The Great Inflation Drift

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1. Introduction

• We suggest that the U.S. Great Inflation involved an increase in stochastic trend inflation—long-term forecast of inflation at each point in time

• This view has support from two sources—long-term interest rates, statistical studies of inflation dynamics

• A basic textbook macromodel delivers a stochastic inflation trend due to shocks to capacity output growth given two hypotheses about central bank behavior that we call “business as usual”
Introduction (cont’d)

• Central bank behavior:
  i) seeks to maintain output at capacity, and
  ii) seeks to maintain a continuity of the short-term interest rate
• Theory identifies major upswings in trend inflation with unexpectedly slow growth of capacity output
• “Business as usual” implies IMA(1,1) time-series process for inflation
• Periods of “inflation fighting” involve forecastable linkages between real activity and inflation

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2. Model Components

• New Keynesian Pricing

\[ \pi_t = \beta E_t \pi_{t+1} + h (y_t - y^*_t) \]

with time-varying trend inflation:

\[ \pi_t = \pi_t + \beta E_t [\pi_{t+1} - \pi_{t+1}] + h (y_t - y^*_t) \]

where \( \pi_t = \lim_{k \to \infty} E_t \pi_{t+k} \)
Model Components (cont’d)

• Real Business Cycle Core:

\[ \Delta y_t^* = \rho \Delta y_{t-1}^* + \nu_t \]

• The Fisher Equation:

\[ R_t = r_t + E_t \pi_{t+1} \]
Model Components (cont’d)

• The Euler Equation:

\[ r_t = \sigma (E_t y_{t+1} - y_t) + r \]

• The Natural Rate of Interest:

\[ r_t^* = \sigma \rho \Delta y_t^* + r \]
Model Components (cont’d)

• The Real Term Structure of Interest Rates:

\[
R_{Lt} = \frac{1}{L} \sum_{j=0}^{L-1} E_t r_{t+j} = r_{Lt} + \frac{1}{L} \sum_{j=1}^{L} E_t \pi_{t+j}
\]

\[
r_{Lt} = -\frac{1}{L} (\sum_{j=0}^{L-1} E_t r_{t+j}) + (r_L - r) = \frac{1}{L} (E_t y_{t+L} - y_t) + r_L
\]

• The Nominal Term Structure of Interest Rates:

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3. Monetary Policy

Central Bank Policy Objectives

i) Output gap stabilization: $y_t = y^*_t$

ii) Attenuation of one-period-ahead nominal interest rate forecast errors: $R_t - E_{t-1}R_t$

iii) Low inflation: $\pi_t = \pi \approx 0$

We view central bank’s attachment to business-as-usual priorities—output gap stabilization and continuity of the short rate—as generally dominant over its low inflation objective.

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4. Equilibrium with “Business as Usual”

----Trend Inflation Variability

• New Keynesian pricing with time-varying trend inflation and \( y_t = y_t^* \)

\[
\pi_t - \pi_t = \beta(E_t \pi_{t+1} - E_t \pi_{t+1})
\]

• Law of iterated expectations implies

\[
\pi_t = E_t \pi_{t+1}
\]

• Substitution yields

\[
\pi_t - \pi_t = \beta(E_t \pi_{t+1} - \pi_t)
\]
Trend Inflation Variability (cont’d)

• Equilibrium inflation follows a stochastic trend

\[ \pi_t = E_t \pi_{t+1} = \pi_t \]

• Stochastic inflation trends are unpredictable

\[ \pi_{t+1} = \pi_t + \epsilon_{t+1} \]

where \( E_t \epsilon_{t+1} = 0 \)

• Absence of long-run tradeoff means zero output gap consistent with stochastically evolving trend inflation

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Equilibrium with “Business as Usual”
----Innovations to Trend Inflation

• Express one-period-ahead forecast error for
the nominal interest rate in terms of forecast
error in natural rate of interest

\[ R_t = E_{t-1}R_t + (1-\phi)(r_t^* - E_{t-1}r_t^*) \]

where the degree of central bank interest rate
continuity increases with \( 0 \leq \phi \leq 1 \)

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Innovations to Trend Inflation (cont’d)

• Fisher equation, random-walk inflation imply

\[ E_t \pi_{t+1} - E_{t-1} \pi_{t+1} = -\phi(r^*_t - E_{t-1} r^*_t) \]

• Hence, stochastic inflation trend innovation is

\[ \varepsilon_t = -\phi \sigma \rho \nu_t \]

• No interest continuity, no inflation innovations

• Full interest continuity, expected inflation innovation negative of natural rate innovation

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Comovement: Short Interest, Inflation

• Natural rate innovation and nominal rate path

\[ E_t R_{t+j} - E_{t-1} R_{t+j} \]
\[ = \left[ E_t r^*_{t+j} - E_{t-1} r^*_{t+j} \right] + \left[ E_t \pi_{t+j} - E_{t-1} \pi_{t+j} \right] \]
\[ = \left[ \rho^j - \phi \right] \rho \sigma \nu_t \]

• Full interest continuity, surprise increase in natural rate leaves current nominal rate unchanged, future nominal rates move lower

• Partial continuity, nearby nominal interest rates rise, while future nominal rates move lower
Term Structure Implications

• Nominal long-bond reflects inflation trend sooner than short rate

\[ R_{Lt} - E_{t-1}R_{Lt} = \frac{1}{L} \sum_{j=0}^{L-1} [E_t R_{t+j} - E_{t-1} R_{t+j}] \]

\[ = \frac{1}{L} \sum_{j=0}^{L-1} \{[E_t r_{t+j}^* - E_{t-1} r_{t+j}^*] + [E_t \pi_{t+j} - E_{t-1} \pi_{t+j}]\} \]

\[ = \frac{1}{L} \sum_{j=0}^{L-1} [\rho^j - \phi] \rho \sigma \nu_t = \left[\frac{1 - \rho^L}{1 - \rho}\right] - \phi \rho \sigma \nu_t \]

• For long bond-- \( R_{Lt} - E_{t-1}R_{Lt} \approx -\phi \rho \sigma \nu_t = \pi_t - \pi_{t-1} \)

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5. Implementing “Business as Usual”

• **Interest Rate Rule:**

\[ R_t = \bar{\pi}_t + r_t^* + \Omega (\pi_t - \bar{\pi}_t) \]

• A sufficiently aggressive response to deviations of inflation from the time-varying “inflation target” keeps \( \pi_t = \bar{\pi}_t \)

• The real interest rate shadows the underlying natural rate and the output gap is stabilized

• “Inflation target” evolves as \( \pi_t - E_{t-1} \pi_t = -\phi \sigma \rho \nu_t \)

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Implementation (cont’d)

• **Money Growth Rule:**
  \[
  \Delta m_t^S = (\alpha - \phi \sigma \rho) \nu_t + \alpha \rho \Delta y_{t-1}^* + \pi_{t-1}
  \]
  in model augmented with money demand function \( \Delta m_t^D = \alpha \Delta y_t + \pi_t \)

• No interest continuity, money growth conforms to money demand, inflation fixed

• With continuity, inflation covaries negatively with shock to capacity output

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6. How “Business as Usual” Creates Inflation Drift

- Central bank focused exclusively on stabilizing output gap would make nominal rate shadow natural rate so that inflation remains anchored.
- If central bank also pursues a degree of interest rate continuity, it attenuates initial response of nominal rate to natural rate innovation.
- For negative shock to capacity output, interest rate continuity pushes current aggregate demand below capacity output.

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How “Business as Usual” Creates Inflation Drift (cont’d)

• To stabilize output gap, central bank steers future interest rates below natural rates
• Doing so pushes future aggregate demand above future capacity output
• Prospect of negative expected future output gaps elevates future expected inflation
• Elevated expected inflation deepens current real rate cut, for a given degree of continuity

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How “Business as Usual” Creates Inflation Drift (cont’d)

• In the limit, economy converges to a rational expectations response in which expected inflation rises enough to push current real rate all the way down to current natural rate

• With output gap stabilized fully, actual and expected inflation rise initially, identically, and permanently in response to a negative shock to capacity output

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How “Business as Usual” Creates Inflation Drift (cont’d)

• Central bank’s commitment to output gap stabilization and interest rate continuity, and the public’s incentive to form expectations of inflation rationally, together push the economy into an equilibrium with stochastic trend inflation

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7. From “Business as Usual” to “Fighting Inflation”

- Business-as-usual monetary policy can be sustained indefinitely with low and reasonably stable inflation if i) shocks to capacity output are small and offsetting and ii) if a central bank pursues little interest continuity
- Otherwise “business as usual” exposes inflation to considerable variability
- Public and central bank can tolerate “orderly” inflation drift
“Business as Usual” to “Fighting Inflation” (cont’d)

• A series of severe cumulative negative shocks to capacity output has the potential to drive inflation, expected inflation, trend inflation, and long-term interest rates all suddenly and sharply higher, even if all had been well-behaved for years.

• If inflation drifts upward too far, too fast in a “disorderly” manner “business as usual” may become unsustainable.

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“Business as Usual” to “Fighting Inflation” (cont’d)

• The public may demand that inflation be contained, and the central bank may be unable to execute stabilization policy effectively in the absence of a “nominal anchor”

• The central bank is forced to switch from “business as usual” to “fighting inflation”

• Central bank fights inflation by raising nominal interest rate policy instrument above expected inflation to elevate real interest rates and create an output gap
“Business as Usual” to “Fighting Inflation” (cont’d)

• According to new Keynesian pricing, central bank must sustain an output gap in order to make progress against inflation, given the expected inflation trend

• Once inflation is stabilized, even without much of a reduction, pressure builds quickly to revert to “business as usual” to close the output gap and normalize interest rates
“Business as Usual” to “Fighting Inflation” (cont’d)

• To sum up: Interpreting the post-war experience, we see a cycling of monetary policy priorities with upward inflation drift interrupted -- periodically but temporarily -- by deliberately contractionary monetary policy followed by a return to “business as usual”
8. Empirical Implications of Business as Usual

i) Inflation is a random walk with a transitory component

ii) The random walk in inflation is driven by shocks to the growth of capacity output

iii) The variance of the shock to trend inflation is directly related to

   ▪ the degree of interest rate continuity pursued by the central bank
   ▪ the serial correlation in the growth of capacity output
   ▪ the variance of the shocks to capacity output

and inversely related to

   ▪ the intertemporal elasticity of substitution in consumption

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Empirical Implications (cont’d)

iv) Short-term interest continuity leads to long-term interest rate random walking

v) Real interest rate and inflation rate innovations are negatively correlated due to interest rate smoothing

vi) Long-term interest rates lead short-term interest rates

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Empirical Implications (cont’d)

vii) In addition to sharply rising inflation, episodes of “inflation fighting” should be preceded by
   - a series of particularly severe, cumulative negative shocks to the growth of capacity output
   - rising long-term interest rates
   - rising short-term interest rates that lag the rise in long-term rates

viii) Progress against inflation should precipitate a recession, and pressure to return to “business as usual” should reverse these gains in the presence of ongoing negative shocks to capacity output

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Empirical Implications (cont’d)

ix) Inclination to pursue “business as usual” when inflation is well-behaved means that low inflation should inherit a stochastic trend, though the variance of the stochastic trend may be small.

x) Marginal predictive content of the output gap for inflation should deteriorate when inflation is low and stable, relative to periods of high and variable inflation interrupted periodically by “inflation fighting”.

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9. Understanding the Great Inflation

We present a variety of evidence to understand the Great Inflation in terms of our business-as-usual model of monetary policy:

• Time-Series Analysis of Inflation
• Factors Precipitating “Inflation Fighting”
• Stop and Go Monetary Policy
• Predictive Content of the Output Gap for Inflation

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Time-Series Analysis of Inflation

• Stock and Watson (2007) find that the inflation process in the United States from the 1950s to 2004 is well-described by the IMA(1,1) process

\[ \Delta \pi_t = (1 - \theta B) a_t \]

where \( B \) is a backshift operator, theta is positive, and \( a_t \) is a mean zero random variable
Time-Series Analysis of Inflation (cont’d)

• The IMA(1,1) statistical model is observationally equivalent to an unobserved components model in which inflation has a stochastic trend and a serially uncorrelated disturbance

\[ \pi_t = \tau_t + \eta_t, \quad \eta_t \text{ serially uncorrelated } (0, \sigma^2_\eta) \]
\[ \tau_t = \tau_{t-1} + \varepsilon_t, \quad \varepsilon_t \text{ serially uncorrelated } (0, \sigma^2_\varepsilon) \]

where \( \text{cov}(\eta_t, \varepsilon_j) = 0 \) for all \( j \).
Time-Series Analysis of Inflation (cont’d)

• Adding a white noise shock to our inflation equation as is standard in the literature, say $\eta_t$, and letting $\tau_t = \pi_t$, our theoretical model implies the IMA (1,1) model of inflation.

• Moreover, we can interpret aspects of Stock and Watson’s statistical analysis from the perspective of our theoretical model.
Time-Series Analysis of Inflation (cont’d)

Stock and Watson’s main findings:

1. inflation driven by random walk component plus a transitory component

2. a time-varying estimate of standard deviation of permanent innovation is 0.5 (percentage points at an annual rate) in the 1950s through the mid-1960s, rises sharply to a peak of 1.4 in the mid-1970s, falls gradually below 0.5 by mid-1980s, falls to 0.2 after the mid-1990s

3. std of transitory innovation is 0.5 throughout
Time-Series Analysis of Inflation (cont’d)

• Stock and Watson’s findings support several empirical predictions of our theoretical model
• Inflation is characterized parsimoniously and consistently as a random walk with a transitory component
• The Great Inflation is a story about the “Great Inflation Drift,” a period of greatly increased variance of the stochastic inflation trend
• Inflation through 2004 continues to contain a small stochastic trend in keeping with “business as usual”

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Factors Precipitating “Inflation Fighting”

- Our model predicts that these Romer dates should be preceded by:
  1. sharply rising inflation
  2. severe cumulative negative shocks to capacity output growth
  3. rising long interest rates
  4. rising short rates lagging long rates

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Factors Precipitating “Inflation Fighting” (cont’d)

• We check whether the Romer dates are preceded by the four developments predicted above, using data on inflation and interest rates together with an annual time series measure of technical change for the U.S. constructed by Basu, Fernald, and Kimball (2006)

• We find evidence in Figures 1 through 5 supporting the predictions of our model
Factors Precipitating “Inflation Fighting” (cont’d)

• The most striking evidence in support of our model is that BFK technology growth slows sharply and cumulatively before each of the Romer dates during the Great Inflation

• Long term rates tend to rise prior to the Romer dates, and short rates tend to lag the rise in long rates

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Stop and Go Monetary Policy

• Shapiro (1994) highlights a recurrent pattern before and after Romer dates: “Inflation fighting” is marked by sharply higher short rates relative to long rates engineered by the Federal Reserve, employment contracts or its growth slows, rising inflation is contained or reversed. But the gains against inflation are soon lost.

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Stop and Go Monetary Policy (cont’d)

• Our model predicts that “stop and go” policy should be an integral part of a period of protracted inflation driven by recurring cumulative negative shocks to technology such as we saw during the Great Inflation.

• Business-as-usual priorities exposed the US economy to upward inflation drift due to unexpectedly slow growth of technology throughout the period.

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Stop and Go Monetary Policy (cont’d)

• Inflation, inflation expectations, and long term interest rates could be brought down only by creating an output gap of enough size and duration to induce a disinflation in line with new Keynesian pricing, given expected inflation.

• But inflation stabilization would soon create pressure to return to “business as usual”, exposing the economy once again to rising inflation when there are negative technology shocks.

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Predictive Content of the Output Gap for Inflation


• We regard the changing informativeness of the output gap for future inflation as evidence in support of our business-as-usual model of monetary policy.

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Predictive Content (cont’d)

• Given the incentive to pursue business-as-usual priorities when inflation is low and stable, and to allow inflation to drift around, we expect the output gap to have little predictive content for inflation since 1984

• Even though “business as usual” was the predominant mode of central bank behavior during the Great Inflation, the Fed was then forced into “fighting inflation” on four Romer-date occasions

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Predictive Content (cont’d)

• According to our model, the output gap had great predictive content for inflation during these “inflation fighting” episodes because the Fed then deliberately created output gaps to contain inflation and bring it down, if only temporarily.

• Thus, it is not surprising that the Great Inflation sample period displays predictive content for inflation far in excess of that during the Great Moderation.

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10. Summary and Conclusions

• According to our model, the Great Inflation resulted from a combination of “bad policy” and “bad luck”

• The presence of a stochastic inflation trend resulted from bad policy—the priority on output gap stabilization and interest continuity—which perpetuated inflation shocks
Summary and Conclusions

- Our model identifies the source of shocks as surprisingly slow productivity growth, and, more generally, factors unexpectedly slowing the growth of capacity output.
- We found evidence of bad luck in that productivity growth was indeed surprisingly and especially slow during episodes of sharply rising inflation.

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Summary and Conclusions

• We study the Great Inflation to prevent its recurrence
• Our interpretation suggests that a preoccupation with short-term interest rates and with maintaining output at capacity in the presence of adverse real shocks, would combine to produce another period of inflation drift with similarly adverse consequences for employment and output

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Fig. 1: Personal Consumption Expenditures: Chain-type Price Index (PCEPI) and Consumption Expenditures: Chain-Type Price Index Less Food and Energy (PCEPILIFE)

* Notes: Vertical lines indicate "Romer dates". Shaded areas indicate NBER recessions. Dates are under 1st Month of Year; tick marks are every 3 months.
Fig. 2: Civilian Employment-Population Ratio (EMRATIO)

* Notes: Vertical lines indicate "Romer dates".
  Shaded areas indicate NBER recessions.
  Dates are under 1st Month of Year; tick marks are every 3 months.
Fig. 3: Effective Federal Funds Rate (FEDFUNDS) and 10 Year Treasury Constant Maturity Rate (GS10)

* Notes: Vertical lines indicate "Romer dates".
Shaded areas indicate NBER recessions.
Dates are under 1st Month of Year; tick marks are every 3 months.
Fig. 4: 1 Year Treasury Constant Maturity Rate (GS1) and 10 Year Treasury Constant Maturity Rate (GS10)

* Notes: Vertical lines indicate "Romer dates". Shaded areas indicate NBER recessions. Dates are under 1st Month of Year; tick marks are every 3 months.
Fig. 5: Productivity Growth Rates (PGR)

* Notes: Vertical lines indicate "Romer dates". Shaded areas indicate NBER recessions. Dates are under 1st Month of Year; tick marks are every 3 months.