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Inflation and Commitment

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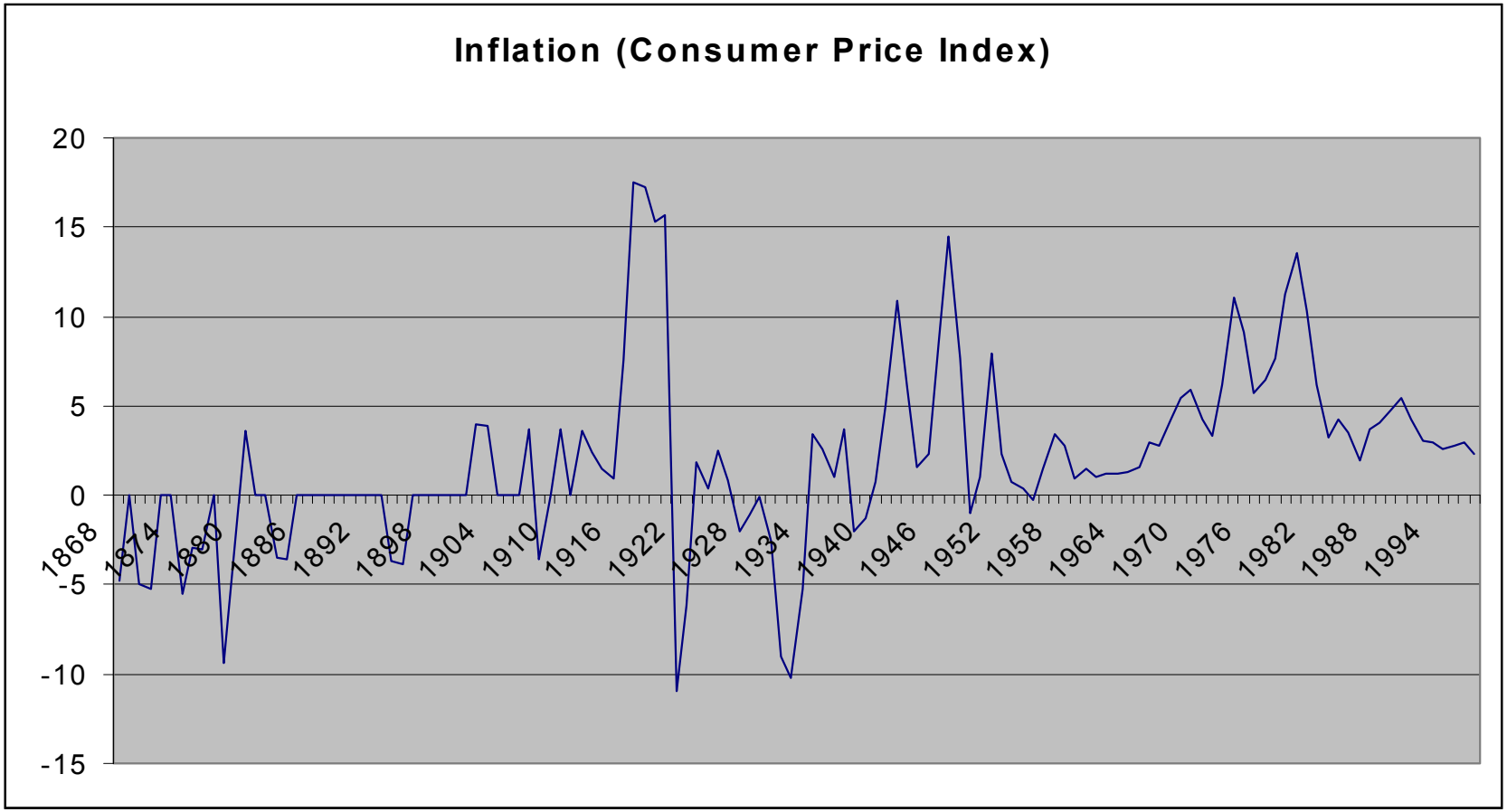
Inflation: A Few Facts

- Average Inflation Higher in Late Part of 20^{th} Century than Before
- Deflation at time of Great Depression
- Inflation in Weak Economy of 1970s



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Issues

- Dynamics of Inflation Still a Hotly Debated Topic
- ‘Spikes’ in Inflation Around War-Time Not Puzzling
- But, Why did Inflation Rise in the 1970s?

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- Two Types of Answer:
  - 'People': Mistakes Happen
    i. Fed Incorrectly Thought Weak Economy of 1970s Was a 'Cyclical' Problem. This Led Them to Try and Heat Up Economy With High Money Growth (Orphanides)
    ii. Fed Sometimes Thinks Trade-off Between Inflation and Unemployment Is Very Favorable, and So They Inflate (Sargent).
    iii. Seems Appealing: Surely Only a Mistake Can Cause Monetary Institutions In Democratic Societies to Produce Socially Bad Inflation Outcomes.
  - 'Institutions': Lack of Commitment to Inflation Target
    i. In Democratic Society, With Fully Informed Agents, It *is* Possible for Monetary Institutions to Produce Bad Inflation Outcomes
    ii. In Absence of Commitment Private Expectations of Inflation Can 'Push' Monetary Authority into Supplying Inflation.
    iii. Expectation Trap.

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- What's At Stake? Diagnosis Determines the Nature of the Solution
- Different Approaches
  - 'People' view - Need More and Better Research on:
    - Identifying the Right Model of the Economy
    - Understanding the Interface Between Monetary Authority and Economy
  - 'Institutions' - Redesign Institution to Have More Commitment
    - Legal Mandate to Focus Central Bank's Attention Exclusively (Subject to Carefully Designed Escape Clauses!) on Inflation
    - Contracts for Central Bankers.

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Outline for Remainder of Talk

- What is 'Commitment' and Why Does it Matter?
  - An Simple Example Based on the Laffer Curve
- Does Lack of Commitment in Monetary Policy Help Us Understand Data?
  - Must Incorporate It into an Economic Model First.
  - Kydland/Prescott - Barro/Gordon Model (KP-BG).
  - KP-BG Model Explains Rise in Average Inflation.
  - KP-BG Model Explains Observed Change in Relation Between Inflation and Unemployment.
- If the KP-BG Model is So Good, How Come 'Committment' Is Not At Heart of Everyone's Explanation of Inflation Dynamics?
  - KP-BG Model Has Hard Time With End of 1970s Inflation.
  - KP-BG Model Has Hard Time With End of European Inflation.
- Should We Dump the Commitment View Because KP-BG Model Has Shortcomings?
  - Maybe
  - But first, Let's See What Modern Models Have to Say.

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Commitment: What is it, and Why Might it Matter?

- Commitment:
  a. Policy Maker Declares Policy 'First', and No One Doubts its Intention.
  b. Private Economy Makes Decisions.
- Lack of Commitment:
  a. Private Economy Makes Decision Based on Guess of What Policy Maker will Do.
  b. Policy Maker Chooses Policy.
- Laffer Curve Example.
  a. Commitment: Get Best Outcome For Sure
  b. Lack of Commitment: Could Get Worst Outcome, But Could Get Worst.

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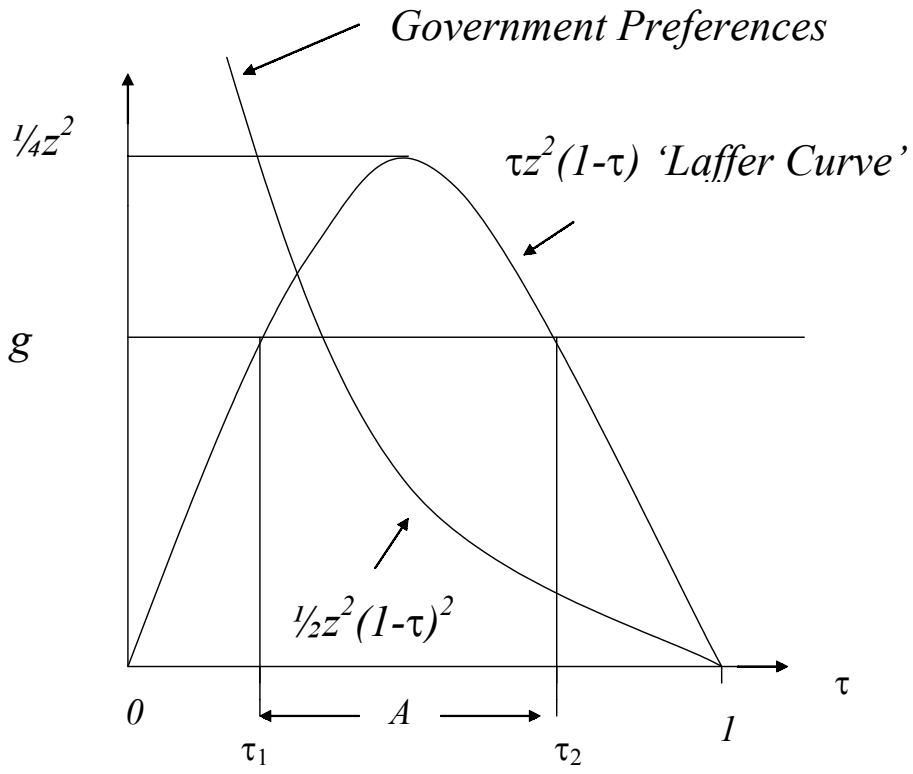

Utility: $c-\frac{1}{2}l^2$
HH Budget constraint: $c=(1-\tau)zl$
Gov't Budget constraint: $g=\tau zl$

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Lack of Commitment in Monetary Policy

- Tax Example Useful for Illustration, But Not So Plausible
- Lack of Commitment in Monetary Policy Very Plausible.
- Kydland-Prescott, Barro-Gordon Used as a Vehicle to Talk About Lack of Commitment

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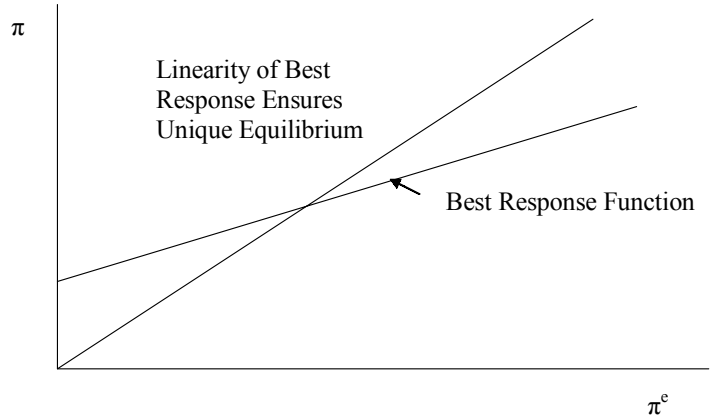
Kydland-Prescott, Barro-Gordon Model

- Monetary Policy Situation Looks Like Situation in Laffer Curve, With No Commitment.
  - Private Decisions Involve Some Lead Time.
  - Monetary Authority Makes Decisions Daily, Balances Benefits of Surprise Inflation Against Costs.



KP-BG Model: Inflation Volatile Only if Fundamentals Are

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Testing the Model

- Before WWII, Monetary Policy Had Commitment (Gold Standard)
- Commitment Lost After WWII With Advent of Keynesian Stabilization Policy
- Predictions of Kydland-Prescott/Barro-Gordon Model
  - Inflation Should have Gone Up.
  - Early Century: Gold Standard. Should Have Negative Relationship Between Inflation and Unemployment.
  - Late Century: Lost Commitment. KP-BG Model Predicts Positive Relationship Between Inflation and Unemployment.

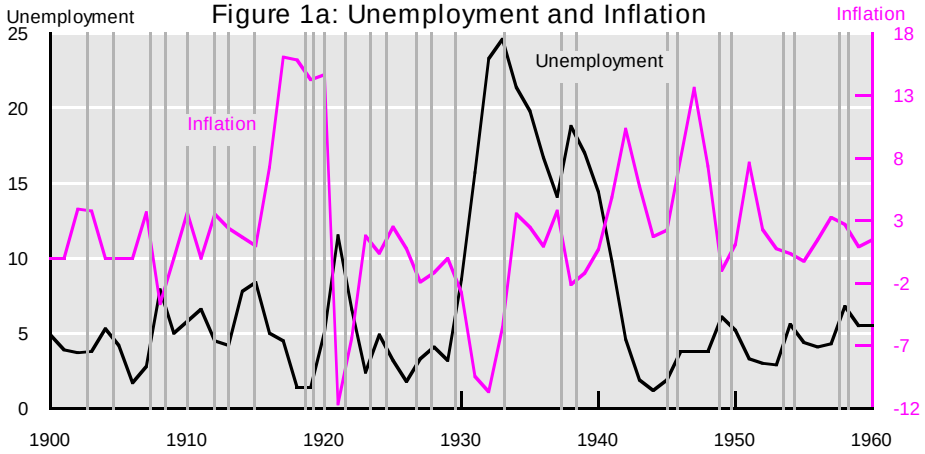
Figure 1a: Unemployment and Inflation
Unemployment
Inflation
Unemployment
Inflation
25
20
15
10
5
0
18
13
8
3
-2
-7
-12
1900
1910
1920
1930
1940
1950
1960

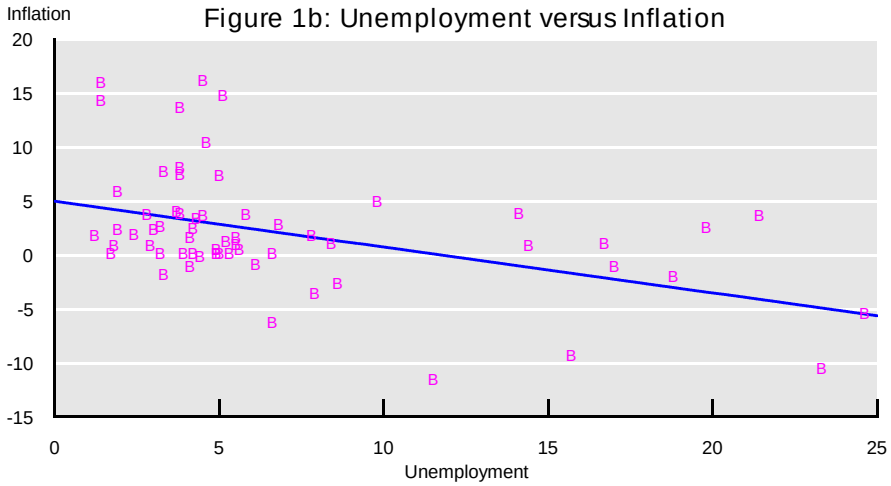
Figure 1b: Unemployment versus Inflation
Inflation
Unemployment
20
15
10
5
0
-5
-10
-15
0
5
10
15
20
25

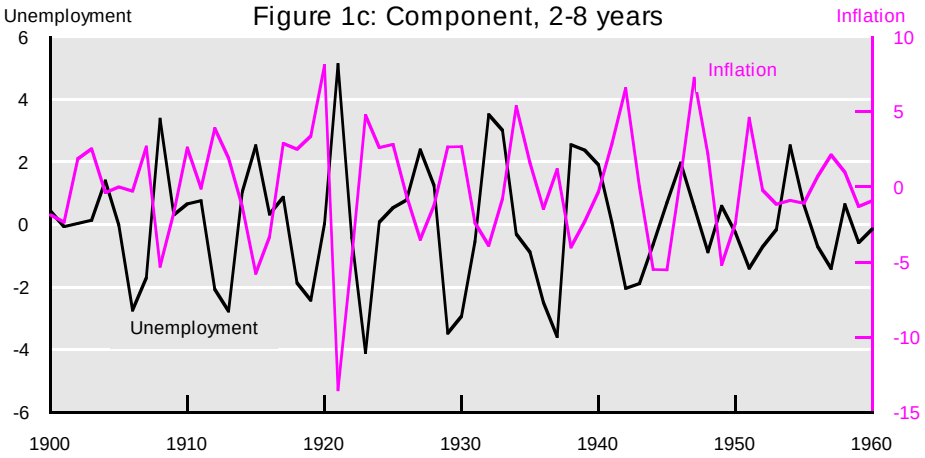
Figure 1c: Component, 2-8 years
Unemployment
Inflation
Inflation
Unemployment
6
4
2
0
-2
-4
-6
10
5
0
-5
-10
-15
1900
1910
1920
1930
1940
1950
1960

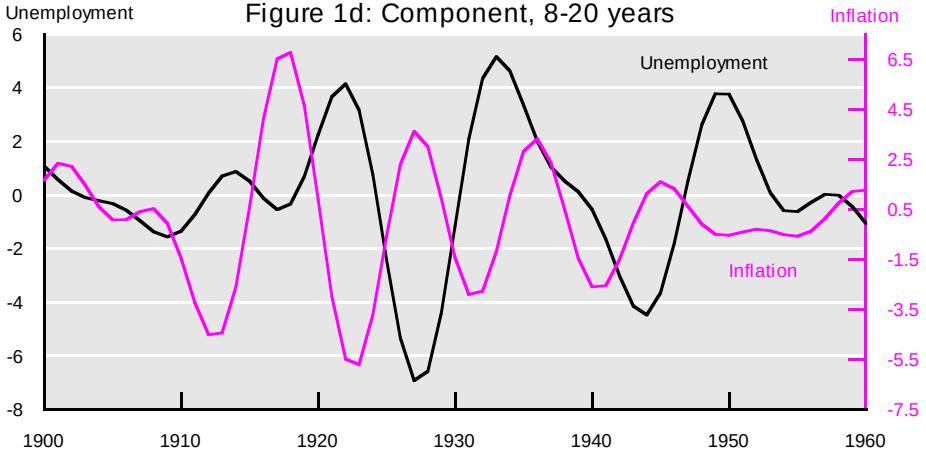
Figure 1d: Component, 8-20 years
Unemployment
Inflation
Unemployment
Inflation
6
4
2
0
-2
-4
-6
-8
6.5
4.5
2.5
0.5
-1.5
-3.5
-5.5
-7.5
1900
1910
1920
1930
1940
1950
1960

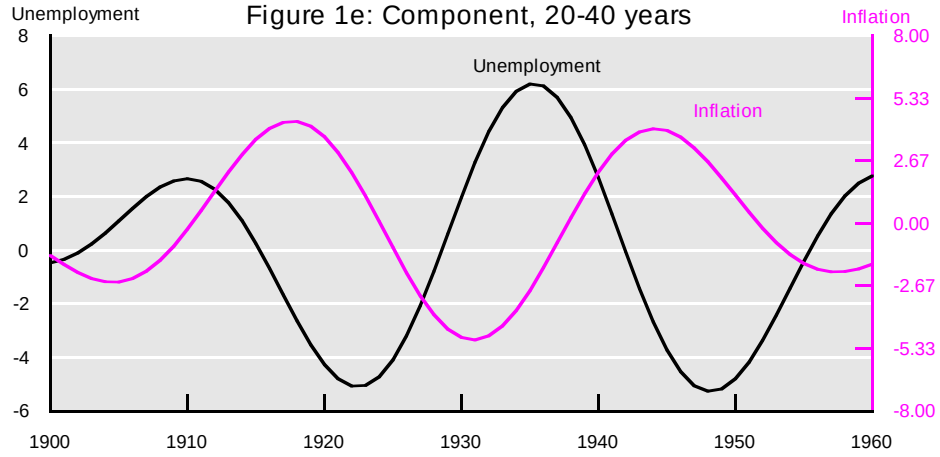
Figure 1e: Component, 20-40 years
Unemployment
Inflation
Unemployment
Inflation
8
6
4
2
0
-2
-4
-6
8.00
5.33
2.67
0.00
-2.67
-5.33
-8.00
1900
1910
1920
1930
1940
1950
1960

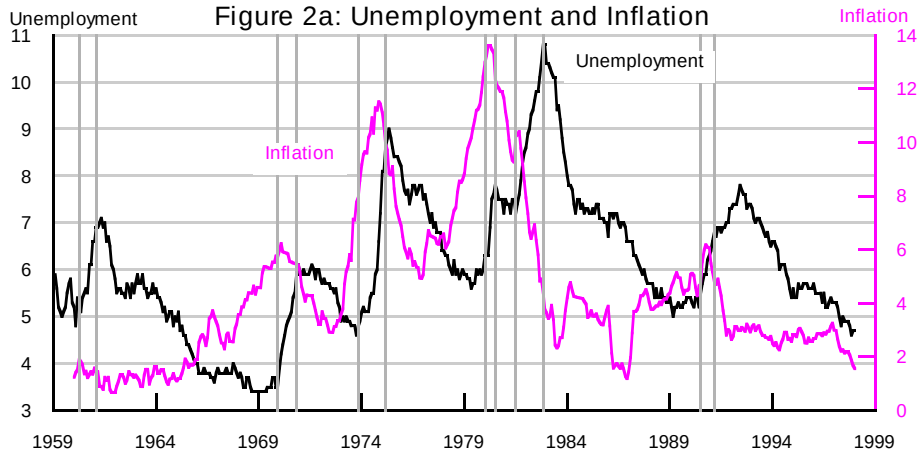
Figure 2a: Unemployment and Inflation
Unemployment
Inflation
Unemployment
Inflation
11
10
9
8
7
6
5
4
3
14
12
10
8
6
4
2
0
1959
1964
1969
1974
1979
1984
1989
1994
1999

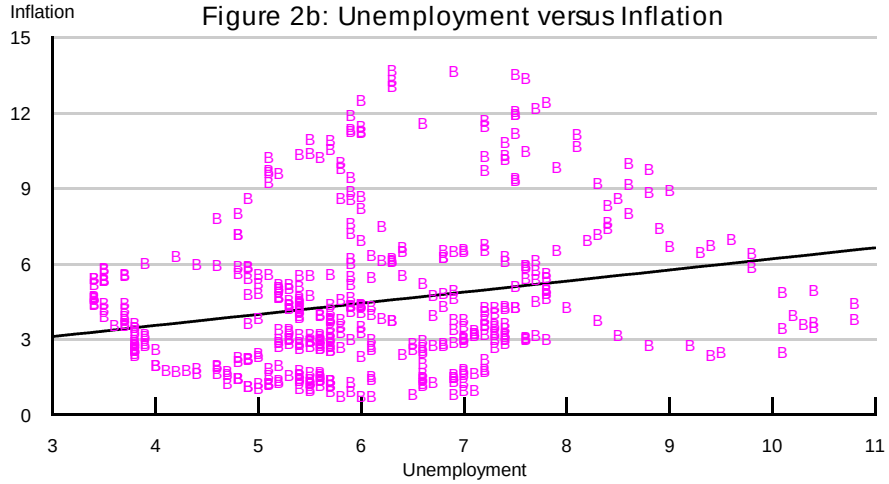
Figure 2b: Unemployment versus Inflation
Inflation
Unemployment
15
12
9
6
3
0
3
4
5
6
7
8
9
10
11

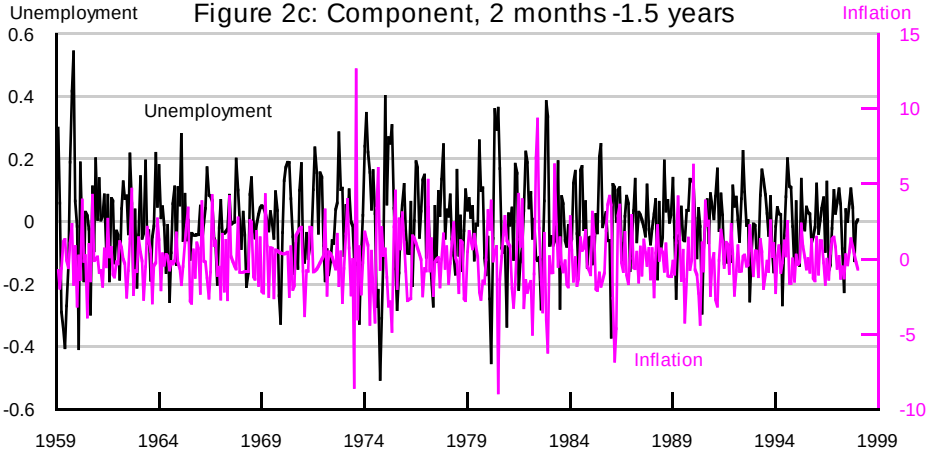
Figure 2c: Component, 2 months -1.5 years
Unemployment
Inflation
Unemployment
Inflation
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
15
10
5
0
-5
-10
1959
1964
1969
1974
1979
1984
1989
1994
1999

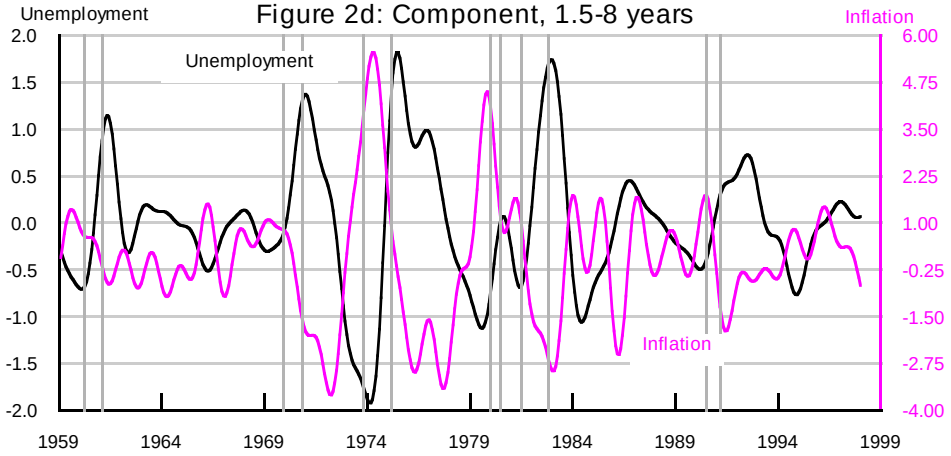
Figure 2d: Component, 1.5-8 years
Unemployment
Inflation
Unemployment
Inflation
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
6.00
4.75
3.50
2.25
1.00
-0.25
-1.50
-2.75
-4.00
1959
1964
1969
1974
1979
1984
1989
1994
1999

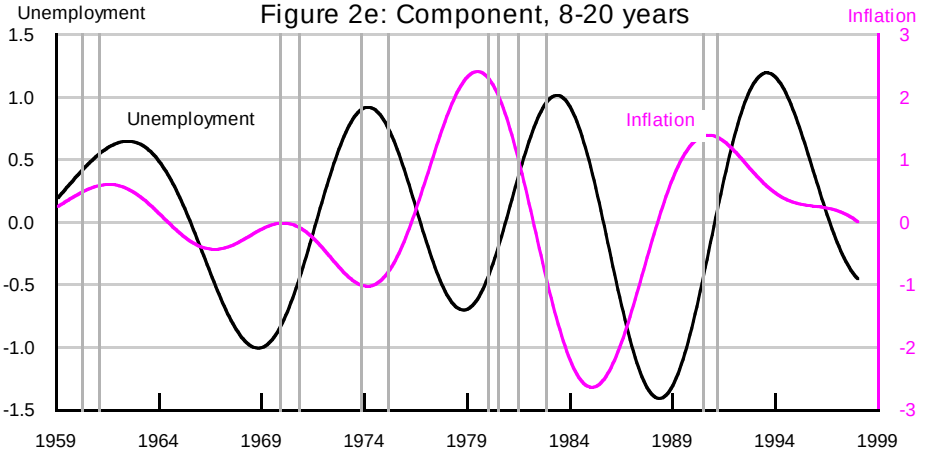
Figure 2e: Component, 8-20 years
Unemployment
Inflation
Unemployment
Inflation
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
3
2
1
0
-1
-2
-3
1959
1964
1969
1974
1979
1984
1989
1994
1999

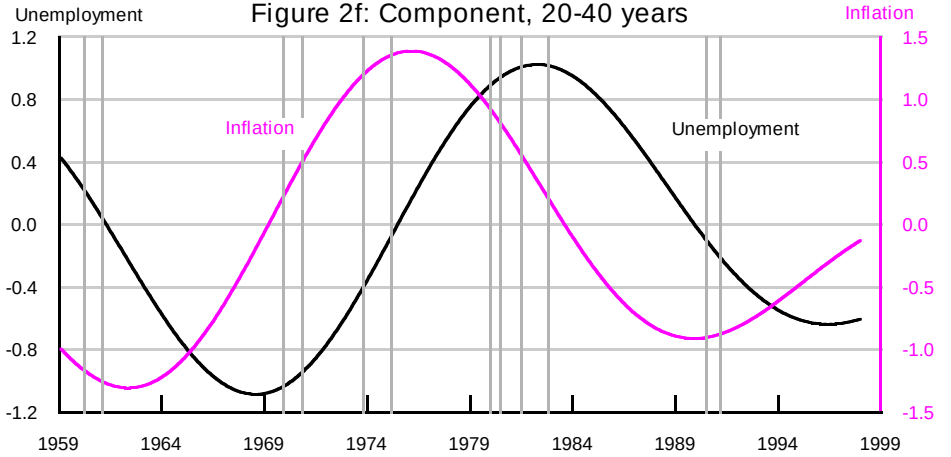
Figure 2f: Component, 20-40 years
Unemployment
Inflation
Inflation
Unemployment
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1959
1964
1969
1974
1979
1984
1989
1994
1999

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- Before WWII, Monetary Policy Had Commitment (Gold Standard)
- Commitment Lost After WWII With Advent of Keynesian Stabilization Policy
- Predictions of Kydland-Prescott/Barro-Gordon Model
  - Inflation Should have Gone Up
  - Early Century: Gold Standard. Should Have Negative Relationship Between Inflation and Unemployment.
  - Late Century: Lost Commitment. KP-BG Model Predicts Positive Relationship Between Inflation and Unemployment
- Predictions Are Born out in US Data.
- These Are (Some of) the Reasons Why Commitment Attracted A Lot Of Attention.
- Problem: End of Inflation In US.

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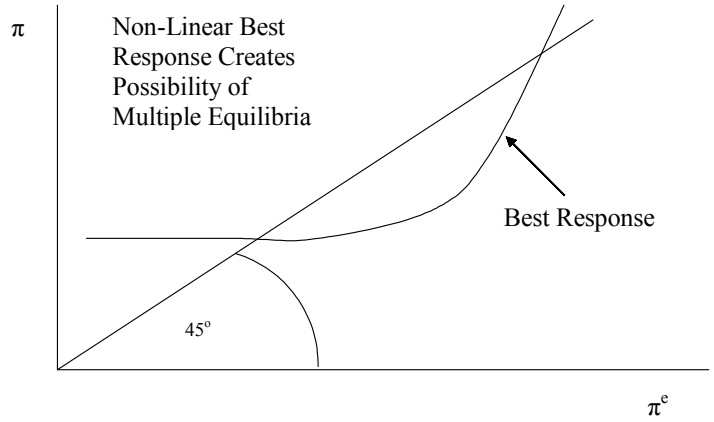
Modern Approach (Based on Structural Models)

- Embed KP/BG Ideas in Standard General Equilibrium Models.
- Models Have Rich Implications:
  - Predicts Persistent Periods of Low as Well as High Inflation.
  - Models Much More Testable than KP-BG Model.



A Possibility Ruled Out By Assumption in KP-BG

- Modest Evidence in Data of Such Equilibria.
- Type of Equilibria That Occur: 'Expectation Traps' (Chari, Christiano, Eichenbaum, 1999 JET).

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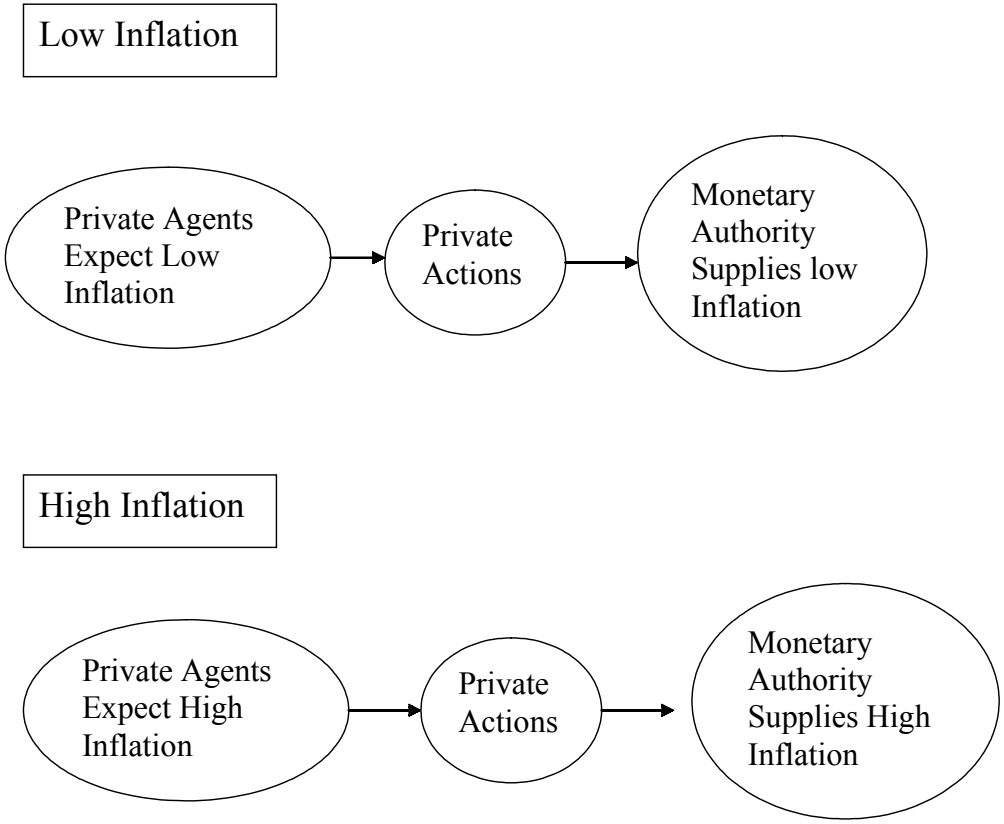
Expectation Traps



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US in the 1970s: An Expectation Trap?

- Arthur Burns, Chairman of the US Federal Reserve in the 1970s, Spoke as Though He Were Caught in an Expectation Trap:
- Burns, May 1970:

"An effort to offset, through monetary and fiscal restraints, all of the upward push that rising costs are now exerting on prices would be most unwise. Such an effort would restrict aggregate demand so severely as to increase greatly the risks of a very serious business recession. If that happened, the outcries of an enraged citizenry would probably soon force the government to move rapidly and aggressively toward fiscal and monetary ease, and our hopes for getting the inflationary problem under control would then be shattered."

US in the 1990s: Another Expectation Trap?

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Conclusion

- Dynamics of Inflation Continues to be a Hotly Debated Topic
- Absence of Commitment In Monetary Policy Has Lost Favor In Recent Years.
  - This is True in Academic Research in Monetary Policy.
  - Notion of Commitment In Monetary Policy is Also Losing its Grip Among Some Policy Makers.
  - This May Be a Mistake.

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Embedding KP/BG in General Equilibrium

- Equilibrium Inflation Reflects Interplay Between Incentives and Disincentives to Inflate.
- Incorporate Incentives and Disincentives into a Lucas-Stokey Cash-Credit Good Model.
- Incentives:
  - Monopolistic Competition.
  - Some Preset Prices.
- Disincentives:
  - Svensson Timing ($Pc \leq M_{-1}$).
  - Distortions to Relative Prices.
- Endogeneity of Payments Technology.
- Finding: Incentives and Disincentives May Balance At Different Inflation Rates.

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Model

- Households, Firms, Monetary Authority.
- Continuum of Goods.
- Infinite Horizon.

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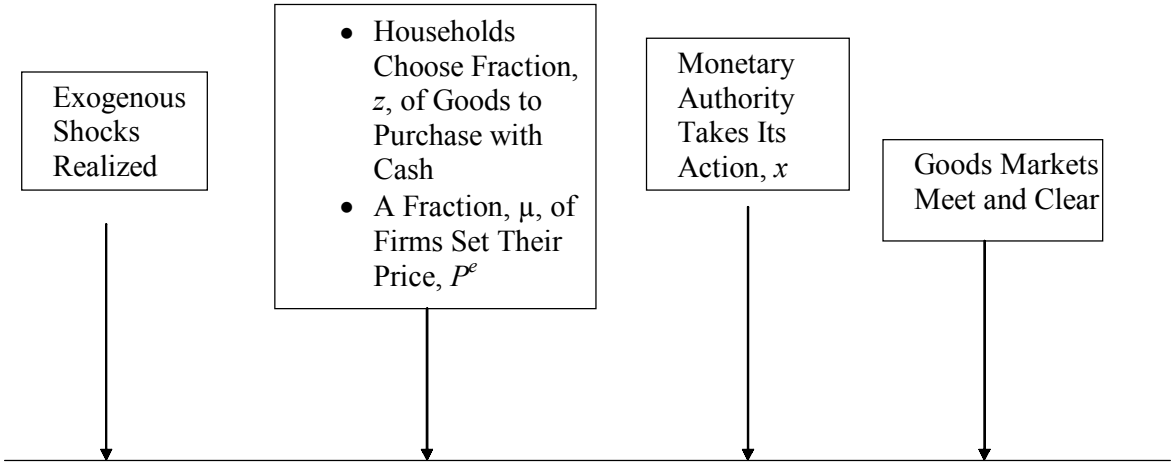
Timing in a Period



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Description of the Model

- Description Proceeds Backward Through Time, Starting With Decisions Taken at End of Period.
- Decision by Firms and Households At the End of the Period.
- Decision by the Monetary Authority.
- Household Choice of z, and Choice of P^e by Firms With Preset Prices.

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Private Sector Decisions At the End of the Period

- Variables that are Pre-Determined At this Point: z, P^e, x
- Description of Agents' Problem:
  - Firms
  - Households

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Firms

- Each good, $y(\omega), \omega \in [0,1]$, produced by a monopolist.
- Production Technology: $y(\omega) = \theta n(\omega), \omega \in [0,1]$.
- Firms use Usual Price Markup Rule.
- $1-\mu$ Firms set Prices, $\hat{P}$, After Monetary Authority:

$$\hat{P} = \frac{W}{\theta \rho}.$$

- (μ 'Sticky Price' Firms set Prices, P^e, Before Monetary Authority.)

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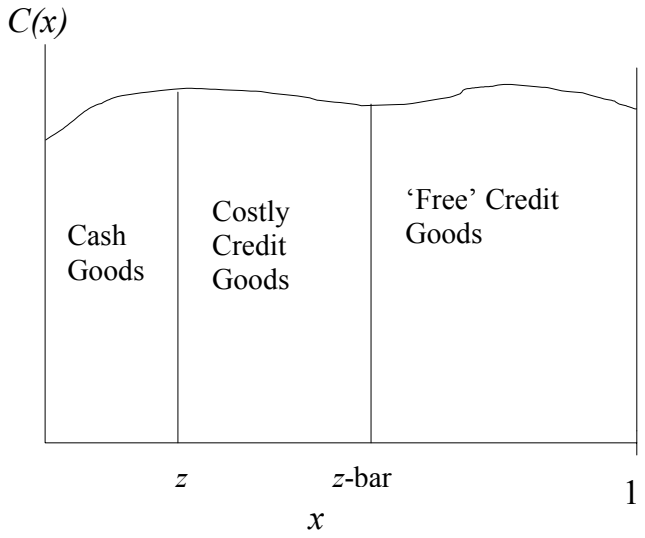
Households

- Problem:

$$\max \sum_{t=0}^{\infty} \beta^t u(c_t, \text{labor}_t),\ c = \left[\int_0^1 c(x)^\rho dx \right]^{\frac{1}{\rho}}$$



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- Payments Technology:

$$\text{labor} = n + \frac{(\bar{z} - z)^{1+\nu}}{1+\nu}\eta, \ \bar{z} \text{ given.}$$

- Cash in advance constraint:

$$M_{-1} \geq P^e \mu z c_{cash,preset\ price} + \hat{P}(1-\mu) z c_{cash,flex\ price}$$

- Usual Wealth Evolution Equation.

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Monetary Authority

- Problem:

$$\max_{R} U(s, z, P^e, R),$$

s ~Exogenous Shocks

- Necessary Conditions for Monetary Authority Maximization:

$$U_R = -\psi_{ID}(R) + \psi_{MD}(R, z) \leq 0$$

with equality if $R > 1$.

'Policy Correspondence'

- ψ_{ID} ~'Inflation Distortion':

$$\psi_{ID} = (R-1) R^{\frac{1}{\rho-1}}$$

$$\tilde{} \ (R-1)\frac{M}{P}$$

$$\psi_{ID}(1) = \lim_{R\to\infty} \psi_{ID}(R) = 0.$$

...

- ψ_{MD} ~'Monopoly Distortion':

$$\begin{aligned}\psi_{MD}(R,z) \;=\; & -(1-\rho)R^{\frac{1}{\rho-1}} \\ & + \frac{R^{\frac{1}{\rho-1}} + \psi R^{\frac{\rho}{\rho-1}} + \frac{\mu}{1-\mu}\frac{\psi}{\rho}\left(R^{\frac{\rho}{\rho-1}} + \frac{1-z}{z}\right)}{\frac{1+\psi}{1-\rho} + \frac{\psi}{\rho}\left(\frac{z}{1-z}R^{\frac{\rho}{\rho-1}} + 1\right)} \\ & \sim \left[-\left(\frac{-u_n}{u_{c_2}}\right) + \theta\right] n_R\end{aligned}$$

  Efficiency Dictates the Term in Square Should Be Zero. With Monopoly Power, it is Positive.

- Properties of ψ_{MD} :

$$\psi_{MD}(1) \lesseqgtr 0, \; \lim_{R\to\infty}\psi_{MD}(R) > 0.$$

- Proposition: Given z, If Monetary Authority FONC Satisfied at All, it Must Be Satisfied At Least Twice.

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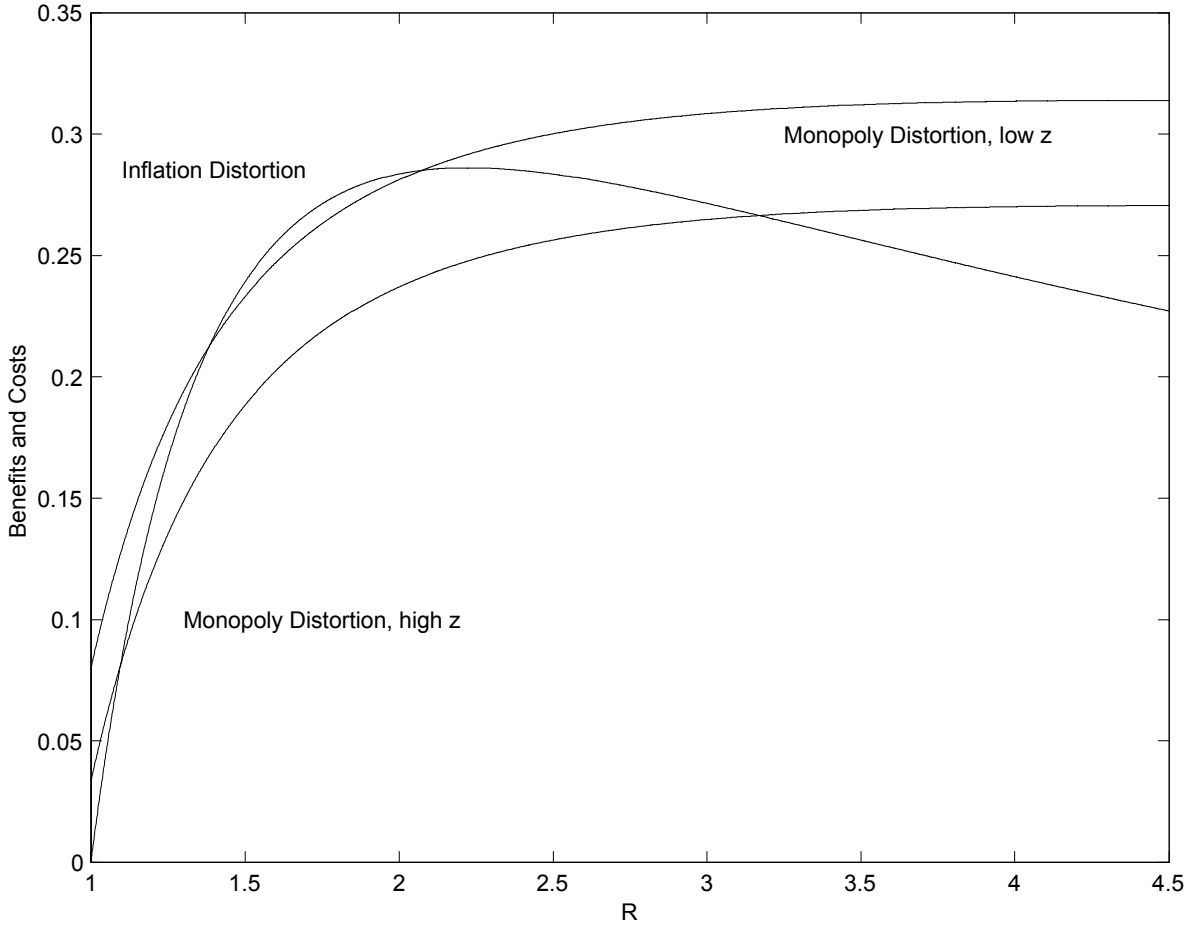
- Numerical example: μ=0.1, ρ=0.45, ψ=1,ν=2, $\bar{z}$=0.15, η=28000. Here are the Ψ_{ID} and Ψ_{MD} curves for a 'low' value of z, $z = .13$ and 'high' value of z, $z = .15$.

Figure 1: Marginal Benefits and Marginal Costs for Monetary Authority



In each case, the necessary conditions for an equilibrium are satisfied twice.

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- Details About the Candidate Equilibria:

	Low Inflation Equilibrium	High Inflation Equilibrium
Panel A: $z = 0.13$		
P^e	49.11	99.23
R	1.38	2.07
c_1	0.16	0.08
c_2	0.28	0.29
n	0.32	0.31
Panel B: $z = 0.15$		
P^e	26.3	165.0
R	1.10	3.17
c_1	0.25	0.04
c_2	0.30	0.33
n	0.34	0.34

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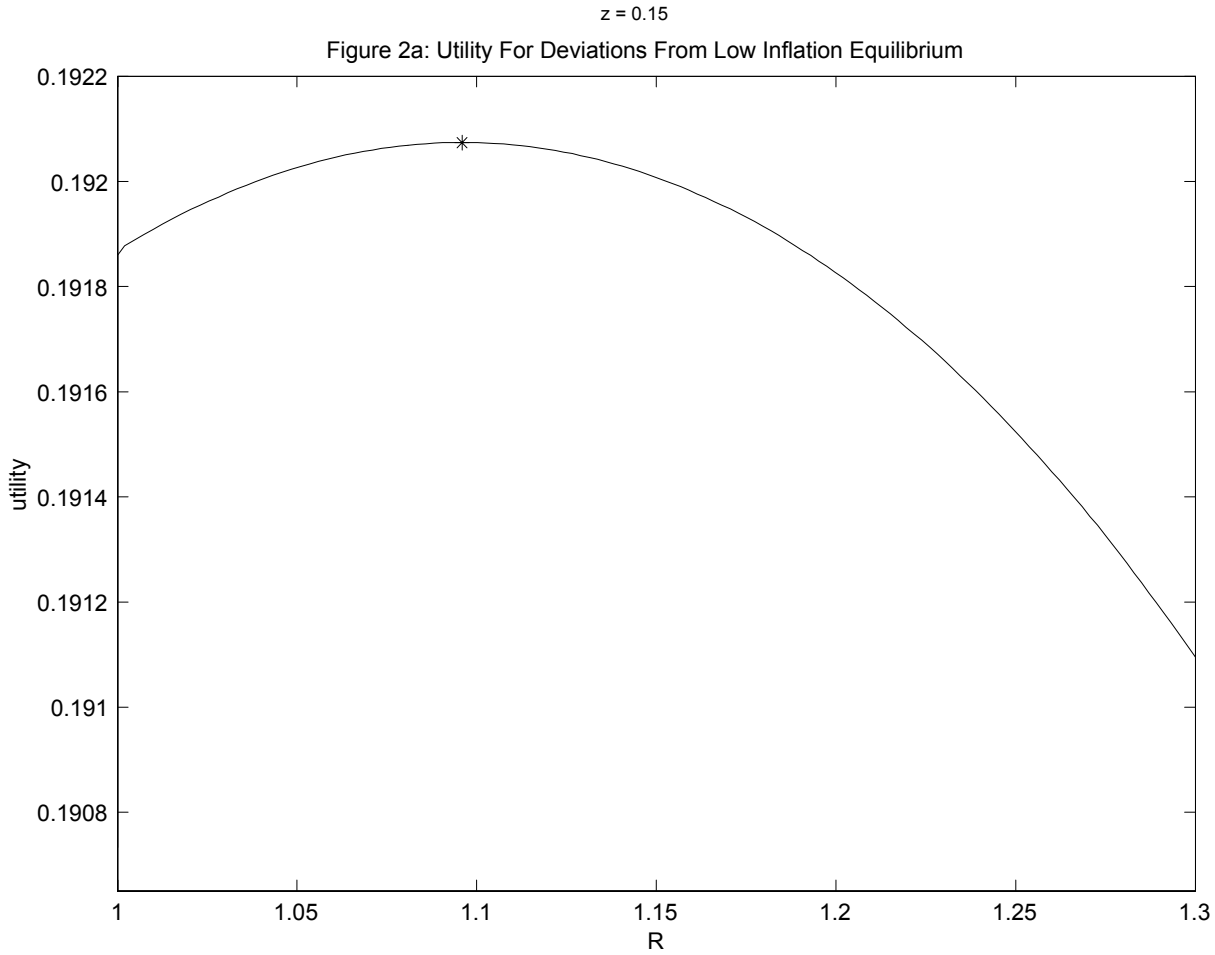
- Necessary Conditions for Monetary Authority Optimization May Not Be Sufficient. Must Verify Numerically. Necessary Conditions Do In Fact Identify Optima.



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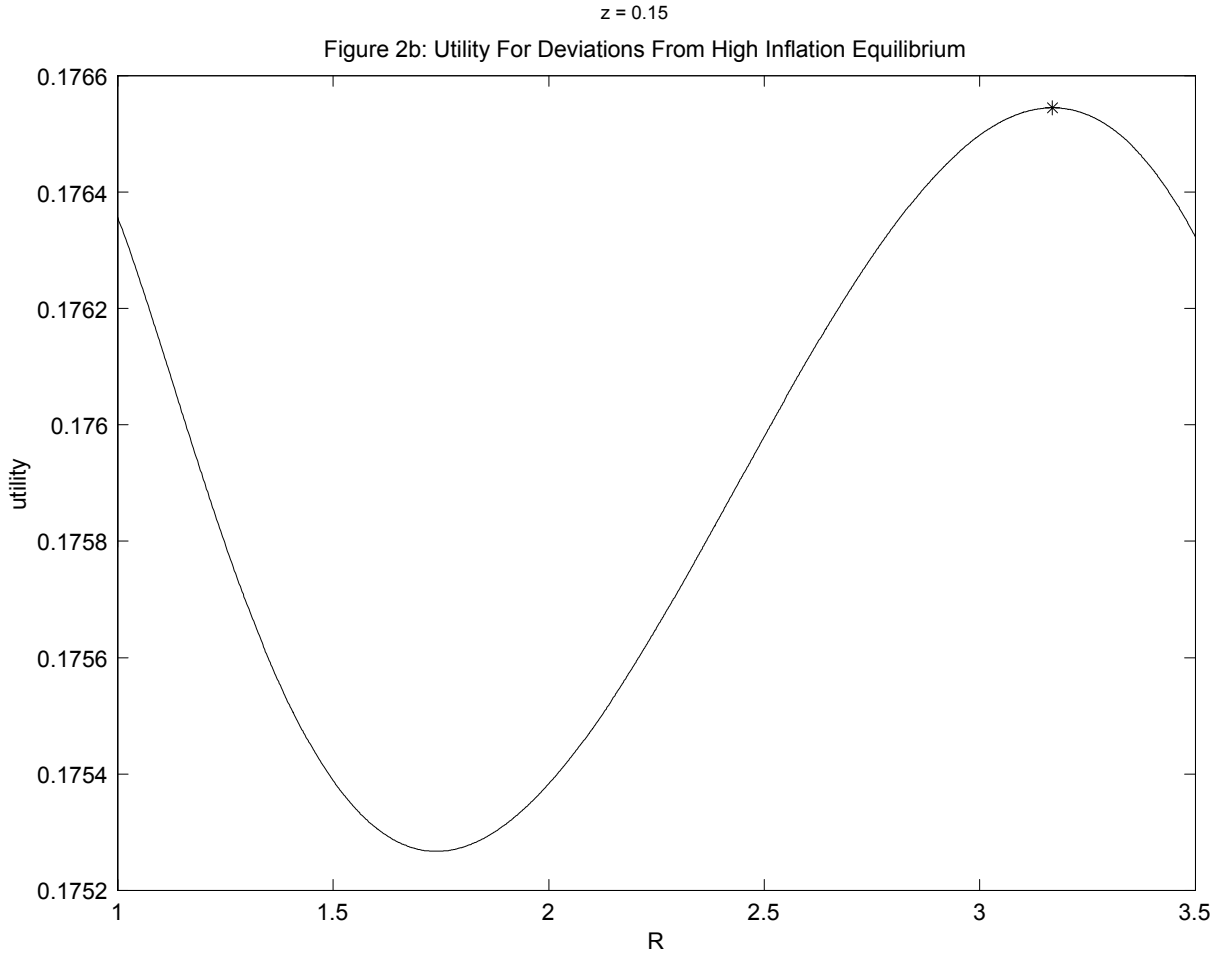
- Note: The High Inflation Candidate Equilibrium Almost Was Not a Global Optimum, with $R=1$ Coming in a Close Second. This Illustrates Importance of Verifying That Candidate Equilibria Identified by FONC's Do, In Fact, Satisfy Monetary Authority Optimization.



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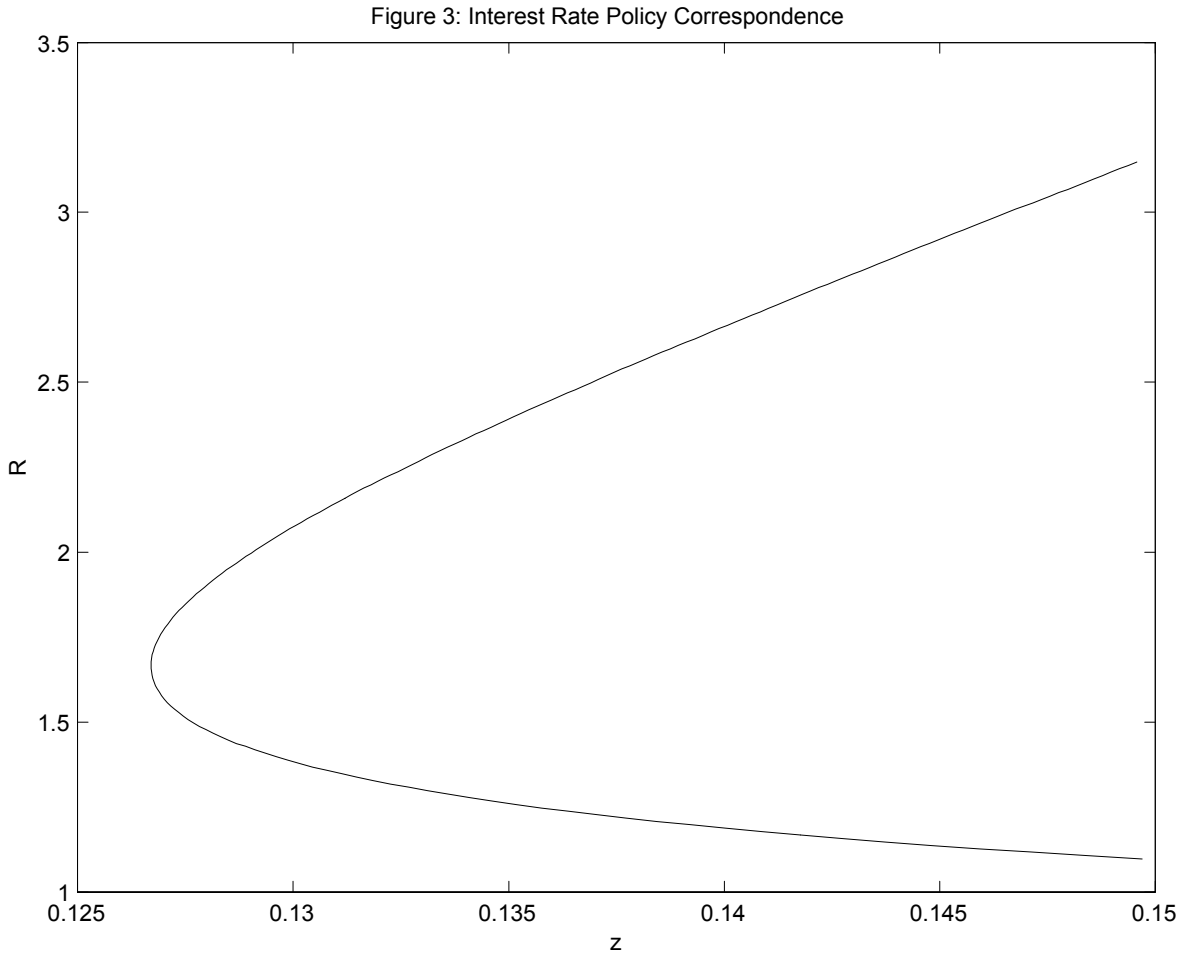
- By Varying z, Can Trace Out Set of R That Satisfy Necessary Conditions for Monetary Authority Optimization:



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Household Choice of z

- Household Euler Equation for Choosing z Yields Another Relationship Between R and z:

$$\frac{(\frac{1}{\rho}-1)(1-R^{\frac{\rho}{\rho-1}})}{z\left[(R^{\frac{1}{\rho-1}}-1)+\frac{\psi}{\rho}(R^{\frac{\rho}{\rho-1}}-1)\right]+(1+\frac{\psi}{\rho})}=\frac{\rho\eta(\bar{z}-z)^{\nu}}{1-\frac{(\bar{z}-z)^{1+\nu}\eta}{1+\nu}-\frac{g}{\theta}}$$

  Household *Payment Technology Function*.

- Note that This is a Function of the Shocks.

- Can Show: Downward Sloping - If Households Expect High R, Choose Low z.

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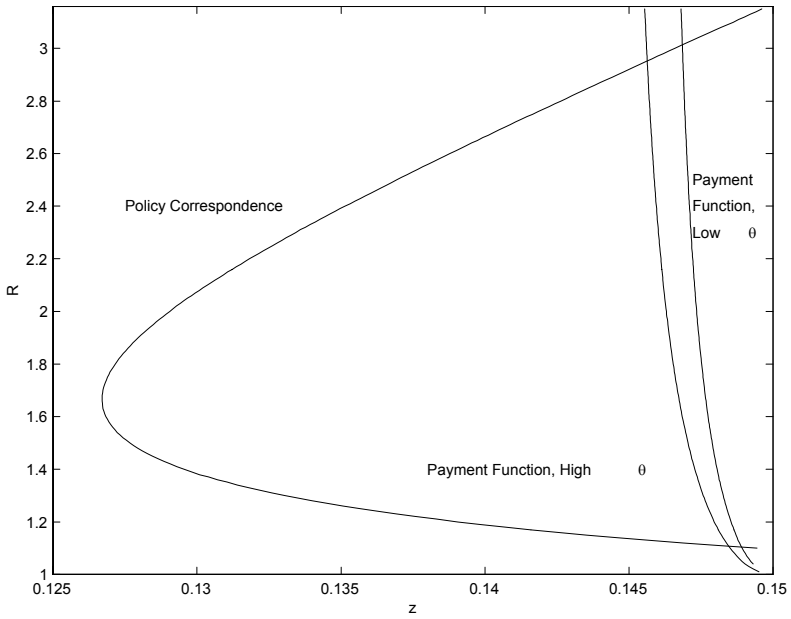
Markov Equilibria

- Figure 4a shows what happens for θ large ($\theta = 1.9$) and small ($\theta = 0.1$). Note how the response in the interest rate is of opposite sign across the high inflation and low inflation equilibria.

Figure 4a: Markov Equilibrium With Production Technology Shocks



Technology Shock, θ: Output is Increasing in Technology Shock in Both Equilibria $\Longrightarrow$

- $*$ $\rho(R, Y) > 0$ in Low Inflation Equilibrium.
  $*$ $\rho(R, Y) < 0$ in High Inflation Equilibrium.

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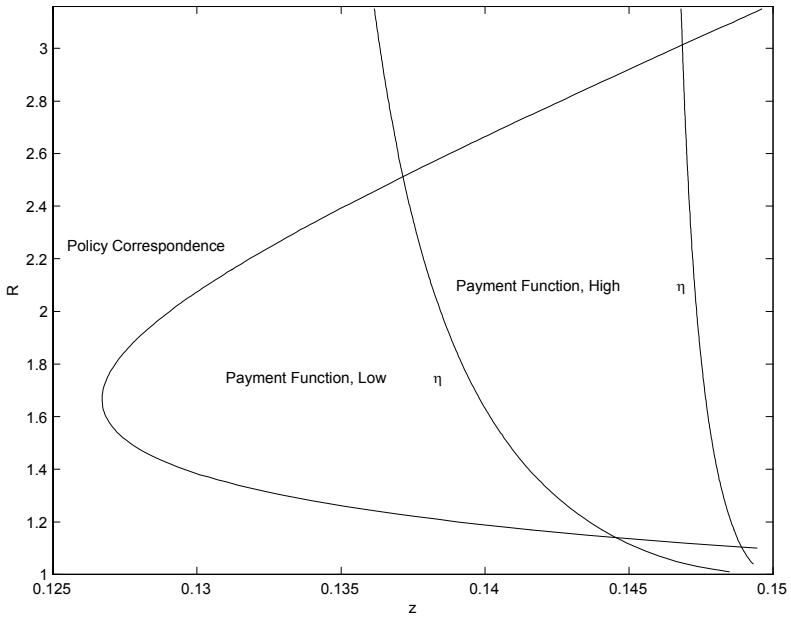
- Figure 4b shows how the equilibrium responds to shocks in η. Results are displayed for high η (28000×1.9) and for η low (28000×0.1)

Figure 4b: Markov Equilibrium With Payment Technology Shocks



  - Payment Shock, η : Output is Increasing in Payment Technology Shock In Low Inflation Equilibrium, and Decreasing in High Inflation Equilibrium$\Longrightarrow$
    - $\rho(R, Y) < 0$ in Low Inflation Equilibrium.
    - $\rho(R, Y) < 0$ in High Inflation Equilibrium.

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- Note Sign Switch: For Either Shock, Response of R Opposite Sign in High and Low Inflation Equilibria.
- With Both Shocks: $\rho(R, Y) < 0$ in High Inflation Equilibrium, and Closer to Zero in Low Inflation Equilibrium.
- Note that R is Less Volatile in Low Inflation Equilibrium.

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Empirical Analysis of $\rho(R, Y)$

- Obtained Data From IFS On Y, R
- 'High Inflation Country': $R > 100$ Percent in at Least One Year
- 'Episode of High Inflation in High Inflation Country': $R > 50$ Percent.
- 'Low Inflation Country': Western Europe, the United States, Canada, Japan, Australia and New Zealand.

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Evidence From High Inflation Countries

- There are seven high inflation countries. Five Had Episodes of High and Low Inflation.
- With one exception, $\rho(R, Y)$ Higher in Low Inflation Episodes than High Inflation Episodes.
- Standard Deviation of R Higher in High Inflation.

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Evidence Across Countries

- High Inflation Countries Tend to Have $\rho(R, Y) < 0$
- Low Inflation Countries Tend to Have Higher $\rho(R, Y)$.

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Conclusion

- Expectation Traps Equilibria Occur in Simple Monetary Models.
  - Expecting Inflation, Agents Take Defensive Actions, Which Lead Monetary Authority to Optimally Provide High Inflation.
  - Similarly, when Agents Expect Low Inflation.
- Prolonged Periods of High and Low Inflation Consistent With the Model.
- Some Empirical Support Found.
- The Expectation Trap Hypothesis About Variation and Persistence in Inflation Deserves Further Consideration.