Monetary Policy and Financial Stability

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August 7, 2013

Introduction

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- Some have argued that conventional approaches to monetary policy — focused exclusively on inflation and output-gap stabilization — act to increase financial instability

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- Preview of conclusion: may be a case for modifying interest-rate policy somewhat to balance financial stability against other stabilization objectives

  — but can still be accomplished within an (appropriately modified) inflation targeting framework

Modeling Approach

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- Funding risk and possibility of "fire sale" of assets modeled as in Stein (2010)

  — but embedded in an intertemporal monetary equilibrium model, in order to consider interaction with monetary policy

Elements of the Model: Agents

- Infinite-lived representative household can be thought of as made up of several "members" with separate budgets within the period, though all funds pooled at end of each period:

  - "worker": supplies inputs used to produce all final goods; receives income available to household at end of period

  - "shopper": buys "regular" final goods [both "cash goods" and "credit goods"]; cash must be set aside earlier

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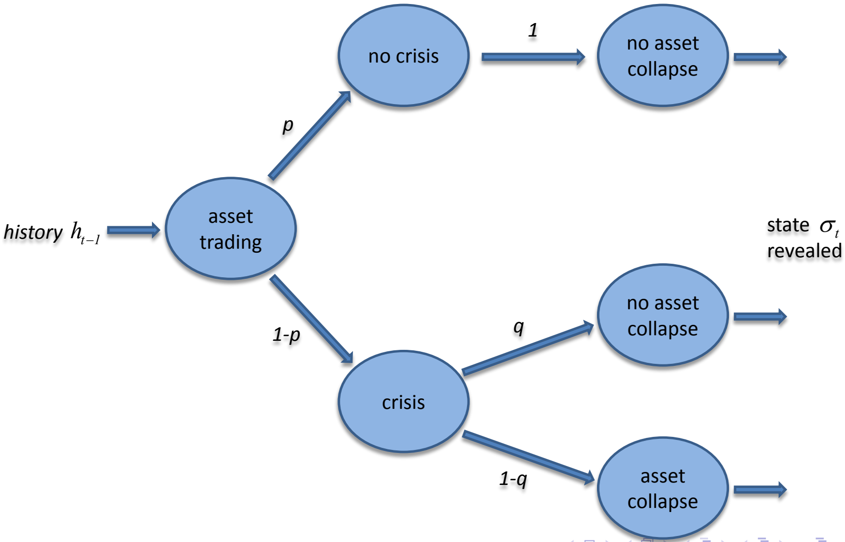
    - "shopper": buys "regular" final goods [both "cash goods" and "credit goods"]; cash must be set aside earlier
    - "investor": buys "special" final goods, using line of credit set up earlier in period; can also bid for risky durables in "fire sale"
    - "banker": buys risky durables, financed from equity investment by household and issuance of short-term debt

Resolution of Within-Period Uncertainty



Elements of the Model: Preferences

Preferences of the representative household:

$$\hat{E}_t \sum_{\tau=t}^{\infty} \beta^{\tau-t} \left[u(c_{1\tau}, c_{2\tau}) + \tilde{u}(c_{3\tau}) + \gamma \underline{s}_\tau - v(Y_\tau) - w(x_\tau) \right]$$

where $\hat{E}_t[\cdot]$ means conditional expectation before learning if crisis occurs in period t, and

$$\begin{aligned} c_{1t} &= \text{consumption of ``cash goods''} \\ c_{2t} &= \text{consumption of ``credit goods''} \\ c_{3t} &= \text{consumption of ``special goods''} \\ \underline{s}_t &= \text{services from [intact] old durables} \\ Y_t &= \text{supply of ``normal goods''} \\ x_t &= \text{supply of ``special goods''} \end{aligned}$$

Elements of the Model: Demand for Liquidity

- purchases of "cash goods" subject to a "cash-in-advance constraint" (as in Lucas-Stokey, 1987)

$$P_t c_{1t} \leq M_t$$

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- cash includes riskless nominal liabilities of the government (Treasury bills)

- can also be short-term debt issued by bankers, if collateralized to ensure completely riskless
  - but to be acceptable as cash, holders of debt must have right to force liquidation of the collateral, if necessary in order to ensure that banker can pay them in full

Elements of the Model: Demand for Liquidity

- Interpretation:
  - households willing to hold shares of MMMFs, despite low yield, because these accounts can be used in transactions
  - hence financial claims that can be held by MMMFs need not pay as high a return
  - T-bills an example, but also ABCP
  - here, for simplicity, assume that T-bills and ABCP directly satisfy the CIA constraint

Elements of the Model: Banks

- A banker can purchase shares s_t of the risky asset, subject to budget constraint

$$Q_t s_t \leq equity_t + D_t$$

where Q_t = price of asset in initial period-t market,
D_t = issuance of short-term debt

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$D_t =$ issuance of short-term debt

- Short-term debt can be marketed as riskless only if

$$D_t \leq \Gamma_t s_t,$$

where $\Gamma_t =$ price of asset in event of fire sale

Elements of the Model: "Fire Sale" Distortions

- If crisis state occurs, banker must offer s_t^{*s} units of the durable for sale, sufficient to allow redemption of short-term debt:

$$D_t \leq \Gamma_t s_t^{*s} \leq \Gamma_t s_t$$

Elements of the Model: "Fire Sale" Distortions

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- Each investor bids for s_t^{*d} units of the durables in the fire sale

- Investor's purchases of "special" goods must then satisfy

$$\tilde{P}_t c_{3t} + \eta_t \Gamma_t s_t^{*d} \leq F_t$$

where $\tilde{P}_t$ is price of special goods, η_t is crisis indicator, and credit limit F_t has been pre-determined in real terms

Elements of the Model: Supply of Durables

- Investment demand at end of period: household purchases I_t units of investment goods on credit, produces $F(I_t)$ units of new risky durables, which yield services in period $t+1$

  — durables produced in period $t-1$ depreciate completely at end of period t

Flexible-Price Equilibrium

An equilibrium is a collection of household choices $\{M_t, s_t, \ldots\}$, and prices $\{Q_t, \Gamma_t, P_t, \tilde{P}_t\}$ such that

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- household choices maximize expected utility subject to the sequence of budget constraints, and
- markets clear:

$$M_t = \tilde{M}_t + D_t$$

$$s_t = F(I_{t-1})$$

$$s_t^{*d} = s_t^{*s}$$

$$c_{1t} + c_{2t} + I_t = Y_t$$

$$c_{3t} = x_t$$

Flexible-Price Equilibrium

- Note that outside supply of liquid assets $\tilde{M}_t$ evolves according to

$$\tilde{M}_{t+1} = R_t^m \tilde{M}_t + T_{t+1}$$

where T_{t+1} is net transfers from the government

(so is determined by fiscal policy)

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  - lower real return R^m/Π on cash
  - larger liquidity premium
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  - greater under-valuation of durables in "fire sale"
  - greater under-consumption of special goods in crisis state

Flexible-Price Equilibrium: Policy and Welfare

- Since all three distortions of resource allocation are reduced by increasing $\tilde{m}$, welfare is unambiguously raised by increasing real supply of short-term public debt (as in Woodford, 1990)

  — abstracting from distortions associated with revenue collection to service debt

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- Here, however, take as given a path for $\{\tilde{m}_t\}$ that is insufficient to satiate demand for liquidity

  — to what extent is there then a role for central-bank policy in mitigating these distortions?

Introducing a Reserve Requirement

- Suppose that bankers that issue short-term debt D_t must hold reserves H_t at CB satisfying

$$H_t \geq kD_t$$

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- Suppose also that reserves may earn a lower interest rate than that paid on "cash," so that

$$\theta_t \equiv R_t^m / R_t^{cb}$$

measures effective cost of reserves to a banker

Introducing a Reserve Requirement

- All that matters about the reserve requirements for resource allocation is the path of

$$\xi_t \equiv \frac{1 - k\theta_t}{1 - k} \in (0, 1]$$

and not the values of k or θ_t separately

—lower ξ_t means greater effective tax rate on issuance of short-term debt

Interest on Reserves and Welfare

- Effects of lowering ζ_t (for given path of $\tilde{m}_t$):
  - reduced incentive for short-term debt issuance by banks
  - tightening cash-in-advance constraint (bad)
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    - reducing size of "fire sale" distortions (good)
- Hence not optimal to pay interest on reserves as high as that on T-bills (as proposed by Friedman, 1959)
- But not optimal to tax "inside money" out of existence either ("100% reserves" proposal)

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Interest on Reserves and Welfare

- Optimal ξ_t is interior $\Rightarrow$ will generally be state-contingent
- Hence scope for macro-prudential policy (as in Kashyap and Stein, 2011)
  - note, however, that the kind of reserve requirement needed is not the kind that already exists in the US

Introducing Sticky Prices

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- Stickiness of prices allows variation in equilibrium capacity utilization

$$u_t \equiv \frac{v'(Y_t)}{\lambda_t}$$

— note that in flexible-price model, $u_t = 1$ is an equilibrium condition

— now replace instead by condition for optimal (ex ante) price setting

Short-Run Policy Trade-Offs

- Treating the paths of $\{\tilde{m}_t, u_t, \bar{D}_t\}$ as parametric, can solve for implied allocation of resources
  - note this doesn't make use of FOCs through which ξ_t affects demand for durables, or R_t^m affects aggregate demand
  - those policy effects implicit in the assumed paths of $\{u_t, \bar{D}_t\}$

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  - those policy effects implicit in the assumed paths of $\{u_t, \bar{D}_t\}$
- Welfare then depends only the paths for $\{\tilde{m}_t, u_t, \bar{D}_t\}$ that are achieved; hence can treat optimal policy problem in two stages:
  - determine desired state-contingent evolution of $\{\tilde{m}_t, u_t, \bar{D}_t\}$
  - then determine the paths of policy variables $\{T_t, R_t^m, \xi_t\}$ required to achieve that equilibrium

Implementation: Interest-Rate Policy

- The path of the interest rate on "cash" required to implement a given equilibrium is given by

$$R_t^m = \beta^{-1} \frac{P_{t+1}}{P_t} \frac{\lambda(u_t, \bar{D}_{t+1}; \sigma_t)}{E_t[\hat{\varphi}_{1,t+1}]}$$

  where

$$E_t[\hat{\varphi}_{1,t+1}] = E_t[\lambda_{t+1}] + \hat{u}'_{t+1} \left(\tilde{m}_{t+1} + \bar{D}_{t+1} / \tilde{E}^c_{t+1}[\lambda_{t+1}]\right)$$

  is value of beginning-of-period real income

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- In flexible-price model, this indicates the real interest rate implied by paths of outside, inside liquidity (required for consistency with $u_t = 1$)

— instead, with sticky prices, shows how an unexpected change in interest rate R_t^m can change capacity utilization u_t

Implementation: Reserve Requirements

- The path for the time-varying cost of reserves required to implement a given equilibrium is

$$\zeta_{t+1} = \frac{\phi(u_t, \bar{D}_{t+1}; \sigma_t)\ \tilde{E}^c_{t+1}[\lambda_{t+1}] + E_t[\lambda_{t+1}]}{E_t[\hat{\varphi}_{1,t+1}]}$$

where

$$\phi(u_t, \bar{D}_{t+1}; \sigma_t) \quad = \quad \frac{\max[\lambda_t / F'(\Delta(\bar{D}_{t+1}); \sigma_t) - \Lambda^{s,fund}(\sigma_t),\ 0]}{\beta \bar{\Gamma}(\bar{D}_{t+1}; \sigma_t)}$$

$$+ \ (1 - p_t)[\hat{\varphi}^c_5(\bar{D}_{t+1}; \sigma_t) - 1]$$

measures other private disincentives to issuance of inside money

Implementation: Reserve Requirements

- Because ϕ is increasing in $\bar{D}_{t+1}$ for given λ_t, this shows how an increased reserve requirement (lower ξ_{t+1}) reduces inside money issuance $\bar{D}_{t+1}$

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- Because ϕ is also increasing in λ_t for given $\bar{D}_{t+1}$, one also sees why a loosening of monetary policy (lowering λ_t) will increase inside money issuance and exacerbate the fire-sale distortion $\hat{\varphi}_5^c(\bar{D}_{t+1})$

Lessons

- Higher interest rates can have a (short-run) effect on incentive to over-issue short-term debt

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- But use of interest-rate policy for this also causes distortions, by reducing aggregate demand relative to efficient level of capacity utilization

  — implies a policy trade-off

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  - even with prices set in advance, consistently higher Taylor-rule intercept will only lower equilibrium Π, with no effect on stationary equilibrium values of R^m/Π or λ

- Adjustment of reserve requirements (or interest on reserves) can offset effects of interest-rate policy on incentive to issue short-term debt: potentially freeing interest-rate policy to serve conventional stabilization goals

Lessons

- But if effective macro-prudential policy not available — or if its optimal use does not fully neutralize effects of interest-rate policy on risks to financial stability:
  - may be appropriate to take financial stability concerns into account in considering optimal interest-rate responses to shocks
  - though not the average level of interest rates

Short-Run Tradeoffs: Welfare Criterion

- Indirect utility (abstracting for now from distortions due to staggered price adjustment):

$$\mathrm{E}\sum_{t=0}^{\infty}\beta^t U(u_t, \bar{D}_{t+1}; \bar{D}_t, \tilde{E}_t^c[\lambda_t(u_t, \bar{D}_{t+1})]; \tilde{m}_t, \sigma_t)$$

where

$$\begin{aligned} U(u, \bar{D}; \bar{D}_{-1}, \lambda; \tilde{m}, \sigma) \quad &\equiv \quad \bar{U}(u, \bar{D}; \sigma) && (\textit{normal goods}) \\ &+ \quad \hat{u}(\tilde{m} + \bar{D}_{-1}/\lambda; \sigma) && (\textit{cash/credit}) \\ &+ \quad \tilde{U}(\bar{D}; \sigma) && (\textit{special goods}) \end{aligned}$$

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- If all prices set at same time: policy should choose $\{\tilde{m}_t,\bar{D}_t,u_t\}$ to maximize this, subject to constraint implied by price-setting.

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where π_t is the ("normal goods") inflation rate, and $\lambda_\pi > 0$ depends on rate of price adjustment

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- To a log-linear approximation, inflation dynamics will be given by

$$\pi_t = \kappa \mathrm{E}_{t-1}(u_t - \bar{u}) + \beta \mathrm{E}_{t-1}\pi_{t+1}$$

where $\kappa > 0$ depends on rate of price adjustment

Optimal Responses: Case of 2 Instruments

- Problem: choose paths $\{u_t, \bar{D}_t\}$ to maximize

$$\mathrm{E} \sum_{t=0}^{\infty} \beta^t \left\{ U_t(u_t, \bar{D}_{t+1}; \bar{D}_t, \tilde{E}_t^c[\lambda_t(u_t, \bar{D}_{t+1})]) - \lambda_\pi \pi_t^2 \right\}$$

subject to constraint that

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  each period

- Paths for policy instruments $\{\xi_t, R_t^m\}$ should be adjusted so as to achieve the equilibrium evolution of $\{u_t, \bar{D}_t\}$ that solves the above problem

Optimal Responses: Case of 2 Instruments

- The conditions for optimality of policy can be summarized by two target criteria, one for each instrument:
  - adjust path of riskless short-term interest rate $\{R_t^m\}$ so as to ensure that

$$\mathcal{P}_t - (\kappa\lambda_\pi)^{-1}\left[U_{1t} + \left(\frac{\eta_t}{1-p_t}\right)U_{4t}\cdot\lambda_{1t}\right] = \mathcal{P}^*$$

    each period;

  - adjust path of interest payment on reserves (or taxation of short-term debt issuance) $\{\xi_t\}$ so as to ensure that

$$U_{2t} + \beta \mathrm{E}_t U_{3,t+1} + \left(\frac{\eta_t}{1-p_t}\right)U_{4t}\cdot\lambda_{2t} = 0$$

    each period.

Optimality of Commitment to Price Stability

- It follows that the optimal equilibrium involves a well-defined time-invariant value for the long-run price level

$$\lim_{T \to \infty} \mathrm{E}_t \mathcal{P}_T = \mathcal{P}_\infty$$

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- It follows that the optimal equilibrium involves a well-defined time-invariant value for the long-run price level

$$\lim_{T\to\infty} \mathrm{E}_t \mathcal{P}_T = \mathcal{P}_\infty$$

- Strict (short-run) price stability not optimal — even in the absence of "cost-push shocks" of the conventional kind

  — but even in response to financial crises, it is never optimal to allow the expected long-run price level to vary

Optimal Responses: Case of 1 Instrument

- Suppose instead that reserve requirement (and spread between policy rate and IOR) is non-state-contingent: $\xi_t = \bar{\xi}$ at all times

  — assume here that $\bar{\xi}$ is the optimal steady-state value (above), so that steady state is same in constrained and unconstrained cases

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- Then there is an additional constraint on the evolution $\{u_t, \bar{D}_t\}$ achievable through monetary policy, which to a linear approximation takes the form

$$E_t[A(L^{-1})\bar{D}_{t+1} - B(L^{-1})u_t] = \mathcal{E}_t$$

  where $A(L), B(L)$ are two first-order polynomials, and $\mathcal{E}_t$ collects terms linear in η_t and other exogenous shocks

Optimal Responses: Case of 1 Instrument

- FOCs for optimal policy:

$$U_{2t} + \beta \mathrm{E}_t U_{3,t+1} + \left(\frac{\eta_t}{1-p_t}\right) U_{4t} \cdot \lambda_{2t} - A(\beta^{-1}L)\psi_t = 0$$

$$U_{1t} + \left(\frac{\eta_t}{1-p_t}\right) U_{4t} \cdot \lambda_{1t} - \kappa\varphi_{t-1} + B(\beta^{-1}L)\psi_t = 0$$

$$\lambda_\pi \pi_t - \varphi_{t-1} + \varphi_{t-2} = 0$$

where ψ_t is now the Lagrange multiplier associated with the additional constraint

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- Additional terms do not change the conclusion that optimal policy requires invariance of the long-run price level

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- If in the 2-instrument case, i-r policy should ensure that $T_t^{ir} = 0$ while m-p policy ensures that $T_t^{mp} = 0$, in the 1-instrument case, i-r policy should be used to ensure that

$$A(\beta^{-1}L)T_t^{ir} + B(\beta^{-1}L)T_t^{mp} = 0$$

Optimal Responses: Case of 1 Instrument

- Again, optimal responses can be characterized by fulfillment of a target criterion

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- Since

$$T_t^{ir} \equiv \mathcal{P}_t - (\kappa\lambda_\pi)^{-1}\left[U_{1t} + \left(\frac{\eta_t}{1-p_t}\right)U_{4t}\cdot\lambda_{1t}\right] - \mathcal{P}^*,$$

the target criterion again has the form of a generalized price-level target

Comparison with Conventional Theory

- Optimal monetary policy in standard New Keynesian analysis (e.g., CGG 1999): requires conformity to a target criterion of similar (but simpler) form:

$$\mathcal{P}_t - (\kappa\lambda_\pi)^{-1}\, U_{1t} = \mathcal{P}^*$$

- Moreover, in the basic NK model one can write (to a log-linear approximation)

$$U_{1t} = -\zeta x_t,$$

where $\zeta > 0$ and

$$x_t \equiv \log(Y_t / Y_t^e)$$

is the "output gap"

Comparison with Conventional Theory

- Hence in basic NK model, target criterion can be written in the form

$$p_t + \phi x_t = p^*$$

i.e., an output-gap adjusted price level target

— or what Hall (1984) calls an "elastic price standard"

Comparison with Conventional Theory

- Differences that result from additional frictions here:

  - variations in U_{1t} no longer solely reflect variations in the output gap (not just aggregate output relative to some function of exogenous disturbances)

    — also depend on variation in the degree of distortion of consumption/investment allocation owing to demand for durables for use as collateral

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- Differences that result from additional frictions here:
  - variations in U_{1t} no longer solely reflect variations in the output gap (not just aggregate output relative to some function of exogenous disturbances)

    — also depend on variation in the degree of distortion of consumption/investment allocation owing to demand for durables for use as collateral

  - additional U_{4t} term in target criterion takes account of effect of interest-rate policy on supply of liquidity given supply of collateral

    — lower λ_t raises $\bar{D}_t/\lambda_t$: looser policy raises price of durables, allowing more short-term debt to be collateralized

Comparison with Conventional Theory

- If only interest-rate policy can be used, further additional T_t^{mp} terms in target criterion

  — must also consider effects of interest-rate policy on departure of $\bar{D}_{t+1}$ from optimal level

  — these terms balance the several effects of variation in $\bar{D}_{t+1}$ discussed above in analysis of optimal macro-prudential policy

Comparison with Conventional Theory

- Concavity of welfare in $\bar{D}$ implies that marginal benefit of increasing $\bar{D}_{t+1}$ should be decreasing function of $\bar{D}_{t+1}$

  — hence additional terms imply that faster growth of "inside money" will justify lower short-term price-level target, just as higher output would

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  — hence additional terms imply that faster growth of "inside money" will justify lower short-term price-level target, just as higher output would

  — but again, it is collateralized debt relative to the (time-varying) optimal level that should matter, not variations in volume of liabilities as such

Lessons for Theory of Inflation Targeting

- General lesson: the interest rate policy that best serves traditional stabilization objectives need not also be the one best for financial stability

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- General lesson: the interest rate policy that best serves traditional stabilization objectives need not also be the one best for financial stability
- But one can introduce a financial stability concerns into a flexible IT framework
  - such an approach would still provide a clear anchor for medium-term inflation expectations
  - financial stability considerations only affect the near-term transition path to that invariant medium-run inflation rate

Lessons for Theory of Inflation Targeting

- Note this proposal maintains a commitment to a well-defined medium-run inflation target

  — in fact, the target criterion implies that the long-run price level should never change as a result of shocks

  — including variations in crisis risk, or occurrence of crises

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  — in fact, the target criterion implies that the long-run price level should never change as a result of shocks

  — including variations in crisis risk, or occurrence of crises

- Inflation should be allowed to undershoot normal target in a period where incentives for over-issuance of short-term debt are elevated risk

  — but there should be a commitment to make up the insufficient inflation later, so that the long-run price level is unaffected

  — credible commitment of this kind would eliminate risk of deflationary spiral

Lessons for Theory of Inflation Targeting

- Interaction between monetary policy and macro-prudential policy:
  - state-contingent adjustment of interest on reserves can help to reduce variations in incentives for over-issuance

    — reducing need to use monetary policy for purposes other than traditional stabilization objectives

Lessons for Theory of Inflation Targeting

- Interaction between monetary policy and macro-prudential policy:
  - state-contingent adjustment of interest on reserves can help to reduce variations in incentives for over-issuance

    — reducing need to use monetary policy for purposes other than traditional stabilization objectives
  - but even with ideal use of this instrument, in general, must still consider effects of interest-rate policy on supply of liquidity, and distortions resulting from scarcity of liquidity