

# A Monetary/Fiscal Theory of Sudden Inflations

Marco Bassetto <sup>1</sup>    David S. Miller <sup>2</sup>

<sup>1</sup>Federal Reserve Bank of Minneapolis

<sup>2</sup>Federal Reserve Board

The views expressed herein are those of the authors and not of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

# Unpleasant Monetarist Arithmetic

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

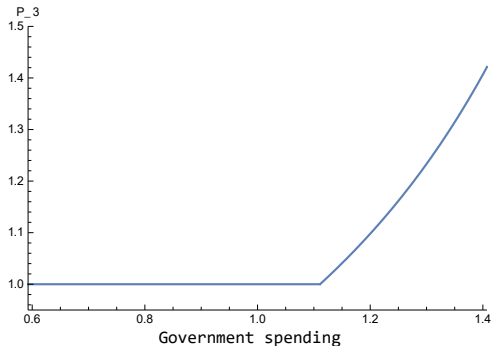
# Unpleasant Monetarist Arithmetic

- 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?

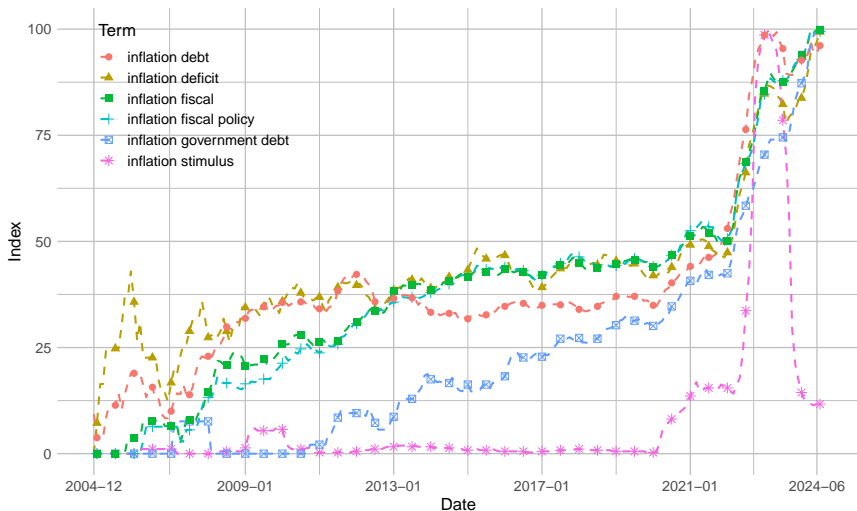
# “Long-run” relationship between prices and government spending



# Government debt as an information-insensitive asset

- Gorton-Ordoñez (2014), Holmstrom (2015) , Caballero-Farhi (2017)
- When in the quiet regime, little incentive to acquire information about deficits (rational inattention)
- Compounds reasons why prices do not respond to deficits
- As bad news pile up, a regime change is triggered
- (Also, prominent irresponsible fiscal policy announcements may trigger it)

# 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  $\implies$  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:

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



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

$$\theta > 1$$

- 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  $F$ :  $\pi$
  - ▶ 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):

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

- **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  $\pi_0$  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  $B_2 \implies P_3 = P_3^*$
- 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

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

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

# Characterizing period 2 under exogenous information

- By assumption

$$\frac{\partial P_2}{\partial \pi} > 0$$

- We then get

$$\frac{\partial^2 P_2}{\partial \pi \partial \tilde{G}_3} > 0$$

- $\implies$  Signals of fiscal stress (higher  $\pi$ ) make the price level respond more to  $G_3$

# Endogenous information: Learning by shoppers

- Shoppers have same info as producers that do not pay  $K$
- $\implies$  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)  
 $\implies u'(c_{i2}) = \theta/(\theta - 1)$
- $P_2 = P_3$  but uninformed producer does not know  $P_3$
- Optimal price for uninformed producer:

$$p_{ij2} = \frac{E_{ij2}^P [P_2^\theta]}{E_{ij2}^P [P_2^{\theta-1}]}.$$

# 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:

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

- 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
- $\implies$  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):

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

- 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:

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

- 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
- $\implies$  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)



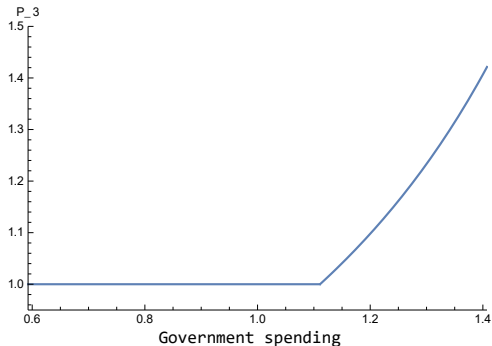
# Period 1

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

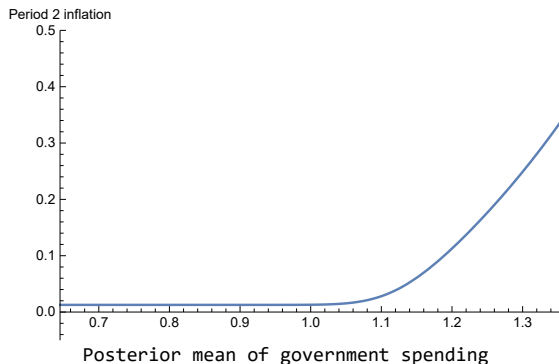
# Numerical Example

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

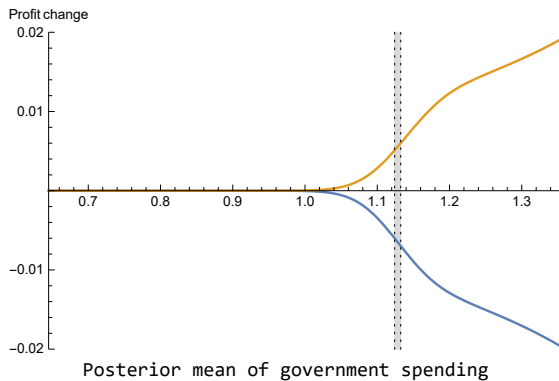
# “Long-run” relationship between prices and government spending



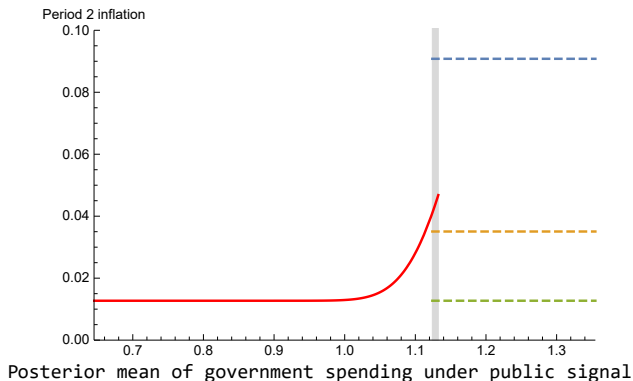
# Inflation in the Uninformed equilibrium ( $K = \infty$ )



# Costs and Benefits of acquiring information



# Period 2 inflation as a function of signal under endogenous information



## 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:

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

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

## 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

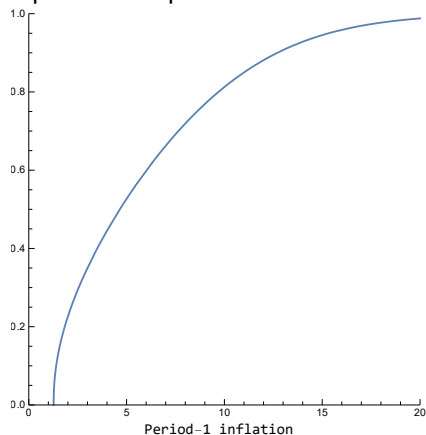
# Endogenous Regime Jumps

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



# Inflation Scares

- Bad news in period 1, but not enough to trigger info acquisition:  $\pi_1$  increases
- News triggers info acquisition in period 2, but information turns out benign:  $\pi_2$  lower

# Other Extensions

- Complementarities in info production (newspapers talk more about fiscal news)
- Debt might be more liquid for low  $\pi \implies$  liquidity role less sensitive to final payoff

# Conclusion

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

# 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...



# 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...

# 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!

# Thank you!