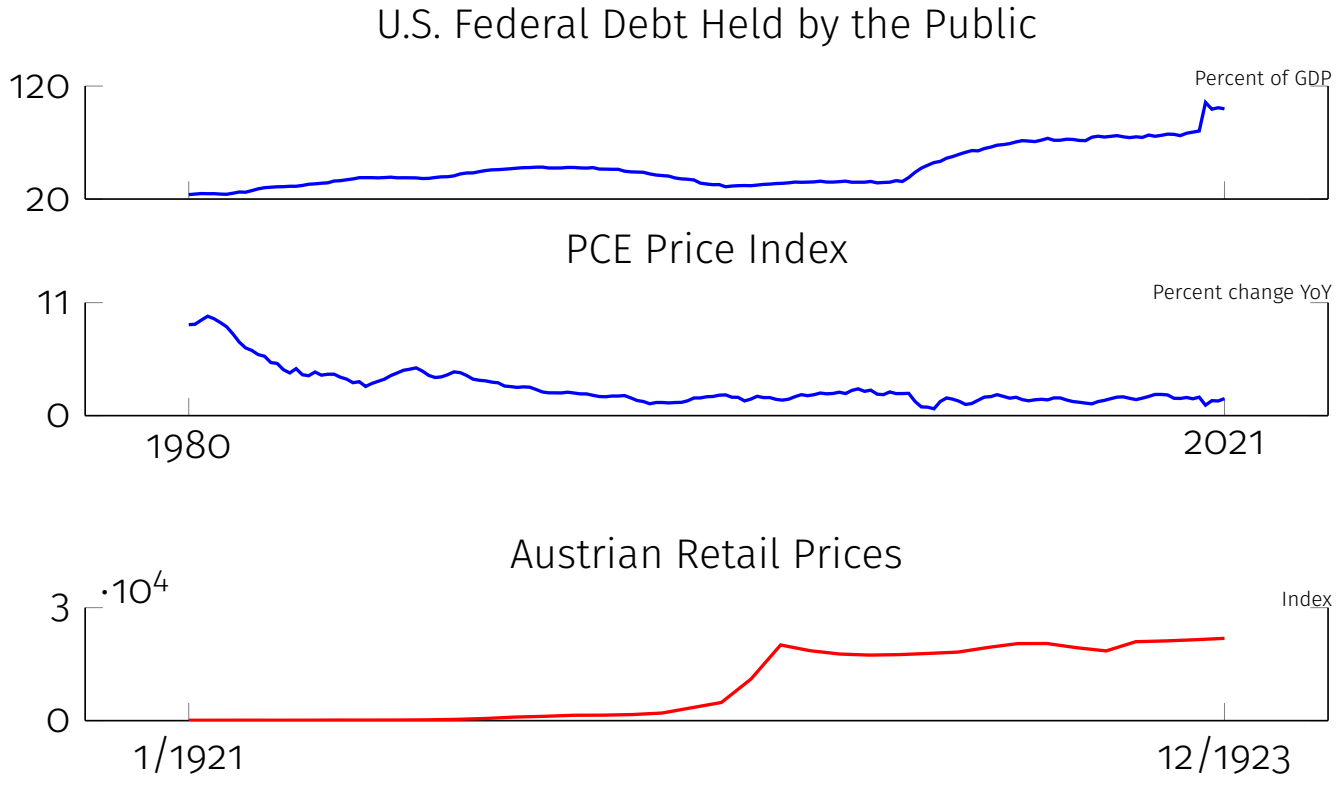
A Monetary-Fiscal Theory of Sudden Inflations

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

Motivation



Large run-up in debt/deficit while inflation stays low.
Inflation usually not sensitive to debt/deficit, until a crisis

- Relationship btwn Deficits and Inflation; Bassetto, Butters (2010)
- Ends of Four Big Inflations; Sargent (1982)

Show

Crises are sudden, unpredictable, feature increased sensitivity of inflation to prospective deficits, and are never deflationary.

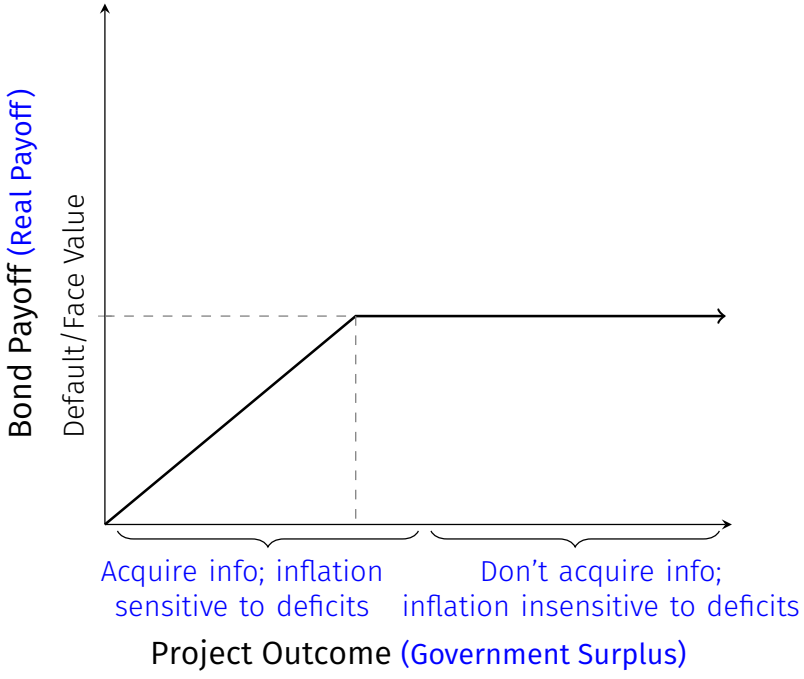
How the model works

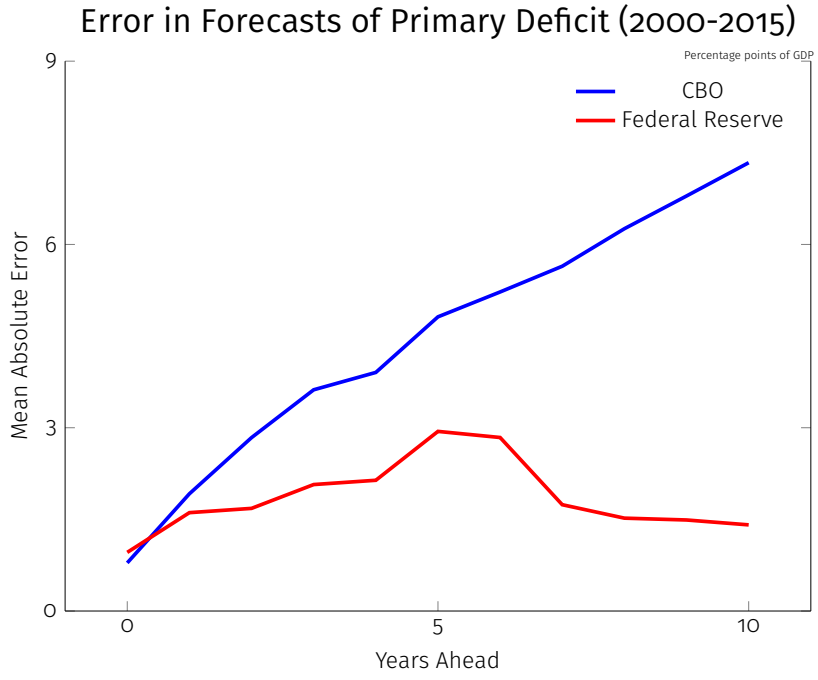
Explain sudden inflations with endogenous information acquisition

- Taxes respond to deficits, up to a point
- Consumers have prior about future deficits, can acquire info
- Gorton-Ordoñez, Rational Inattention: little incentive to acquire information about future deficits unless there's a large payoff

	Exogenous Information	Endogenous Information
Low Deficits	Deficits don't predict inflation, Low inflation sensitivity	No incentive to acquire info, Low inflation sensitivity
High Deficits	Deficits predict inflation, High inflation sensitivity	Incentive to acquire info, High inflation sensitivity
Transition in Inf. Sensitivity	Smooth	Abrupt, possibly discontinuous switch when acquire info

Model of Government Bonds





Holmstrom (2015): Bonds have purposefully opaque backing

- Optimal ignorance of project outcome
- Costly research valuable only if beliefs near/below kink

Safe assets most opaque backing/expensive to research

- Money/Gov't bonds backed by "full faith and credit"
- Hard, but possible, to forecast government surplus

Plan

1. Preview
2. Model
   - 2.1 Model Setup
   - 2.2 Description of the 3 Periods
   - 2.3 Equilibrium, from Periods 3 to 1
3. Conclusions

Families, Preferences, Technology, and Goods

Families separate setting prices, quantities (Mackowiak and Wiederholt, 2015)

$$E\left[\sum_{t=1}^{3}\beta^{t-1}\left(u(c_{it})-\int_0^1 \ell_{ijt}\right)\right], c_{it}=\left(\int_0^1\int_0^1 c_{kjt,i}^{\frac{\theta-1}{\theta}}djdk\right)^{\frac{\theta}{\theta-1}}, \theta>1$$

- Continuum of families $i \in [0,1]$
- Each family has a shopper that buys consumption
- Each family has a continuum of producers running firms $j \in [0,1]$ producing differentiated variety (Dixit-Stiglitz)
- Set of goods indexed by kj, one unit of kj time produces one unit of kj good

Government, Timing

Government

- All gov't bonds nominal, one period
- Gov't bonds are numeraire
- Price level target P_3^*
- Gov't spending uses same aggregator as family consumption
- No spending in periods 1, 2, uncertain spending G_3 in period 3
- Taxes in period 3, the "long run"
  - Regime M: Gov't sets real taxes $G_3 + B_2/P_3^*$, hence $P_3 = P_3^*$
  - Regime F: Gov't sets real taxes $\hat{T}$, hence $P_3 = \frac{B_2}{\hat{T} - G_3}$

Timing within periods

- Monetary-fiscal policy is set
- Producers may acquire information and set prices
- Shoppers observe prices, choose quantities, allocate residual resources to buying bonds

Model: 3 Periods

Exogenous information: Know probabilities of period 3 surplus

Endogenous information: Know probabilities of period 3 surplus, can acquire actual realization

Period 1	Period 2	Period 3: "Long-run"
Start with B_0,	B_1 repaid	$\{M, F\}$, surplus revealed
Purchase B_1	Public signal, Option to learn	B_2 repaid
P_1 determined	Purchase B_2	P_3 determined
	P_2 (hence P_2/P_1) determined	

Compare how inflation responds to news about the future surplus

$$\frac{\partial(P_2/P_1)}{\partial(\text{Likelihood fiscal stress})}$$

Periods 3 and 2

Period 3: Gov't owes B_2; Regime and G_3 realized; P_3 determined

Period 2

- Gov't starts with nominal debt B_1
- Fixed nominal interest rate i (for simplicity $i = 1/\beta$)
- $P_2 T_2 = \frac{i}{1+i} B_1$ (implies $B_2 = B_1$)
- Families get signal about fiscal regime:
  - Posterior probability of regime F: π
  - Mean of the posterior for G_3 conditional on F: $\tilde{G}_3$
  - Regime and spending not independent
  - Assume regime F associated with higher prices: $\frac{[\hat{T} - \tilde{G}_3]}{B_2} < \frac{1}{P_3^*}$
- Producers can pay a utility cost K, observe future regime and spending realization
- Producers set prices, shoppers learn from prices, choose quantities

Period 1

Period 1: Defines P_1 so we can talk about inflation P_2/P_1

- Gov't starts with nominal debt B_0
- Fixed nominal interest rate i (for simplicity $i = 1/\beta$)
- $P_1 T_1 = \frac{i}{1+i} B_0$ (implies $B_1 = B_0$)
- Families' information
  - Price level target in period 3 P_3^*
  - Prior π_0 on the regime $\{M, F\}$
  - Prior distribution on spending G_3

Plan

1. Preview
2. Model
   - 2.1 Model Setup
   - 2.2 Description of the 3 Periods
   - 2.3 Equilibrium, from Periods 3 to 1
     - Period 3
     - Period 2: Exogenous vs. Endogenous Information
     - When do producers acquire/not acquire information?
     - Period 1
3. Conclusions

Equilibrium: Period 3, Regime *M*

- Gov't taxes B_2 / P_3^*, repay B_2, hence $P_3 = P_3^*$
- 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, $c_{ij3} = c_{i3} = C_3$

Equilibrium: Period 3, Regime *F*

- Gov't taxes $\hat{T}$, surplus is $\hat{T} - G_3$, hence $P_3 = B_2 / (\hat{T} - G_3)$
- 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

Equilibrium: Period 2, Exogenous Information

- Shopper optimality

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

- Producers optimality

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

Defines a relation between the price level P_2 and the signaled probabilities of regimes and spending

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

- By assumption $\frac{\partial P_2}{\partial \pi} > 0$, then $\frac{\partial P_2}{\partial \pi \partial \tilde{G}_3} > 0$
- Hence the more likely the realization of the F regime π, the more the price level responds to (prior on) G_3

Equilibrium: Period 2, Endogenous Information

Shoppers

- Have same info as producers that do not acquire information
- Know optimal price charged by producers without more info
- If they observe different price, can infer information from price
- (Neglect prices charged by measure zero of agents)

Look at pure-strategy equilibria:

- If no producers pay K, equilibrium same as exogenous info
- If all producers pay K, shoppers are fully informed too

Endogenous Equilibrium vs. Exogenous Equilibrium

- Equilibrium same as exogenous with $\pi \in \{0, 1\}$ and G_3 known.
- If $\pi = 1$ (regime F), sensitivity to G_3 is higher than exogenous

$$\left(\frac{\partial P_2}{\partial \pi \partial \tilde{G}_3} \,\middle|\, \pi = 1 \right) > \left(\frac{\partial P_2}{\partial \pi \partial \tilde{G}_3} \,\middle|\, \pi \in [0, 1) \right)$$

When do producers not acquire information?

Assume no one acquires information, check unilateral deviation

- Producer ij pays cost, learns future price P_3
- Optimal choice for producer
  - Marginal revenue (in utility terms):

$$\frac{(1-\theta)u'(c_{i2})C_2}{P_2}\left(\frac{p_{ij2}}{P_2}\right)^{-\theta}$$

  - Marginal cost (in utility terms):

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

  - Profits (in utility terms):

$$\underbrace{u'^{-1}\left(\frac{\theta}{\theta-1}\right)\frac{1}{\theta-1}}_{\text{Symmetric profit}}$$

  - Only c_{i2} (set by shopper) and P_2 (set by other producers) matter
- There is always an equilibrium with no information acquisition

When do producers acquire information?

Assume everyone acquires information, check unilateral deviation

- Shoppers fully informed (learn from other prices) so $u'(c_{i2}) = \theta/(\theta-1)$
- $P_2 = P_3$ but uninformed producer does not know P_3
- Optimal price for uninformed producer:

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

- Profits of uninformed producer in utility terms:

$$\underbrace{u'^{-1}\left(\frac{\theta}{\theta-1}\right)\frac{1}{\theta-1}}_{\text{Symmetric profit}}\underbrace{\left[E^P_{ij2}\left(P_2^{\theta}\right)\right]^{1-\theta}\left[E^P_{ij2}\left(P_2^{\theta-1}\right)\right]^{\theta}}_{\text{Cost of ignorance}}$$

- If cost of ignorance is large enough (fear of low $\hat{T}$, high P_2), or cost of info small, optimal to acquire information

Equilibrium: Period 1, Main points

Period 1

- Equilibrium in period 1 exists (unique conditional on period 2)
- Get baseline price level P_1, which only depends on prior
- Previous discussion of P_2 is really discussion of inflation P_2/P_1

Sensitivity of inflation to fiscal news is increasing in likelihood of fiscal stress

$$\frac{\partial(P_2/P_1)}{\partial\pi\partial\tilde{G}_3} > 0$$

For small cost or large fear of high inflation, producers will acquire information, hence a jump in inflation's sensitivity to fiscal stress

$$\left(\frac{\partial(P_2/P_1)}{\partial\pi\partial\tilde{G}_3} \,\middle|\, \pi = 1\right) > \left(\frac{\partial(P_2/P_1)}{\partial\pi\partial\tilde{G}_3} \,\middle|\, \pi \in [0,1)\right)$$

Conclusions

A Monetary-Fiscal Theory of Sudden Inflations

Crises are sudden, unpredictable...

- Sharp shift uninformed prior to acquiring info, learning state
- Difficulty acquiring information, little benefit; key to safety

...feature increased sensitivity of inflation to prospective deficits...

- Normal times: Not worthwhile to learn about prospective deficits
- Fiscally stressed times: Worthwhile to acquire information about prospective deficits

...and are never deflationary

- Strictly inflationary from asymmetric benefit, not worthwhile to acquire information

Ends of Four Big Inflations

"...government debt is valued according to the same economic considerations that give private debt value..."



- Large debt, deficits covered by printing money 1919-1922
- Bailout negotiations begin end of August '22, signed October
- "...even before the precise details of the protocols were publicly announced... brought relief to the situation."

"The essential measures that ended hyperinflation... value[d] that debt according to whether it was backed by sufficiently large prospective taxes relative to public expenditures... Once it became widely understood that the government would not rely on the central bank for its finance, the inflation terminated..." Back