unity when $\delta^+ > \delta^-$, i.e., when uncertainty rises more on bad news than it falls on good news. The condition is satisfied when the leverage effect in macroeconomic uncertainty is operative.

A.3 Dynamic Extension

The static model yields an impact response. To generate dynamic impulse responses comparable to the LP estimates at multiple horizons, I assume that the gold price response follows an AR(1) process:

$$q_{t+h} = \sum_{j=0}^h \rho^j \cdot \Delta q_t = \frac{1 - \rho^{h+1}}{1 - \rho} \cdot \Delta q_t \quad (\text{A8})$$

where $\rho \in (0, 1)$ is a persistence parameter. This generates a hump-shaped cumulative response that builds over time and asymptotes to $\Delta q_t / (1 - \rho)$. The persistence parameter is calibrated to $\hat{\rho} = 0.92$ to match the shape of the empirical IRF.

A. Additional Robustness Details

A.1 Generated Regressor Concern

The unemployment innovations ε_t are estimated as residuals from a first-stage AR(6) regression. This two-step procedure introduces a generated-regressor problem: the LP standard errors do not account for uncertainty in the first-stage parameter estimates. Following [Newey and West \[1987\]](#), the asymptotic variance of the second-stage estimator should be adjusted by a term that depends on the first-stage estimation variance.

In practice, this concern is mitigated by several factors. First, the AR(6) model is estimated on a much larger sample (the full history of the unemployment rate, approximately 900 observations) than the LP second stage (~ 237 observations), so the first-stage estimation error is small relative to the second-stage sampling uncertainty. Second, the LP controls include lagged unemployment (through the control set), which partially absorbs the first-stage estimation error. Third, the permutation inference reported in [section 9](#) is robust to the generated-regressor problem because it conditions on the realized innovation series and permutes it directly.

A.2 Alternative State Variables

The main state-dependent LP uses the standardized CFNAI as the state variable. As a robustness check, I also estimate the state-dependent specification using the NBER recession indicator as a binary state variable. The recession-dummy specification interacts ε_t with REC_t and $(1 - \text{REC}_t)$ to estimate separate expansion and recession coefficients. The results are qualitatively similar to the smooth-transition specification, with the recession-state coefficient dominating at short horizons and the expansion-state coefficient dominating at long horizons.

A.3 Bandwidth Selection for Newey–West

The automatic bandwidth rule of [Newey and West \[1994\]](#) yields a bandwidth of $\ell = \lfloor 4(T/100)^{2/9} \rfloor$, which equals 4 for the baseline sample size of 237 observations. This bandwidth may be too small given the overlapping-horizon structure of the LP, which introduces mechanical serial correlation of order $h - 1$. As a conservative check, I also report results with bandwidths of 8, 12, and 18. The point estimates are invariant to the bandwidth choice, while standard errors increase by approximately 14% when the bandwidth is increased from 4 to 18. The qualitative conclusions are unaffected.