A Monetary/Fiscal Theory of Sudden Inflations

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Unpleasant Monetarist Arithmetic

- Deficits have a lot to do with historical high-inflation episodes
- Fiscal imbalances threaten CB independence
- Liz Truss and the UK

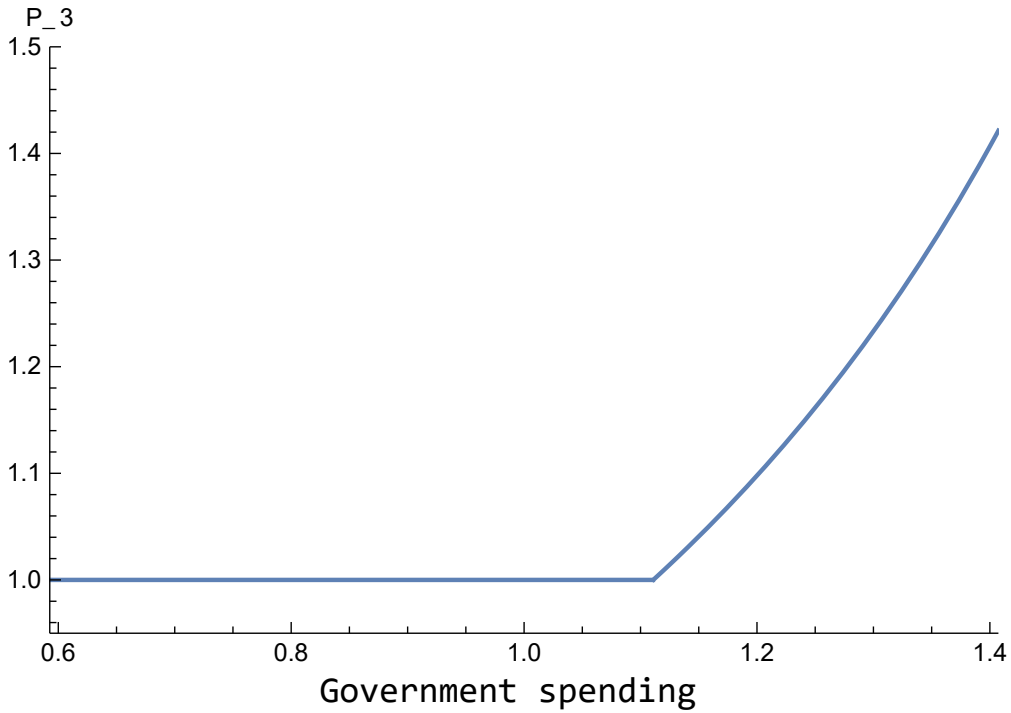
Unpleasant Monetarist Arithmetic

- Deficits have a lot to do with historical high-inflation episodes
- Fiscal imbalances threaten CB independence
- Liz Truss and the UK
- Evidence of relationship between fiscal deficits and inflation somewhat weak
- A Monetary and Fiscal History of Latin America, 1960–2017 (Kehoe and Nicolini eds., 2022)
- Lots of episodes of large deficits with no inflationary consequences (Bassetto and Butters, 2010)
- Postwar U.S., real return on debt very weakly related to deficits (Berndt, Lustig, and Yeltekin, 2012)
- Bianchi-Melosi: regime changes, mostly identified indirectly

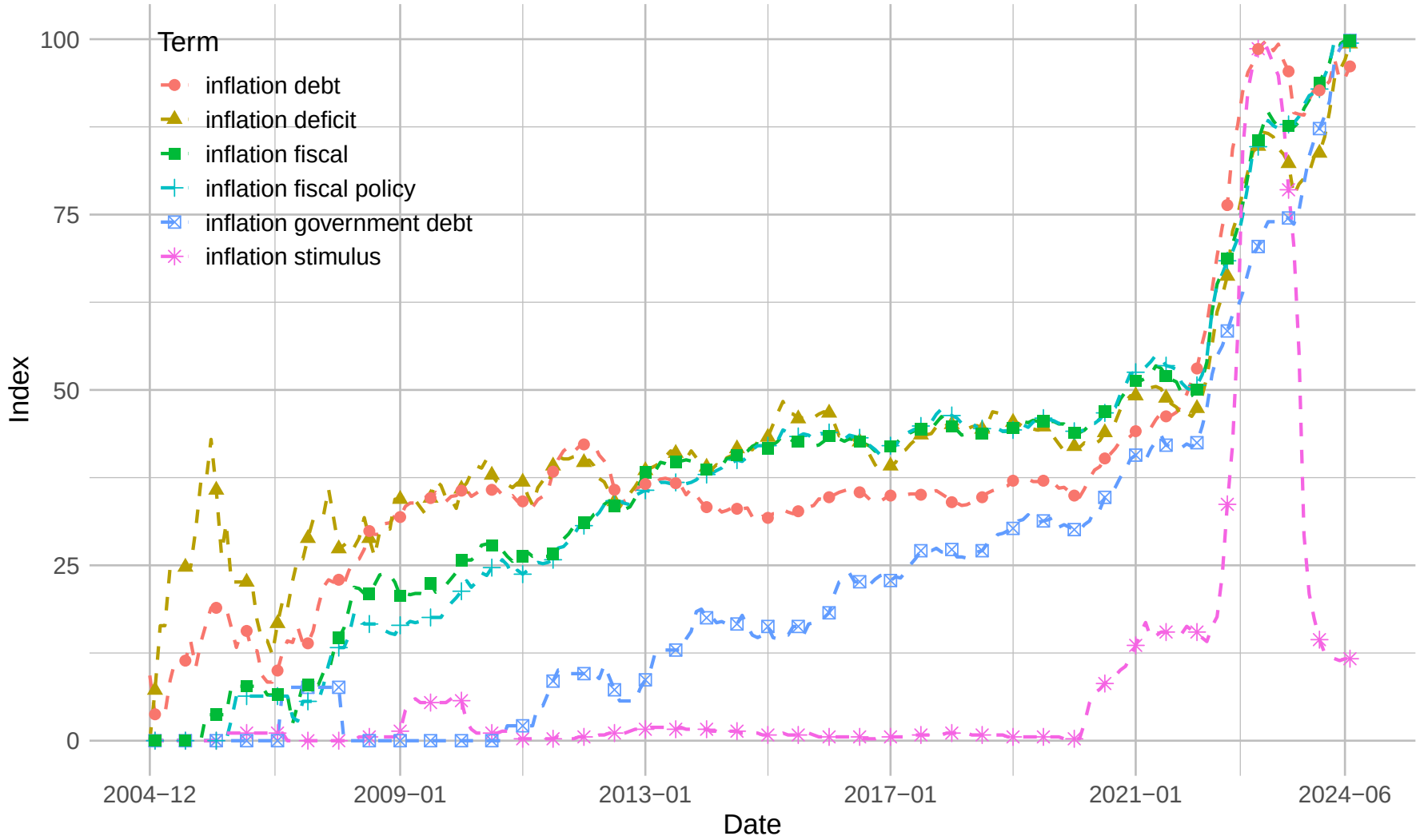
Nominal Debt as an Option-like Payoff

- In normal times, CB independence prevails, fiscal policy in charge of balancing the budget
- In times of crisis, fiscal policy is hamstrung, monetary policy steps in
  - How long before a crisis spills over into inflation?
  - Role of endogenous attention

"Long-run" relationship between prices and government spending



Google Trends: (12-month MA)



What we do

1. Model with exogenous information, but two regimes
   - At low deficits, taxes react to fiscal needs, deficits not predictive of future inflation
   - At higher deficits, taxes do not respond, deficits start predicting inflation
   - Model predicts smooth transition in inflation sensitivity to deficits
2. With endogenous information:
   - At low deficits, no incentive to acquire information/pay attention to deficits $\Longrightarrow$ little response
   - At higher deficits, incentive to acquire information kicks in, inflation responds to deficit news
   - Transition from one regime to the other more abrupt, may be discontinuous

The model: timing

3 periods:

- Period 1: baseline
- Period 2: deficit news arrive
- Period 3: "The long run" (all deficits are realized)

Where we are going with the model

- Exogenous information: could keep things simple, rely purely on competitive model
- Endogenous information: need somebody to set prices and somebody to set quantities (see e.g. Mackowiak and Wiederholt, 2015)

Agents, technology and goods

- Continuum of families $i \in [0, 1]$
- Each family has a continuum of entrepreneurs running firms $j \in [0, 1]$ producing differentiated variety
- A family also has a shopper that buys consumption
- Set of goods: indexed by kj

Preferences and technology

- Over aggregates:

$$E\left[\sum_{t=1}^{3}\beta^{t-1}\left(u(c_{it})-\int_0^1 \ell_{ijt}\right)\right]$$

- $$c_{it}=\left(\int_0^1\int_0^1 c_{kjt,i}^{\frac{\theta-1}{\theta}}djdk\right)^{\frac{\theta}{\theta-1}},$$

  $\theta > 1$
- Government spending: aggregate value exogenous, varieties aggregated with the same price elasticity
- One unit of kj time produces one unit of kj good

Government

- Starts period 0 with B_0 nominal liabilities (one period)
- Gov't bonds are numeraire
- No spending in periods 1 and 2. Uncertain spending in period 3: G_3
- Taxes: to be described below

Timing within each period

- Monetary-fiscal policy is set;
- Producers choose information (if allowed) and set prices;
- Shoppers observe prices, choose quantities, allocate residual resources to buying bonds

Monetary-fiscal policy in period 3 (the "long run")

- Gov't starts owing B_2 (nominal)
- G_3 realized
- Two monetary-fiscal regimes:
  - Regime M: gov't sets real taxes $G_3 + B_2/P_3^*$, uses surpluses to withdraw debt
  - Regime F: gov't sets real taxes $\hat{T}$ (fixed and exogenous)

Monetary-fiscal policy and information in period 2

- Gov't starts with nominal debt B_1
- Fixed nominal interest rate $i (= 1/\beta)$
- $P_2 T_2 = \frac{i}{1+i} B_1$ (implies $B_2 = B_1$)
- Everybody gets signal about fiscal regime:
  - Posterior probability of regime F: π
  - Mean of the posterior for G_3 conditional on F: $\tilde{G}_3$
  - Note: regime and spending not independent
  - Assumption (F regime associated with higher prices):

$$\frac{\hat{T} - \tilde{G}_3}{P_3^*} < B_2$$

- Under endogenous information: producers can pay a utility cost K, observe future regime and spending realization
- Producers set prices, shoppers (may) learn from prices, choose quantities

Period 1

- Gov't starts with nominal debt B_0
- Fixed nominal interest rate $i(= 1/\beta)$
- $P_1 T_1 = \frac{i}{1+i} B_0$ (implies $B_1 = B_0$)
- No information beyond a prior π_0 on the regime and a distribution on spending G_3
- (Not much action, serves to establish a base price level)

Computing Equilibrium - Period 3, regime M ("Ricardian policy")

- Gov't has B_2/P_3^* units of the good, hhs redeem $B_2 \Longrightarrow P_3 = P_3^*$
- Producer:
  - Marginal revenue (in utility terms):

$$\frac{(1-\theta)u'(c_{i3})(C_3+G_3)}{P_3}\left(\frac{p_{ij3}}{P_3}\right)^{-\theta}$$

  - Marginal cost (in utility terms):

$$\frac{\theta(C_3+G_3)}{P_3}\left(\frac{p_{ij3}}{P_3}\right)^{-\theta-1},$$

  - Equilibrium requires (usual Dixit-Stiglitz distortion):

$$u'(c_{i3}) = \frac{\theta}{\theta-1}, \quad p_{ij3} = P_3$$

- Shopper: exhausts budget constraint, with c_{i3} given as above, $c_{ij3} = c_{i3} = C_3$

Computing Equilibrium - Period 3, regime F

- Taxes are $\hat{T}$, primary surplus $\hat{T} - G_3$
- FTPL determination of the price level: $P_3 = B_2/(\hat{T} - G_3)$
- Other than that, everything the same as in regime M:

$$u'(C_3) = \frac{\theta}{\theta - 1}, \quad p_{ij3} = P_3$$

- Prices and consumption of all varieties the same

Computing equilibrium - Period 2, exogenous information only

- Euler equation of the shopper:

$$u'(C_2) = \beta u'(C_3)(1+i)P_2 \left[\frac{1-\pi}{P_3^*} + \frac{\pi[\hat{T} - E_2(G_3|F)]}{B_2} \right],$$

- Optimality of the producers

$$u'(C_2) = \frac{\theta}{\theta - 1}$$

- $$\Longrightarrow \frac{1}{P_2} = \frac{1-\pi}{P_3^*} + \frac{\pi[\hat{T} - \tilde{G}_3]}{B_2}$$

Characterizing period 2 under exogenous information

- By assumption
$$\frac{\partial P_2}{\partial \pi} > 0$$
- We then get
$$\frac{\partial^2 P_2}{\partial \pi \partial \tilde{G}_3} > 0$$
- $\Longrightarrow$ Signals of fiscal stress (higher π) make the price level respond more to G_3

Endogenous information: Learning by shoppers

- Shoppers have same info as producers that do not pay K
- $\Longrightarrow$ can compute optimal price charged by them
- If they observe other prices, can infer information from price
- (Neglect prices charged by measure zero of agents)
- Look at pure-strategy equilibria:
  - When no producers pay K, equilibrium same as under exo info
  - When all producers pay K, shoppers are fully informed too (learning from prices)

Prices and quantities when producers are fully informed

- Same as under exo info, but now $\pi = 0$ or $\pi = 1$ and G_3 known.
- Get $P_2 = P_3$, same sensitivity to G_3 as in period 3
- If regime F known to prevail, sensitivity to G_3 is higher than under exo info ($\pi = 1$ vs $\pi \in [0, 1]$)

When do producers pay K?

- Assume all producers acquire information
- Check incentive for single producer to deviate and not pay K

When do producers pay K?

- Assume all producers acquire information
- Check incentive for single producer to deviate and not pay K
- Shoppers fully informed (learn from prices of informed producers) $\Longrightarrow u'(c_{i2}) = \theta/(\theta - 1)$
- $P_2 = P_3$ but uninformed producer does not know P_3
- Optimal price for uninformed producer:

$$p_{ij2} = \frac{E^P_{ij2}\left[P_2^{\theta}\right]}{E^P_{ij2}\left[P_2^{\theta-1}\right]}.$$

Determination of cost threshold

- Profits of informed producers:

$$u'^{-1}\left(\frac{\theta}{\theta-1}\right)\frac{1}{\theta-1}$$

- Profits of single uninformed producer in utility terms:

$$u'^{-1}\left(\frac{\theta}{\theta-1}\right)\frac{1}{\theta-1}\left[E^{P}_{ij2}\left(P_2^{\theta}\right)\right]^{1-\theta}\left[E^{P}_{ij2}\left(P_2^{\theta-1}\right)\right]^{\theta}$$

- Red term<1 (Jensen's inequality)
- Cost threshold dictated by uncertainty
- Particularly sensitive to right-tail risk
- Worst-case scenario: P_3 really high, uninformed sets low P_2 sells a ton of goods at a loss

When do producers not pay K?

- Check unilateral deviation again
- Producer ij pays cost, learns future price P_3
- Complication: now shoppers do not know P_3
- Euler equation of shoppers

$$\frac{u'(C_2)}{P_2 \beta u'(C_3)(1+i)} = \frac{1-\pi}{P_3^*} + \frac{\pi[\hat{T} - E_2(G_3|F)]}{B_2},$$

- From perspective of informed producer, shoppers off the Euler equation
- $\Longrightarrow$ envelope condition fails
- It matters when the extra resources are consumed

When are extra resources consumed

- If price of deviating producer is observed by the family's shoppers, could spread over the two periods
- Otherwise, in period 3
- Assume the latter (algebra simpler)
- Results robust, region of multiplicity expands when some resources consumed in period 2

Optimal choice for single informed producer

- Marginal revenue (in utility terms):

$$\frac{\frac{\theta}{\theta-1} u'^{-1}\left(\frac{\theta}{\theta-1}\right)}{P_3}\left(\frac{p_{ij2}}{P_2}\right)^{-\theta}. \tag{1}$$

- Marginal cost (in utility terms):

$$\frac{\theta C_2}{P_2}\left(\frac{p_{ij2}}{P_2}\right)^{-\theta-1},$$

- Optimal choice: set $p_{ij2} = P_3$!

Determination of cost threshold

- Profits of uninformed producers (same as informed producers in the informed equilibrium):

$$u'^{-1}\left(\frac{\theta}{\theta-1}\right)\frac{1}{\theta-1}$$

- Profits of single informed producer in utility terms:

$$(u')^{-1}\left(\frac{\theta}{\theta-1}\right)\frac{1}{\theta-1}\left[E_2 P_3^{-1}\right]^{-\theta} E_2 P_3^{-\theta}$$

- Red term>1 (Jensen's inequality again)
- Cost threshold dictated by uncertainty
- Particularly sensitive to left-tail risk
- Best-case scenario: P_3 really low, informed sets low P_2, sells a ton of goods with a good markup

Tail asymmetry in our application

- Downside risk limited, when fiscal resources are plentiful we are in the M regime (with high probability)
- Risk tilted to the upside
- $\Longrightarrow$ Likely that cost threshold for optimally acquiring information lower when others do
- Strategic complementarity
- Region of multiple equilibria

Summing up: As uncertainty about regime increases...

- First, equilibrium with no info acquisition, little response to fiscal news
- Then, multiple-equilibrium regime, at some point jump to info acquisition, response jumps up
- Finally, only informed equilibrium survives (jump must occur at that point)

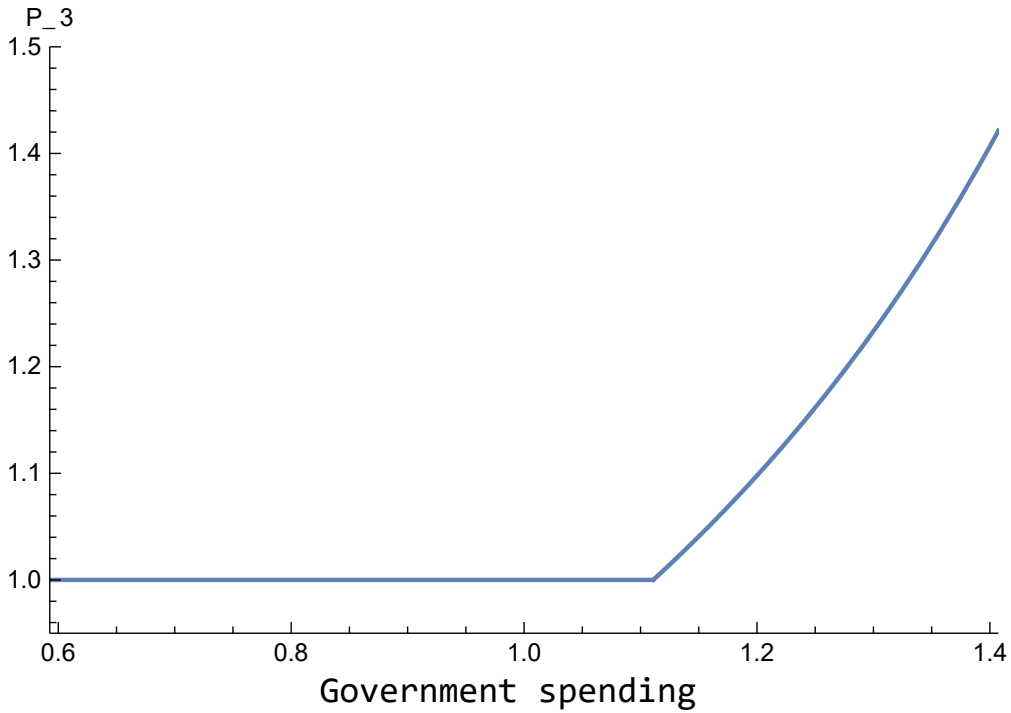
Period 1

- Equilibrium exists (unique conditional on period 2 eq'm selection)
- Get baseline price level P_1 (only depends on prior)
- $\Longrightarrow$ Everything we said about P_2 is true of inflation between periods 1 and 2

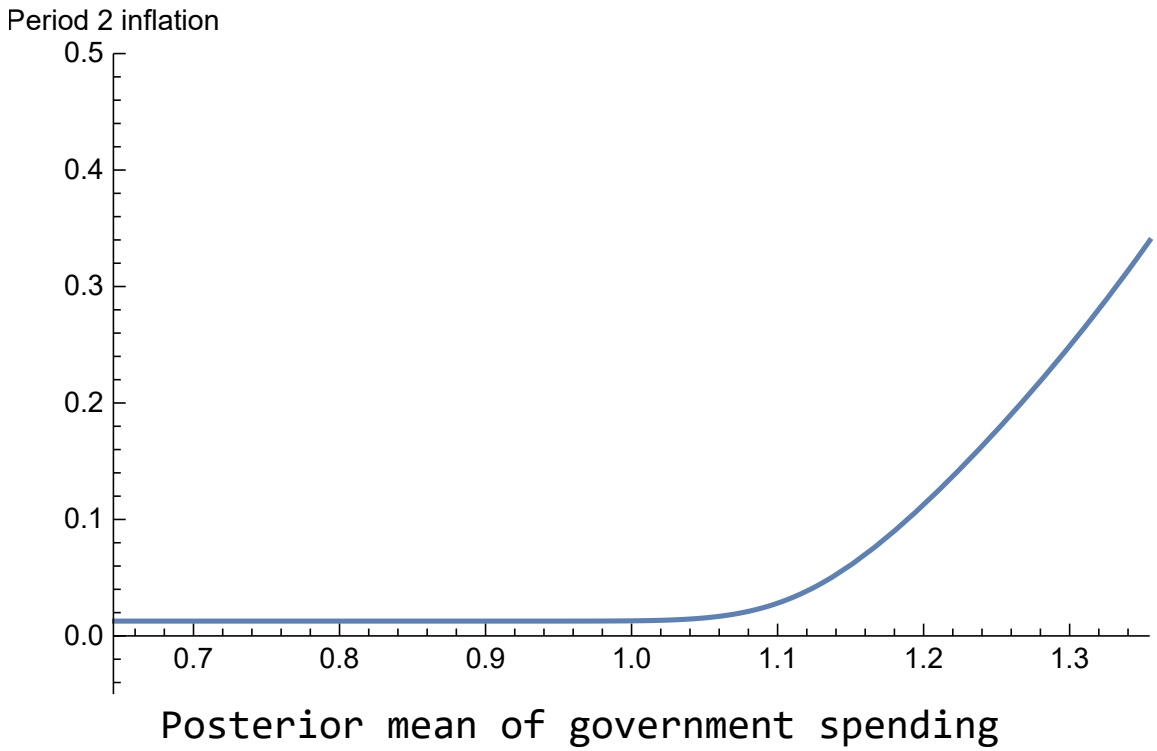
Numerical Example

- Normal shocks to G_3
- Normal signal
- Maximum tax rate $\bar{T}$: when insufficient, regime F is triggered

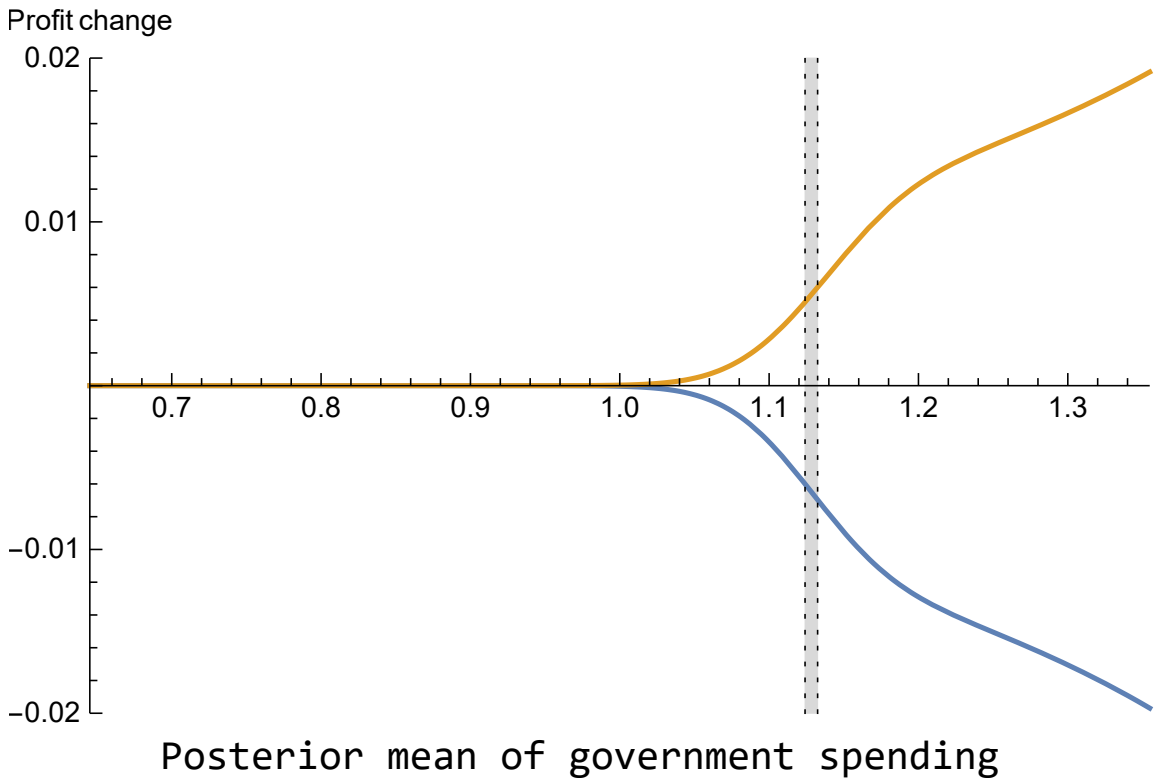
"Long-run" relationship between prices and government spending



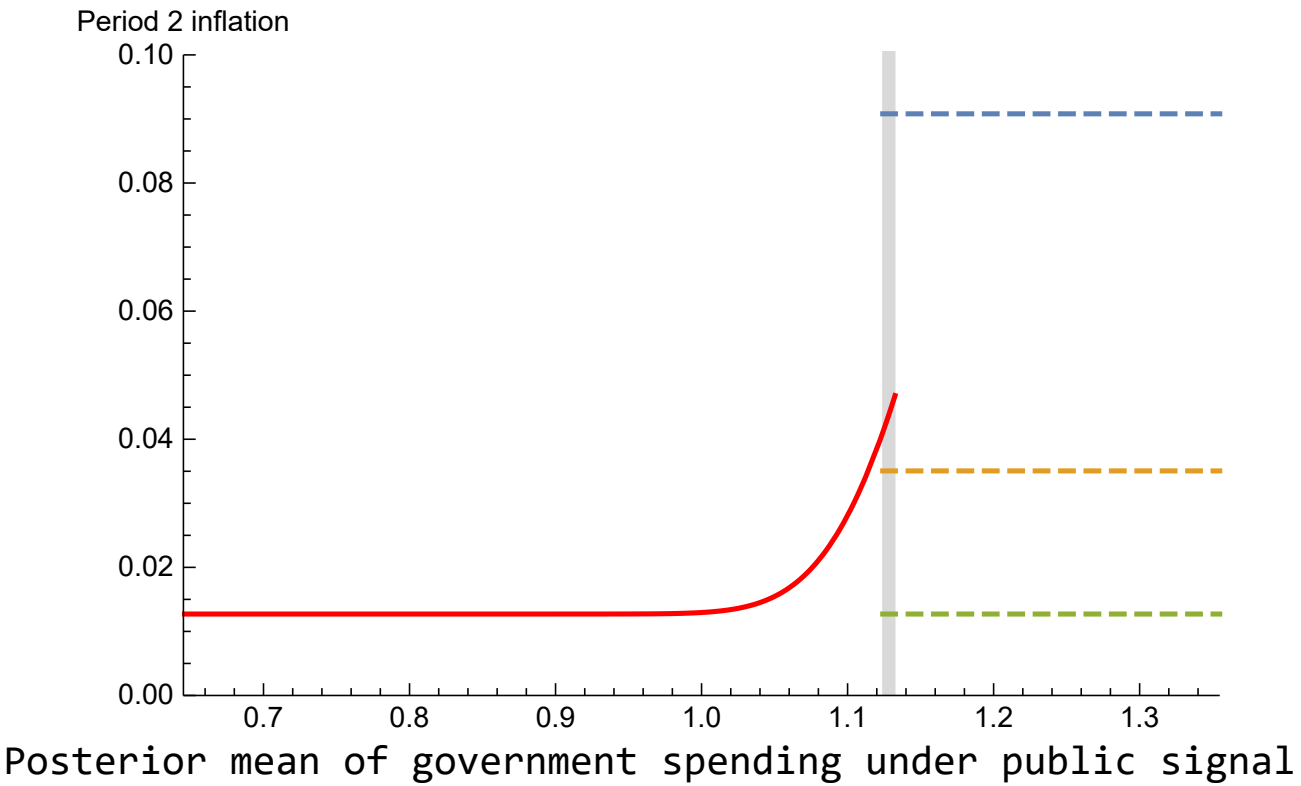
Inflation in the Uninformed equilibrium ($K = \infty$)



Costs and Benefits of acquiring information



Period 2 inflation as a function of signal under endogenous information



Extensions

- Fiscal shocks in period 2
- Learning in multiple periods: 4-period model
  - Persistent high volatility in a continuous learning regime
  - "Inflation scares:" learning yields goods news and inflation drops down
  - Example
- Complementarities in info production (newspapers talk more about fiscal news)
- Debt might be more liquid for low $\pi \Longrightarrow$ liquidity role less sensitive to final payoff

Conclusion

- Developed model where not much happens to inflation in response to fiscal news over some range...

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Conclusion

- Developed model where not much happens to inflation in response to fiscal news over some range...
- ... but reaction becomes stronger as a "fiscal limit" is attained...
- ... can observe sudden jumps with endogenous information acquisition...
- ... dangerous to take for granted that inflation will not move because it did not in the past!

Extension: 4 periods

- Add a period 0
- Now news arrive in two periods: 1 and 2
- Producers can choose whether to learn in either period, by paying the fixed cost
- Retain perfect (costly) learning in period 2
- Noisy (costly) learning in period 1

Additional Complication

- If all producers choose to acquire info in period 1...
- P_1 reveals (noisy) information, single producer learns as of period 2
- Possible incentive to delay or free-ride

Information Trade-Offs in period 2

If agents acquired information in period 1:

- Better informed in period 2, further information has less value
- It must be that there were bad news in period 1, more likely that information is valuable in period 2 as well

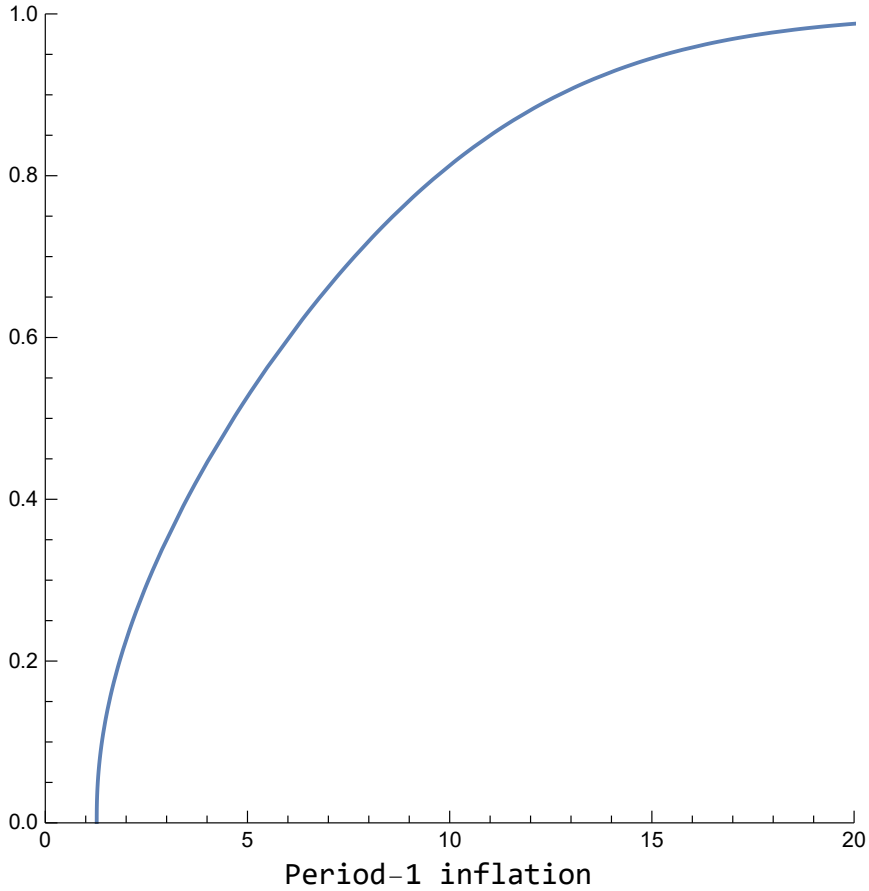
Endogenous Regime Jumps

If bad-news effect dominates, with bad news:

- Information acquisition in period 1
- Same in period 2
- Bad news triggers persistently high and volatile inflation

Example

Probability of info acquisition in period 2 after info acquisition in period 1



Back to extensions

Inflation Scares

- Bad news in period 1, but not enough to trigger info acquisition: π_1 increases
- News triggers info acquisition in period 2, but information turns out benign: π_2 lower

Back to extensions

Extension: Multiple Shocks

- Current version: only shock in period 2 is news about future deficits
- Could add deficit shock in period 2 (through either spending or taxes)
- Key equation:

$$\frac{B_1}{P_2} = T_2 - G_2 + \beta E_2(T_3 - G_3), \tag{2}$$

- As long as bigger deficits in period 2 $\Longrightarrow$ higher probability of F regime...
- P_2 more responsive to deficits, the bigger they are

Back to extensions

Thank you!