The Effects of Monetary Policy on Asset Price Bubbles: Some Evidence

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Monetary Policy and Asset Price Bubbles

- Should monetary policy respond to asset price bubbles?
- Pre-crisis consensus:

  - focus on inflation and output gap
  - ignore asset price developments, unless threat to objectives
  - the case against a monetary response to bubbles:
    (i) difficult detection
    (ii) interest rate: "too blunt" an instrument

- Challenges to the pre-crisis consensus:

  - macro stability $\not\Rightarrow$ financial stability
  - bubble-driven asset price booms $\Rightarrow \uparrow$ risk of financial crisis

  $\Rightarrow$ *calls for a "leaning against the wind" policy: raise interest rates in response to developing asset price bubbles*

Monetary Policy and Asset Price Bubbles

- Key maintained assumption:

$$\uparrow \text{interest rate} \Rightarrow \downarrow \text{bubble}$$

...but no theoretical or empirical support

- Galí (2013): *What does economic theory have to say regarding...*

...the effects of monetary policy on (rational) asset price bubbles?
...the desirability of leaning against the wind policies?

- Present paper: *What is the evidence on the effects of monetary policy on asset price bubbles?*

Interest Rates and Rational Bubbles: Theoretical Issues

- Key assumption in the case for leaning against the wind policies:

$$\uparrow \text{interest rate} \Rightarrow \downarrow \text{bubble}$$

- Based on "fundamentals" intuition:

$$\uparrow \text{interest rate} \Rightarrow \downarrow \text{asset price}$$

- It ignores two key features of a bubble:

(i) no payoffs to be discounted
(ii) return on the bubble = growth in bubble size

- Equilibrium requirement:

$$\uparrow \text{interest rate} \Rightarrow \uparrow \text{expected bubble growth}$$

$\Rightarrow$ *risk of amplified fluctuations in the size of the bubble resulting from "leaning against the wind" policies (Galí (2013))*

- Asset yielding a stream of dividends $\{D_t\}$
- Exogenous time-varying (gross) real rate $\{R_t\}$
- Risk neutral investors
- Fundamental price:

$$Q_t^F \equiv E_t \left\{ \sum_{k=1}^{\infty} \left(\prod_{j=0}^{k-1} (1/R_{t+j}) \right) D_{t+k} \right\}$$

or, in log-linear version:

$$q_t^F = const + \sum_{k=0}^{\infty} \Lambda^k \left[(1-\Lambda) E_t\{d_{t+k+1}\} - E_t\{r_{t+k}\} \right]$$

where $\Lambda \equiv \Gamma/R < 1$

Interest Rates and Bubbles: Theoretical Issues

- Observed stock price

$$Q_t = Q_t^F + Q_t^B$$

- Dynamic response of stock price to an interest rate shock:

$$\frac{\partial q_{t+k}}{\partial \varepsilon_t^m} = (1 - \gamma_{t-1}) \frac{\partial q_{t+k}^F}{\partial \varepsilon_t^m} + \gamma_{t-1} \frac{\partial q_{t+k}^B}{\partial \varepsilon_t^m}$$

  where $\gamma_t \equiv Q_t^B / Q_t$

- Theory (and evidence) suggest:

$$\frac{\partial q_{t+k}^F}{\partial \varepsilon_t^m} < 0$$

- Conventional view:

$$\frac{\partial q_{t+k}^B}{\partial \varepsilon_t^m} \leq 0 \quad \Rightarrow \quad \frac{\partial q_{t+k}}{\partial \varepsilon_t^m} < 0$$

The Rational Bubble Theory Perspective

- Asset pricing equation

$$Q_t R_t = E_t\{D_{t+1} + Q_{t+1}\}$$

- Fundamental component:

$$Q_t^F R_t = E_t\{D_{t+1} + Q_{t+1}^F\}$$

- Bubble component:

$$Q_t^B R_t = E_t\{Q_{t+1}^B\}$$

or, equivalently

$$\Delta q_t^B = r_{t-1} + \xi_t$$

where $\xi_t \equiv q_t^B - E_{t-1}\{q_t^B\}$ and $E_{t-1}\{\xi_t\} = 0.$ Without loss of generality

$$\xi_t = \psi_t(r_t - E_{t-1}\{r_t\}) + \xi_t^*$$

where $E_{t-1}\{\xi_t^*\} = 0$ and. $E\{\xi_t^* r_{t-k}\} = 0$, for $k = 0, \pm 1, \pm 2, ..$

$\Rightarrow$ both the sign and the size of ψ_t are *indeterminate*

The Rational Bubble Theory Perspective

- Predicted dynamic response of the bubble to an interest rate shock

$$\frac{\partial q^B_{t+k}}{\partial \varepsilon^m_t} = \begin{cases} \psi_t \frac{\partial r_t}{\partial \varepsilon^m_t} & \textit{for } k = 0 \\ \psi_t \frac{\partial r_t}{\partial \varepsilon^m_t} + \sum_{j=0}^{k-1} \frac{\partial r_{t+j}}{\partial \varepsilon^m_t} & \textit{for } k = 1, 2, \ldots \end{cases}$$

- Predicted dynamic response of the stock price:

$$\frac{\partial q_{t+k}}{\partial \varepsilon^m_t} \lesseqgtr 0$$

The Rational Bubble Theory Perspective: An Example

- Assumptions:

$$\frac{\partial r_{t+k}}{\partial \varepsilon_t^m} = \rho_r^k \qquad ; \qquad \frac{\partial d_{t+k}}{\partial \varepsilon_t^m} = 0$$

for $k = 0, 1, 2, \ldots$

- Dynamic response of the asset price

$$\frac{\partial q_{t+k}}{\partial \varepsilon_t^m} = -(1 - \gamma_{t-1}) \frac{\rho_r^k}{1 - \Lambda \rho_r} + \gamma_{t-1} \left(\psi_t + \frac{1 - \rho_r^k}{1 - \rho_r} \right)$$

The Rational Bubble Theory Perspective: An Example

- Assumptions:

$$\frac{\partial r_{t+k}}{\partial \varepsilon_t^m} = \rho_r^k \qquad ; \qquad \frac{\partial d_{t+k}}{\partial \varepsilon_t^m} = 0$$

for $k = 0, 1, 2, ...$

- Dynamic response of the asset price

$$\frac{\partial q_{t+k}}{\partial \varepsilon_t^m} = -(1-\gamma_{t-1})\frac{\rho_r^k}{1-\Lambda\rho_r} + \gamma_{t-1}\left(\psi_t + \frac{1-\rho_r^k}{1-\rho_r}\right)$$

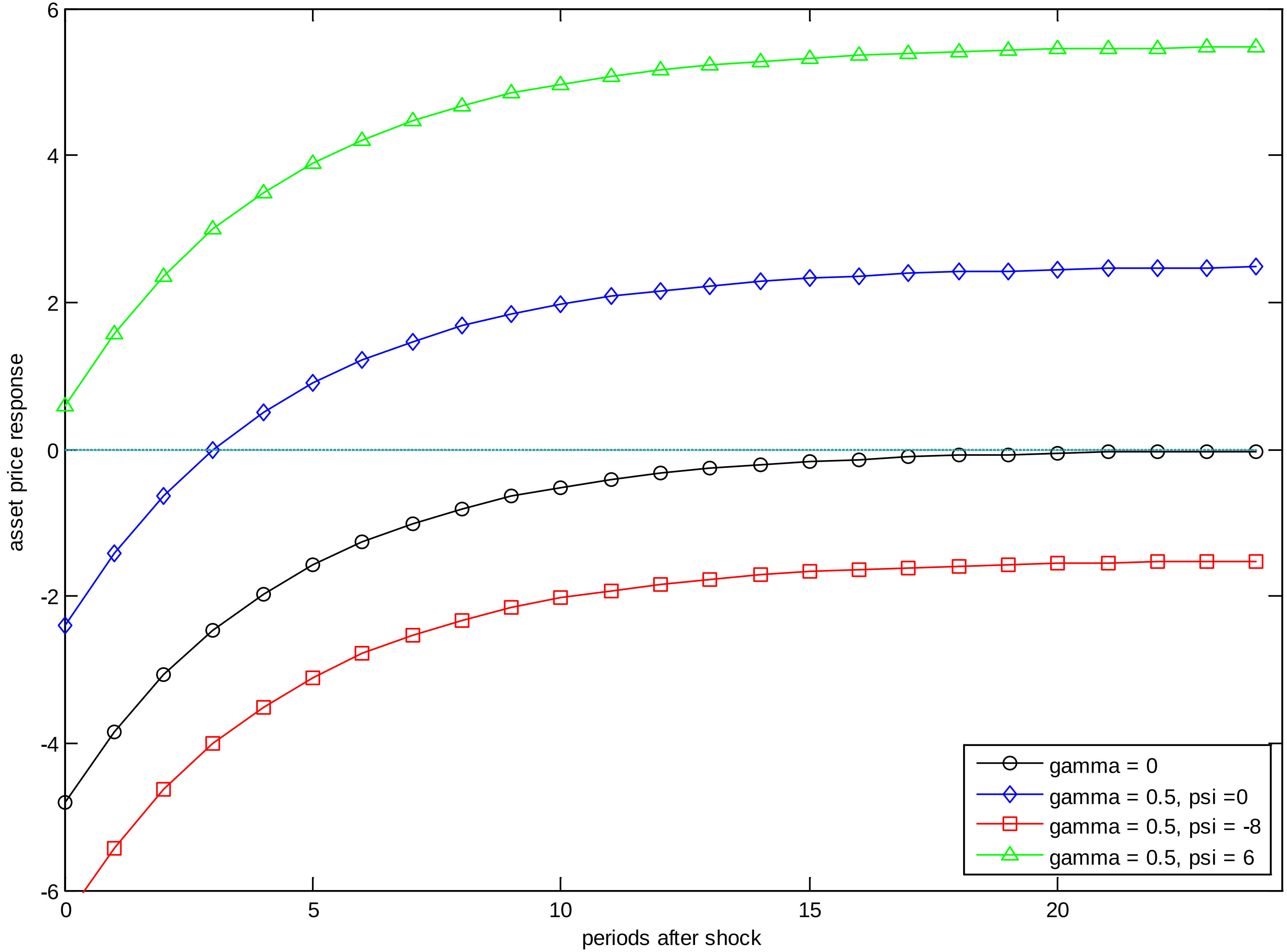
- Implications for the response of asset prices to an interest rate shock:

$$\gamma_t \simeq 0 \qquad \Rightarrow \frac{\partial q_{t+k}}{\partial \varepsilon_t^m} < 0$$

$$\gamma_t \gg 0,\ \psi_t \gtrsim 0 \quad \Rightarrow \frac{\partial q_{t+k}}{\partial \varepsilon_t^m} > 0 \text{ for large } k$$

- Simulated responses under alternative calibrations

Figure 1 : Asset Price Response to an Exogenous Interest Rate Increase: Alternative Calibrations



Evidence based on Vector Autoregressions

- VAR with constant coefficients

$$x_t = A_0 + A_1 x_{t-1} + A_2 x_{t-2} + ... + A_p x_{t-p} + u_t$$

where

$$x_t \equiv [\Delta y_t, \Delta d_t, \Delta p_t, i_t, \Delta q_t]'$$

$$E_t\{u_t u'_{t-k}\} = \Sigma$$

$$u_t = S\varepsilon_t$$

with $E\{\varepsilon_t \varepsilon'_t\} = I$ and $E\{\varepsilon_t \varepsilon'_{t-k}\} = 0$ for $k = 1, 2, 3, ...$

- *Identification* of monetary policy shocks:

- i_t instrument of monetary policy
- $(\Delta y_t, \Delta d_t, \Delta p_t)$ predetermined with respect to i_t
- S block lower-triangular (CEE (2005))

Evidence based on Vector Autoregressions

- VAR with time-varying coefficients

$$x_t = A_{0,t} + A_{1,t}x_{t-1} + A_{2,t}x_{t-2} + ... + A_{p,t}x_{t-p} + u_t$$

where

$$E_t\{u_t u'_{t-k}\} = \Sigma_t$$

$$u_t = S_t \varepsilon_t$$

with $E\{\varepsilon_t \varepsilon'_t\} = I$ and $E\{\varepsilon_t \varepsilon'_{t-k}\} = 0$ for $k = 1, 2, 3, ...$

- *Identification* of monetary policy shocks:

- i_t instrument of monetary policy
- $(\Delta y_t, \Delta d_t, \Delta p_t)$ predetermined with respect to i_t
- S_t block lower-triangular, for all t

- *Assumptions*

Letting $\theta_t = vec([A_{0,t}, A_{1,t}..., A_{p,t}])$,

$$\theta_t = \theta_{t-1} + \omega_t$$

where $\omega_t \sim N(0, \Omega)$ is white noise.

Letting $\Sigma_t \equiv F_t D_t F_t'$ where F_t is lower triangular with ones on the diagonal and D_t diagonal. Define $\phi_t = vec(F_t^{-1})$ and $\sigma_t = vec(D_t)$.

$$\phi_t = \phi_{t-1} + \zeta_t$$

$$\log \sigma_t = \log \sigma_{t-1} + \xi_t$$

where $\zeta_t \sim N(0, \Psi)$ and $\xi_t \sim N(0, \Xi)$ are (uncorrelated) white noise.

- *Estimation*: Bayesian approach (Primiceri (2005))

Evidence

- Impulse responses: VAR with constant coefficients

Figure 2.a : Estimated Responses to Monetary Policy Shock

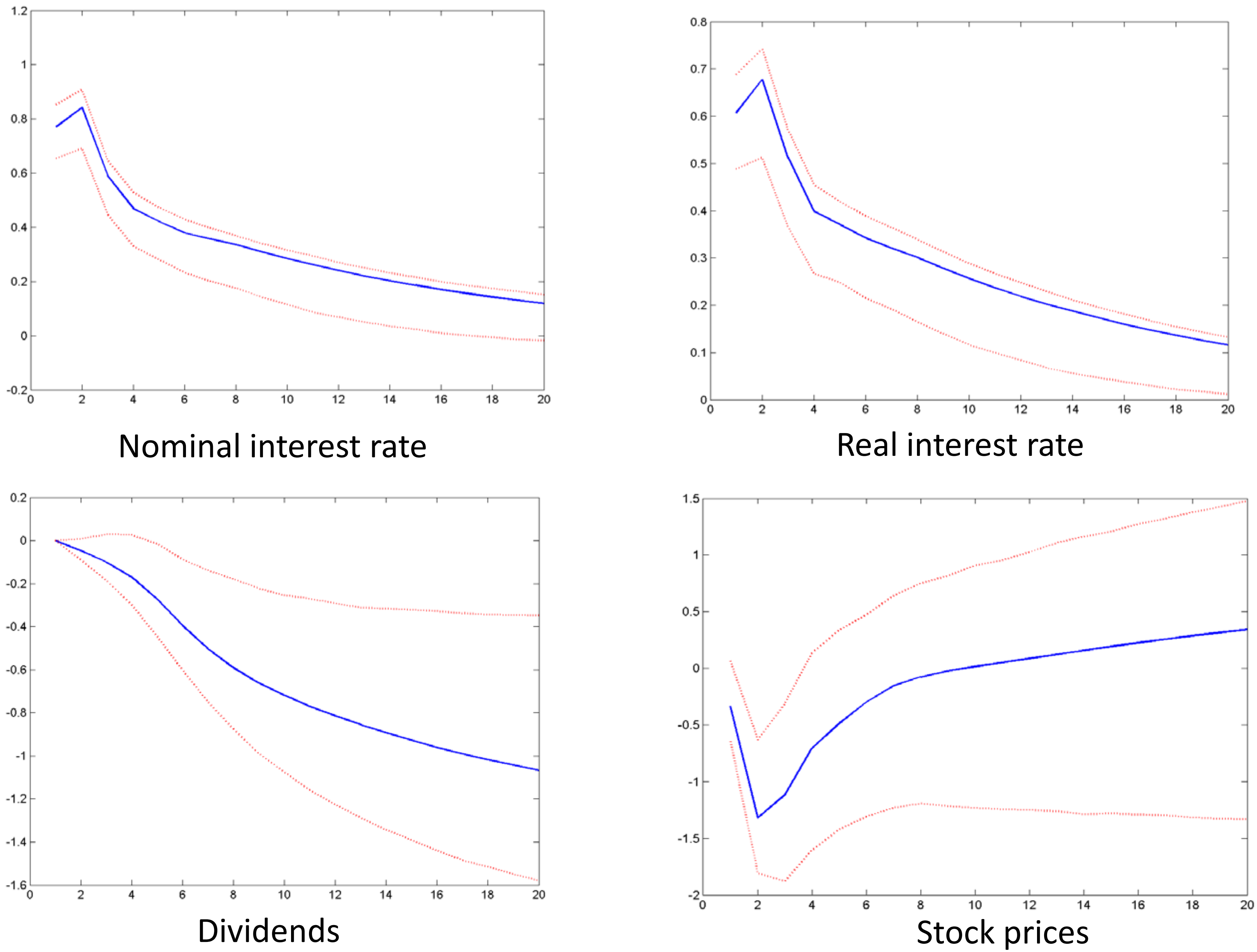
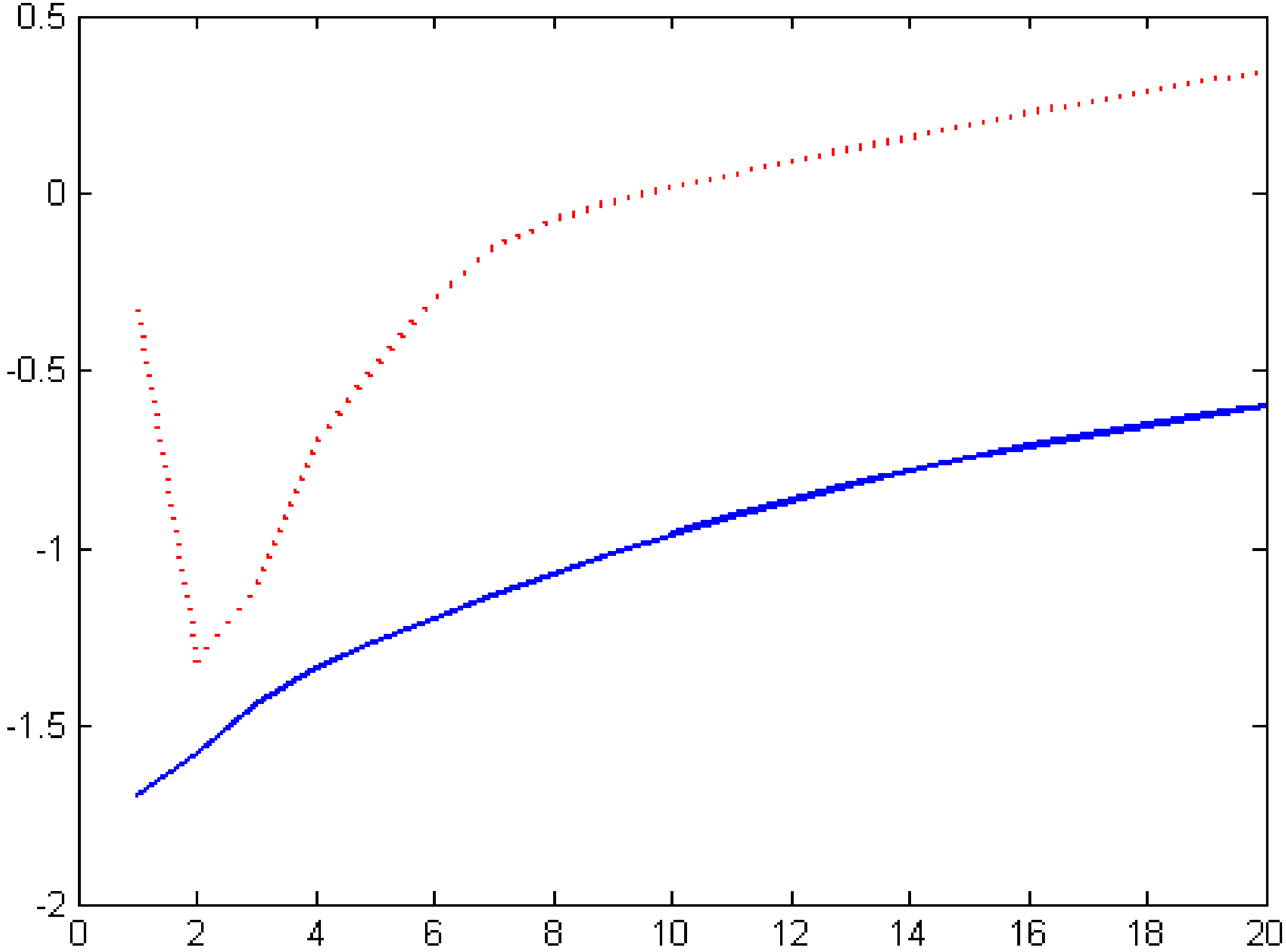


Figure 2.b : Estimated Responses to Monetary Policy Shock



Observed (red, dotted) vs. Fundamental (blue, solid) Stock Price

Evidence

- Impulse responses: VAR with constant coefficients
- Impulse responses: VAR with time-varying coefficients

Figure 3.a : Estimated Responses to Monetary Policy Shock: TVC-VAR

Nominal Interest Rate

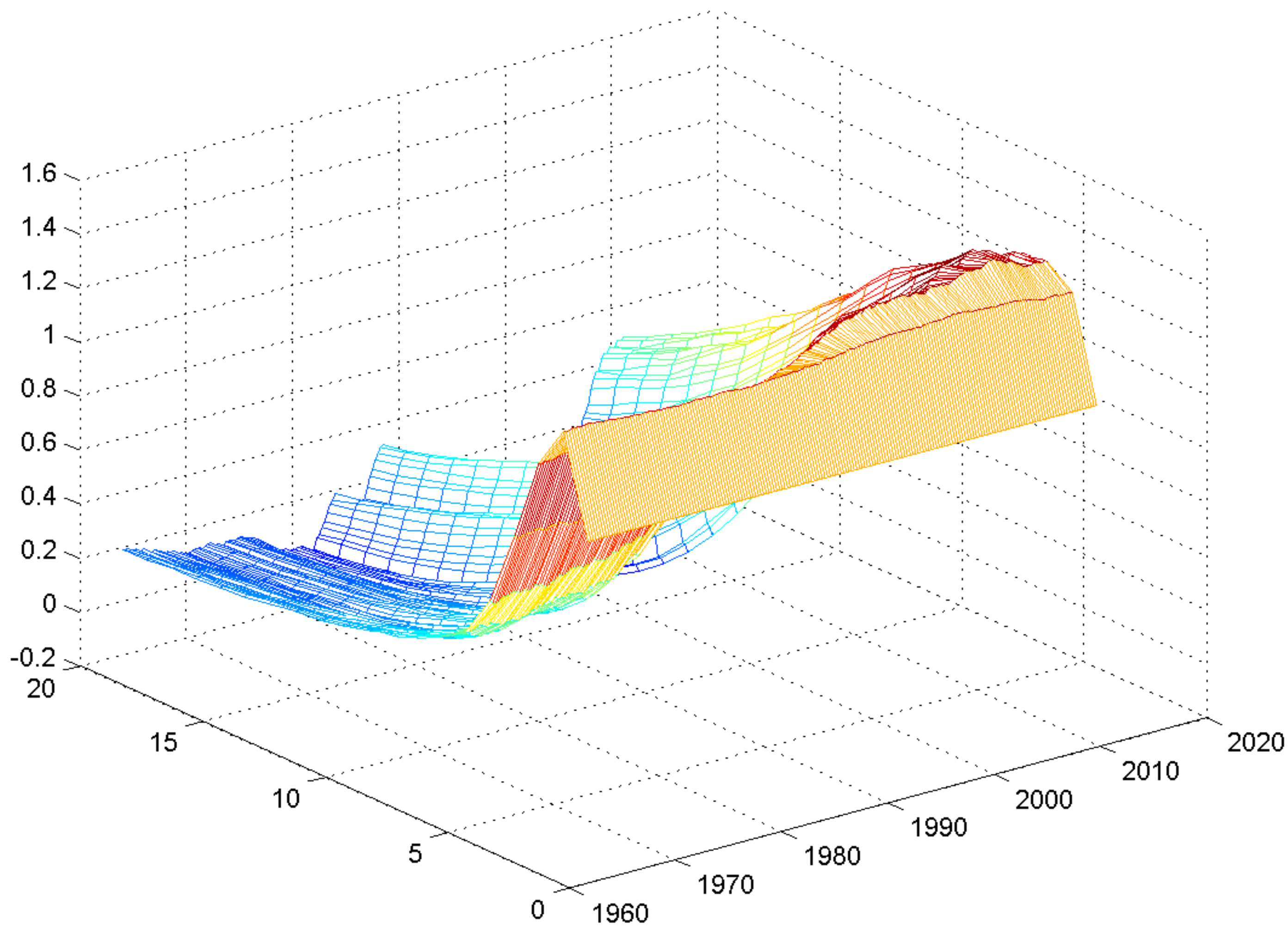


Figure 3.b : Estimated Responses to Monetary Policy Shock: TVC-VAR
Real Interest Rate

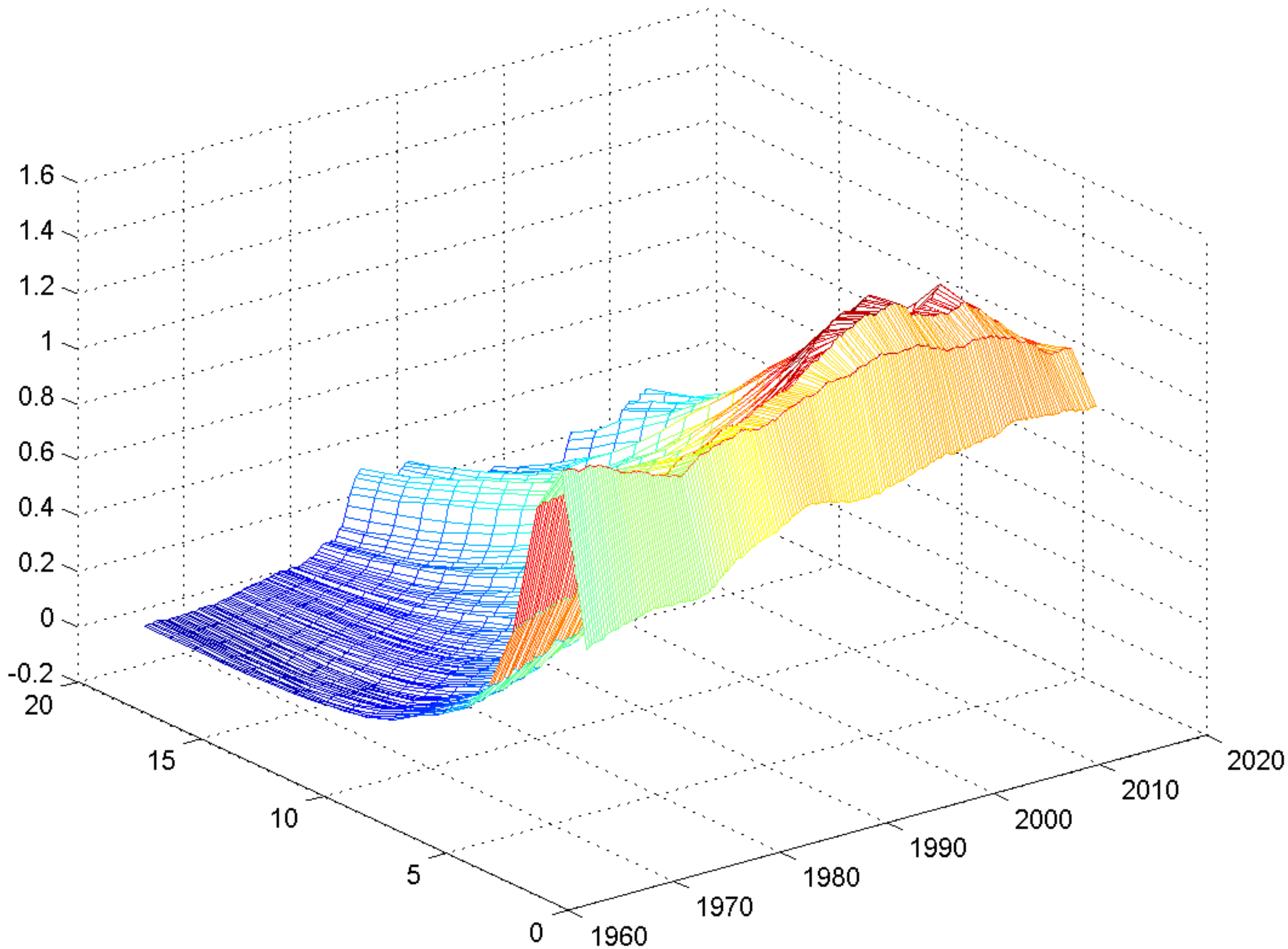


Figure 3.c : Estimated Responses to Monetary Policy Shock: TVC-VAR
Dividends

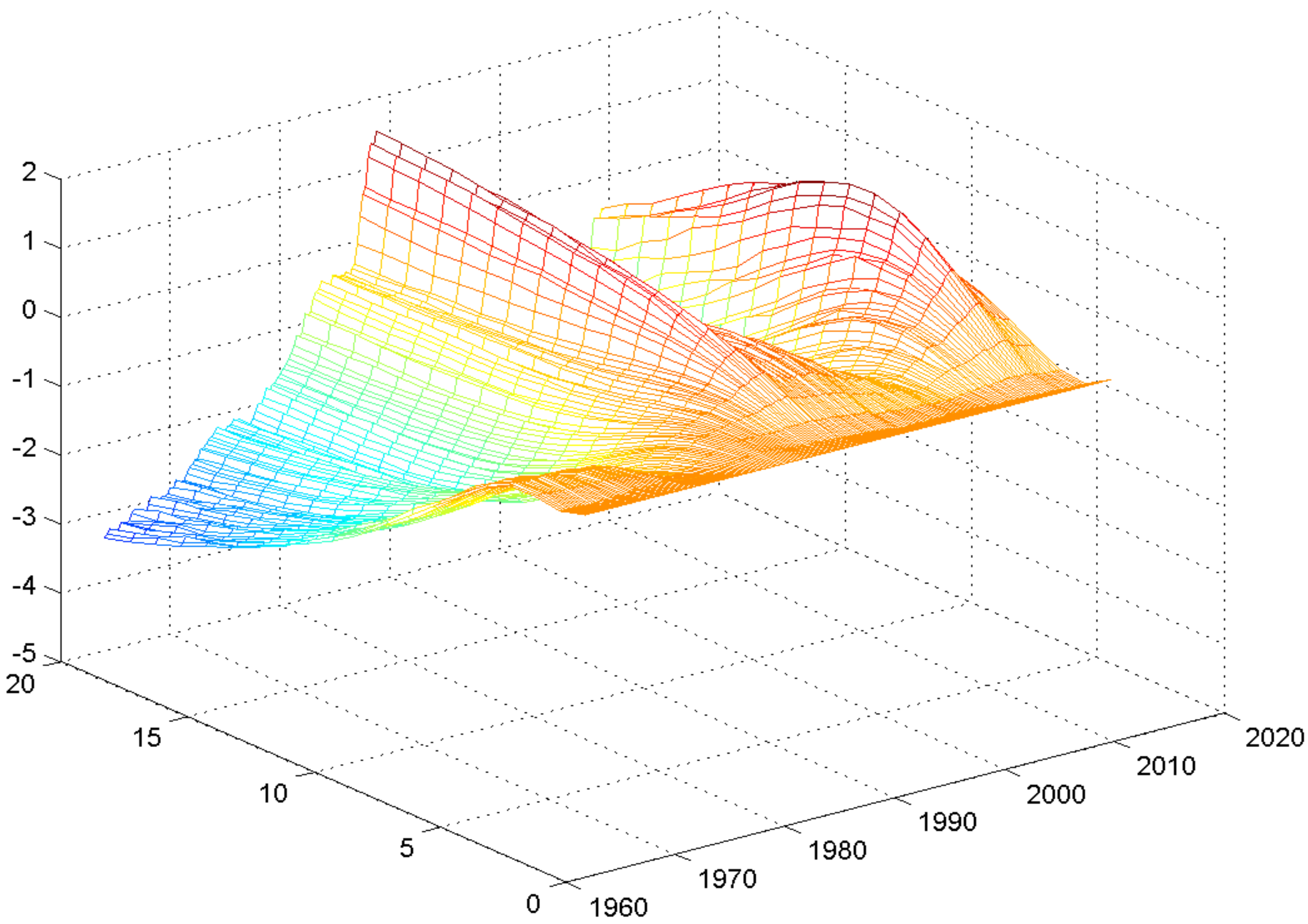
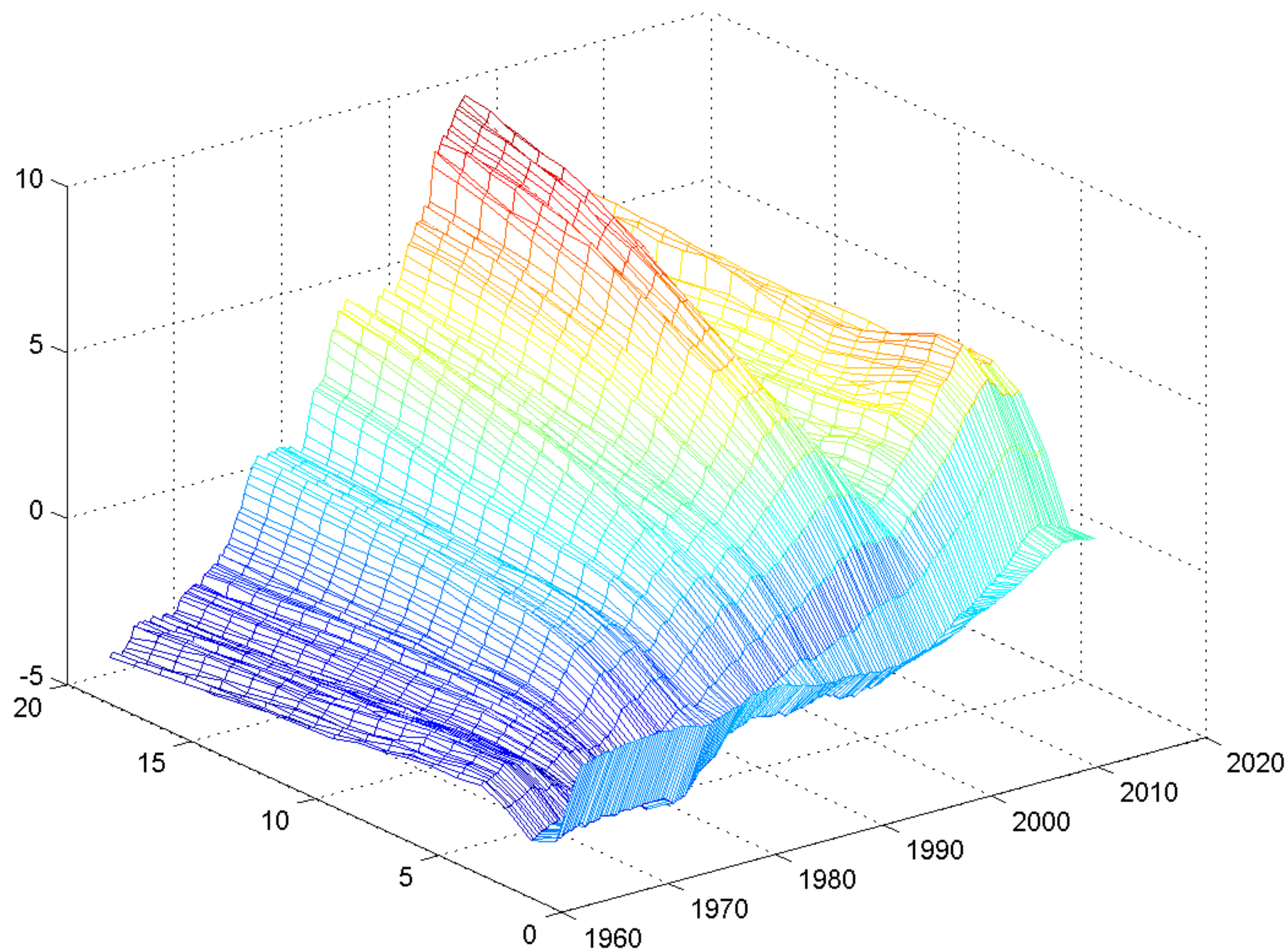


Figure 3.d : Estimated Responses to Monetary Policy Shock: TVC-VAR

Stock Prices



Evidence

- Impulse responses: VAR with constant coefficients
- Impulse responses: VAR with time-varying coefficients

$$\frac{\partial(q_{t+k} - q^F_{t+k})}{\partial \varepsilon^m_t} = \gamma_{t-1} \left(\frac{\partial q^B_{t+k}}{\partial \varepsilon^m_t} - \frac{\partial q^F_{t+k}}{\partial \varepsilon^m_t} \right)$$

In the simple example above:

$$\begin{aligned} \frac{\partial(q_{t+k} - q^F_{t+k})}{\partial \varepsilon^m_t} &= \gamma_{t-1} \left(\frac{\rho^k_r}{1 - \Lambda \rho_r} + \psi_t + \frac{1 - \rho^k_r}{1 - \rho_r} \right) \\ &\simeq \gamma_{t-1} \left(\frac{1}{1 - \rho_r} + \psi_t \right) \end{aligned}$$

which is positive, as long as $\gamma_{t-1} > 0$ and $\psi_t \gtrsim 0$.

Figure 3.e : Estimated Responses to Monetary Policy Shock: TVC-VAR

Fundamental Stock Price

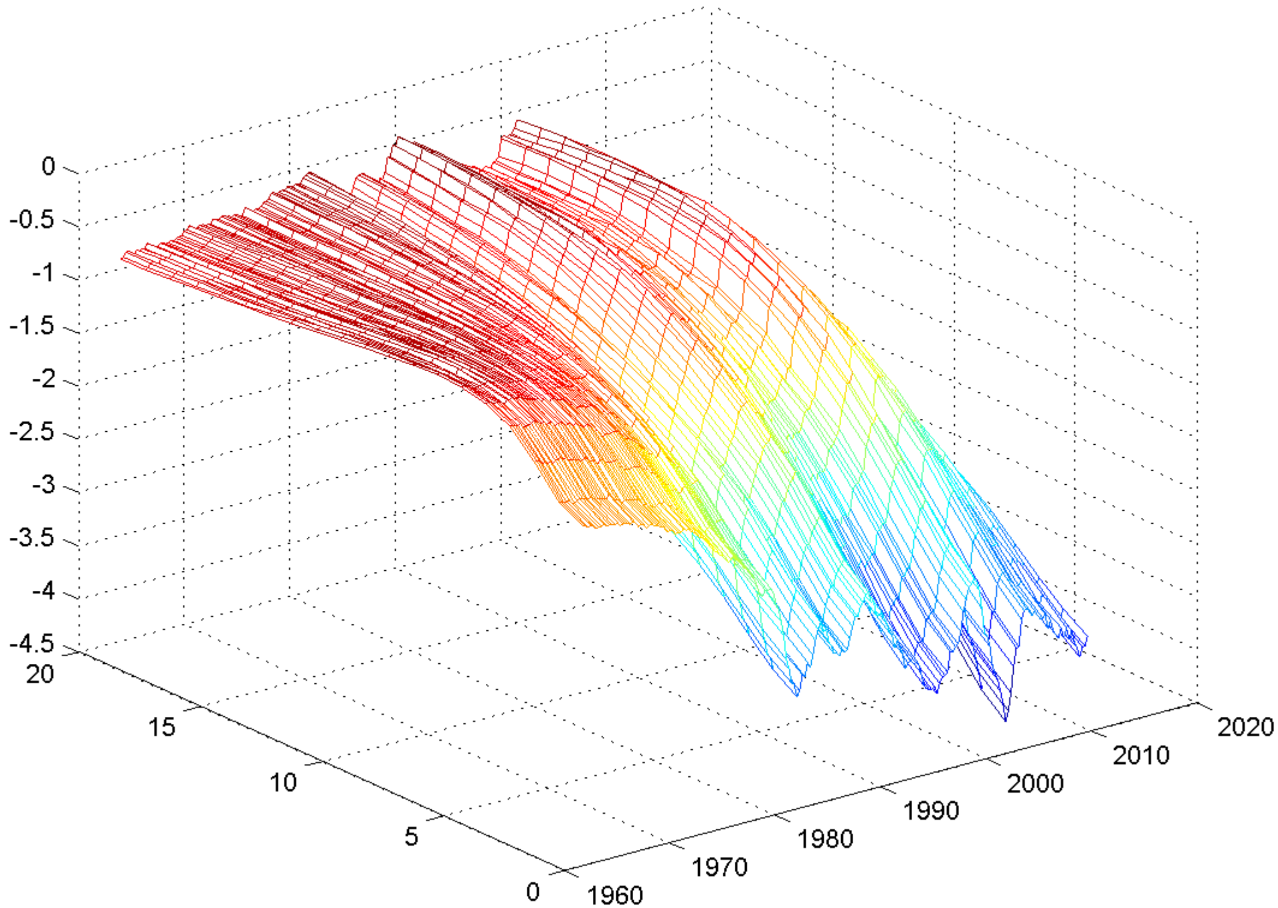


Figure 3.f : Estimated Responses to Monetary Policy Shock: TVC-VAR

Observed minus Fundamental Stock Price

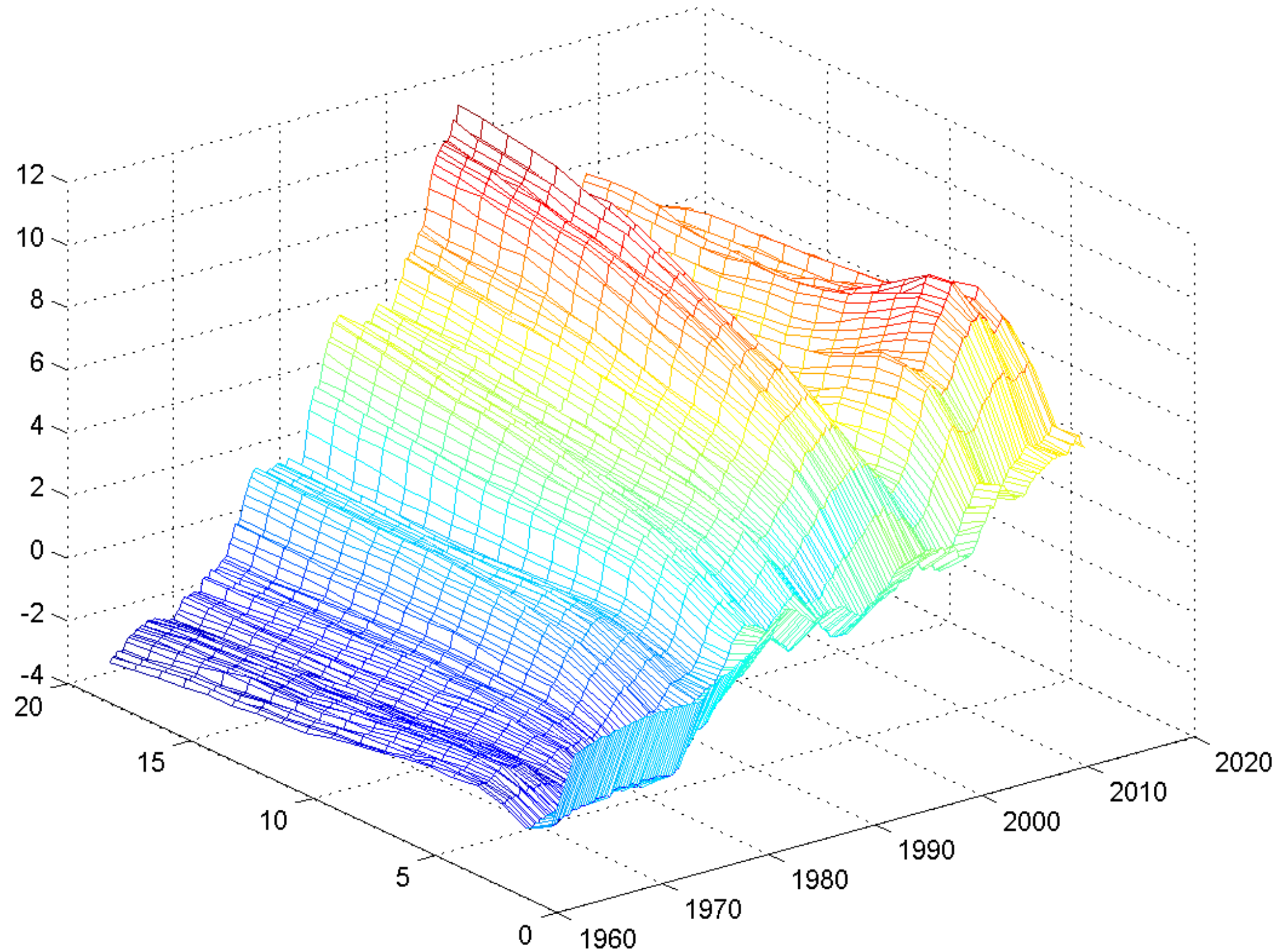


Figure 4.a : Response of $q - q^F$ at different horizons

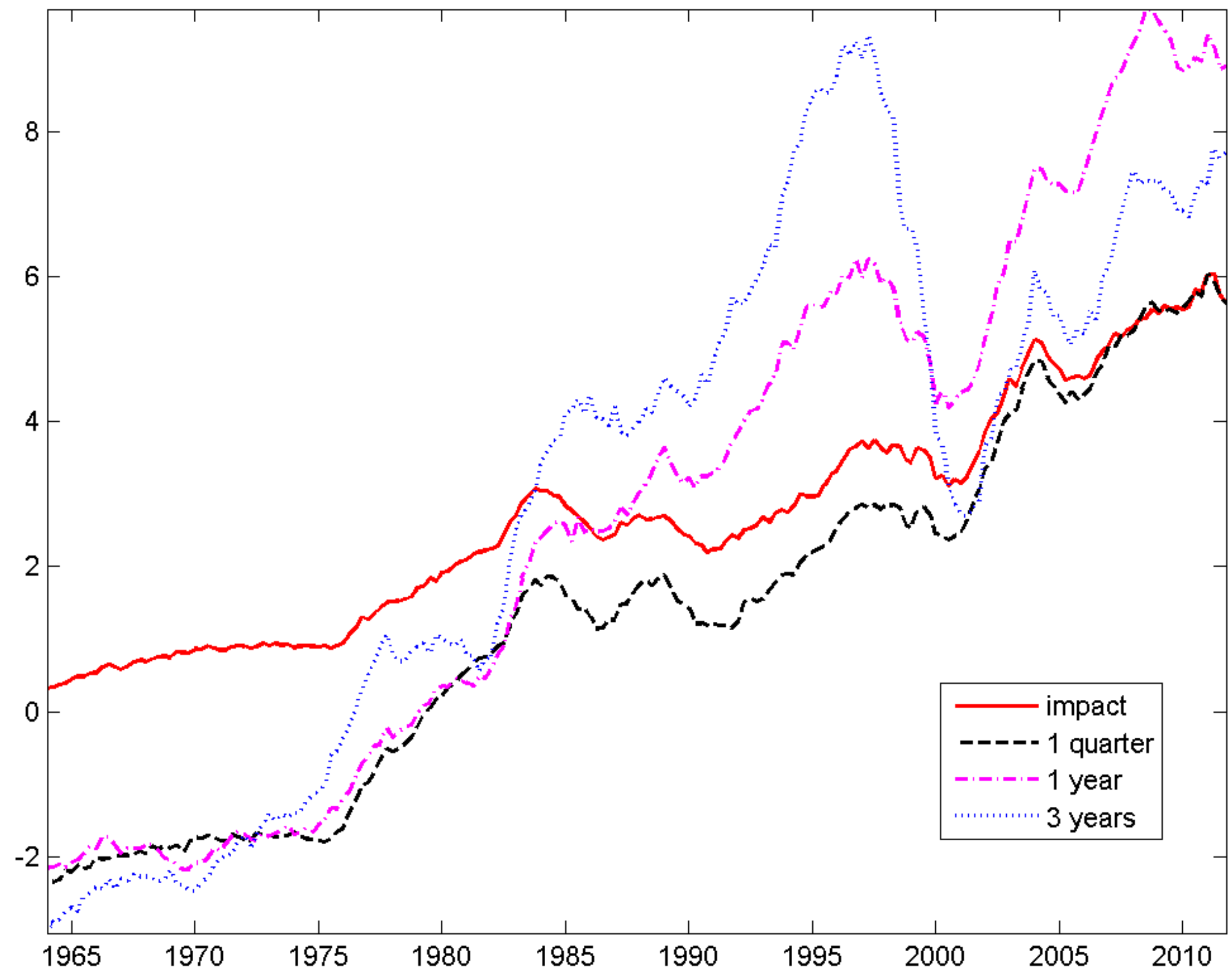


Figure 4.b : Probability of a positive response of $q - q^F$ at different horizons

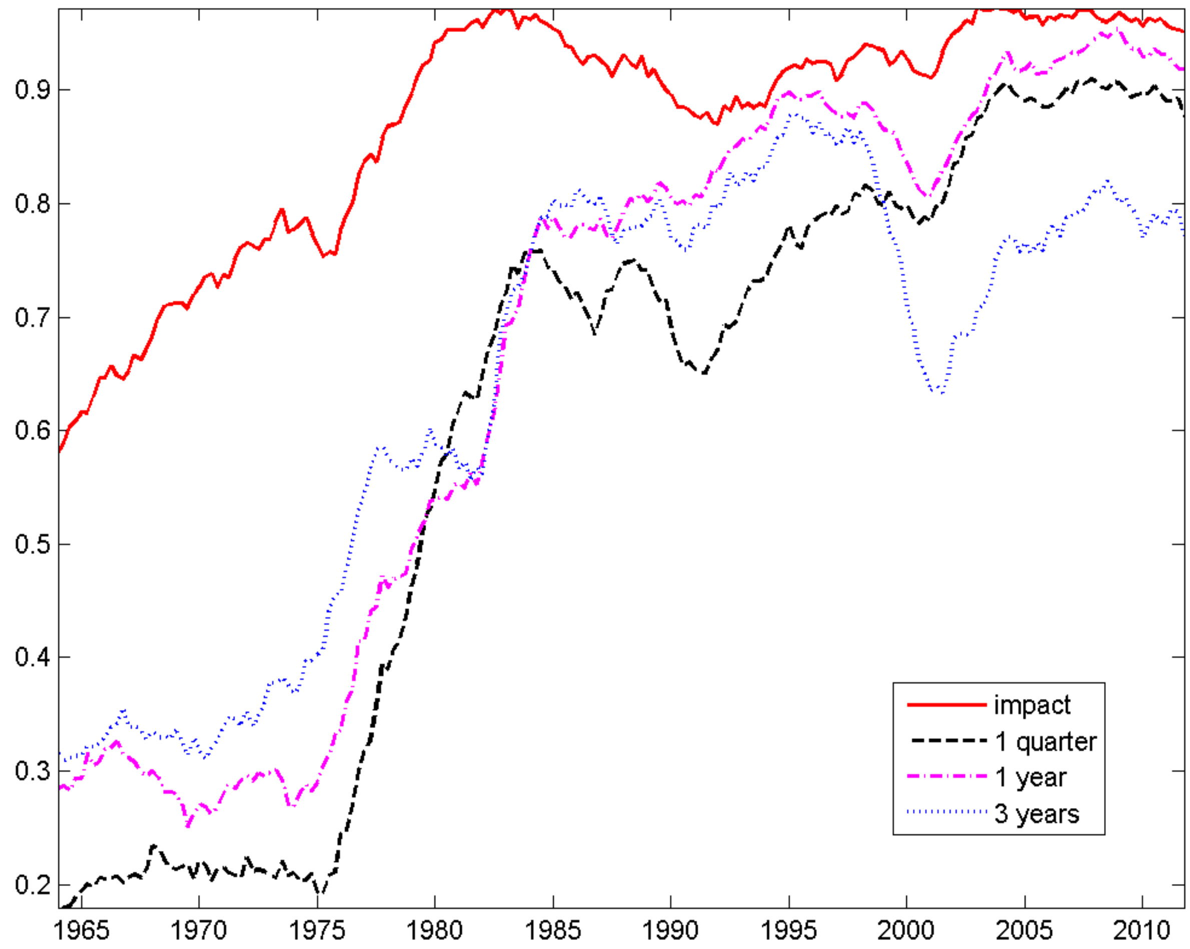
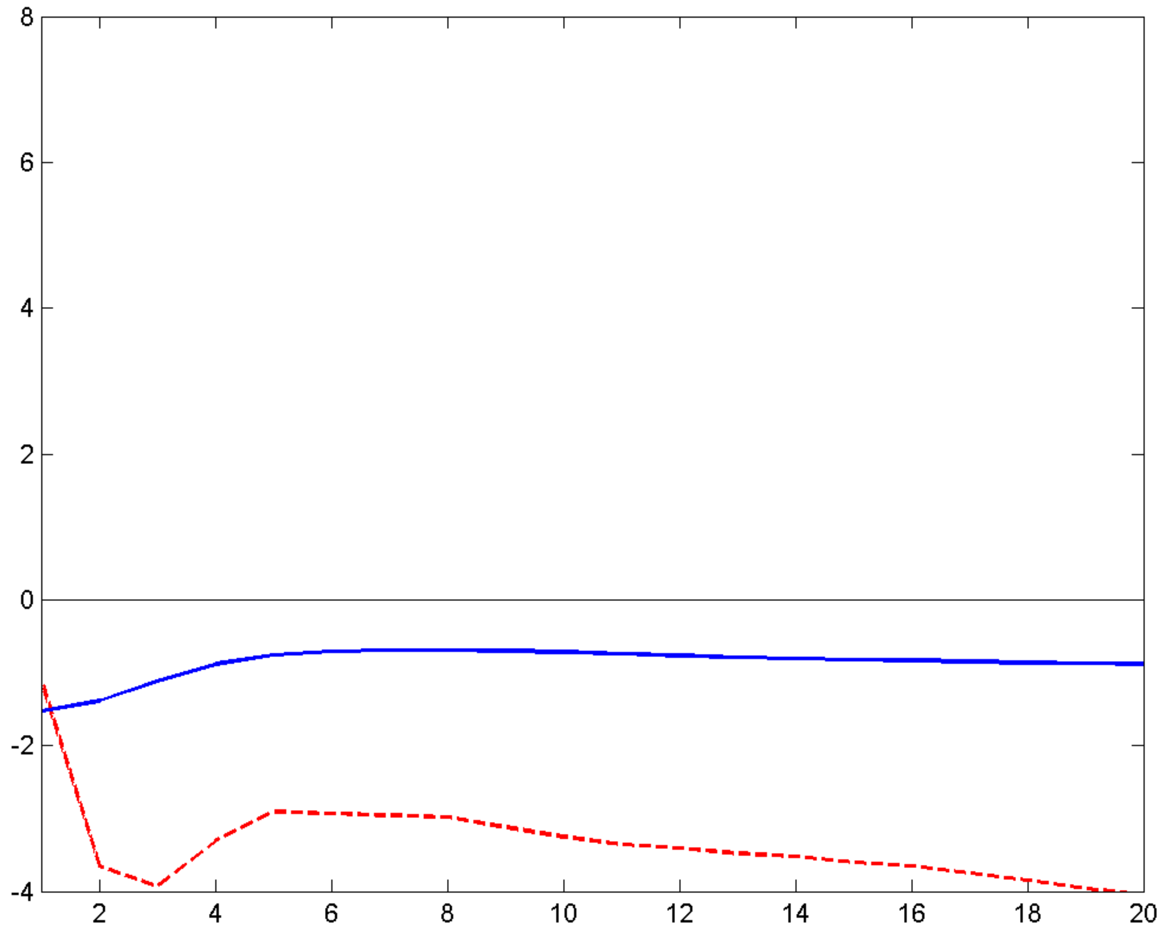
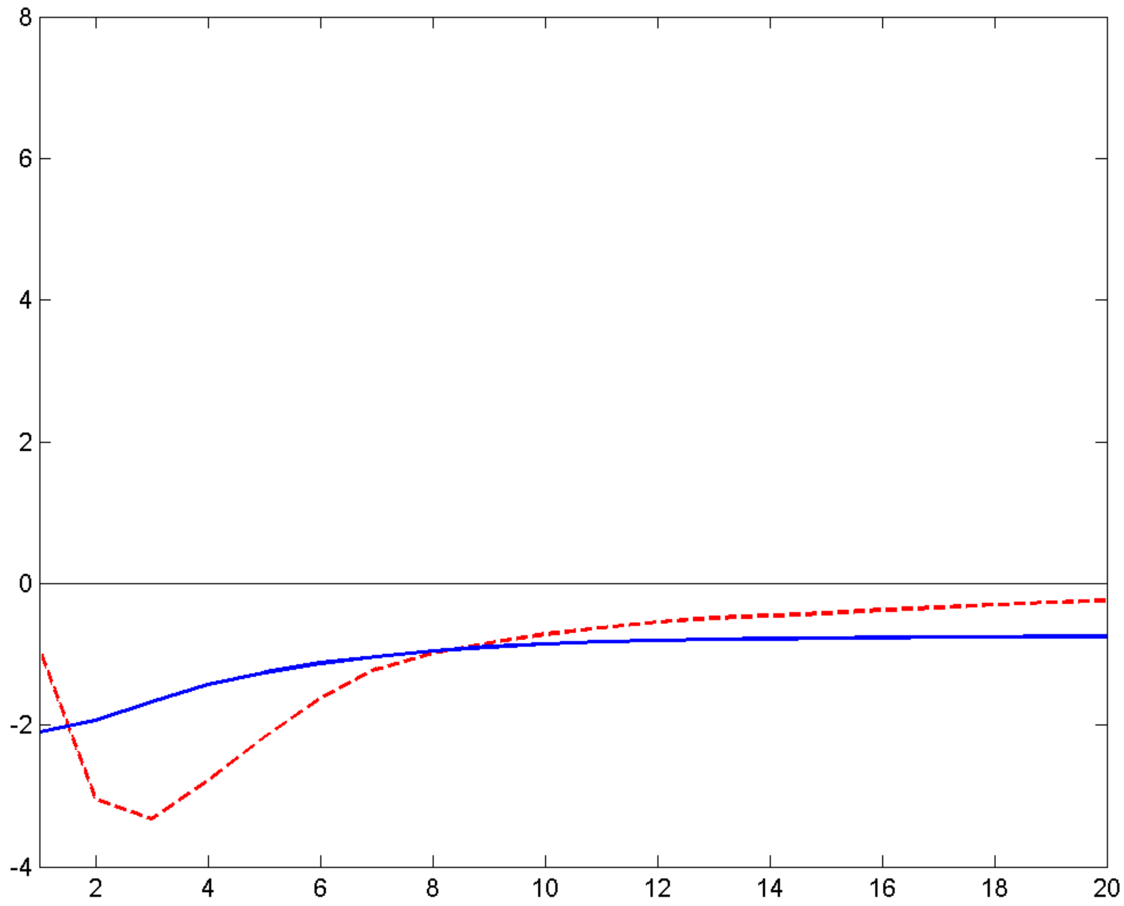


Figure 5.a : Estimated Responses to Monetary Policy Shock: TVC-VAR
Observed vs. Fundamental Stock Price: 1965Q1-1967Q4



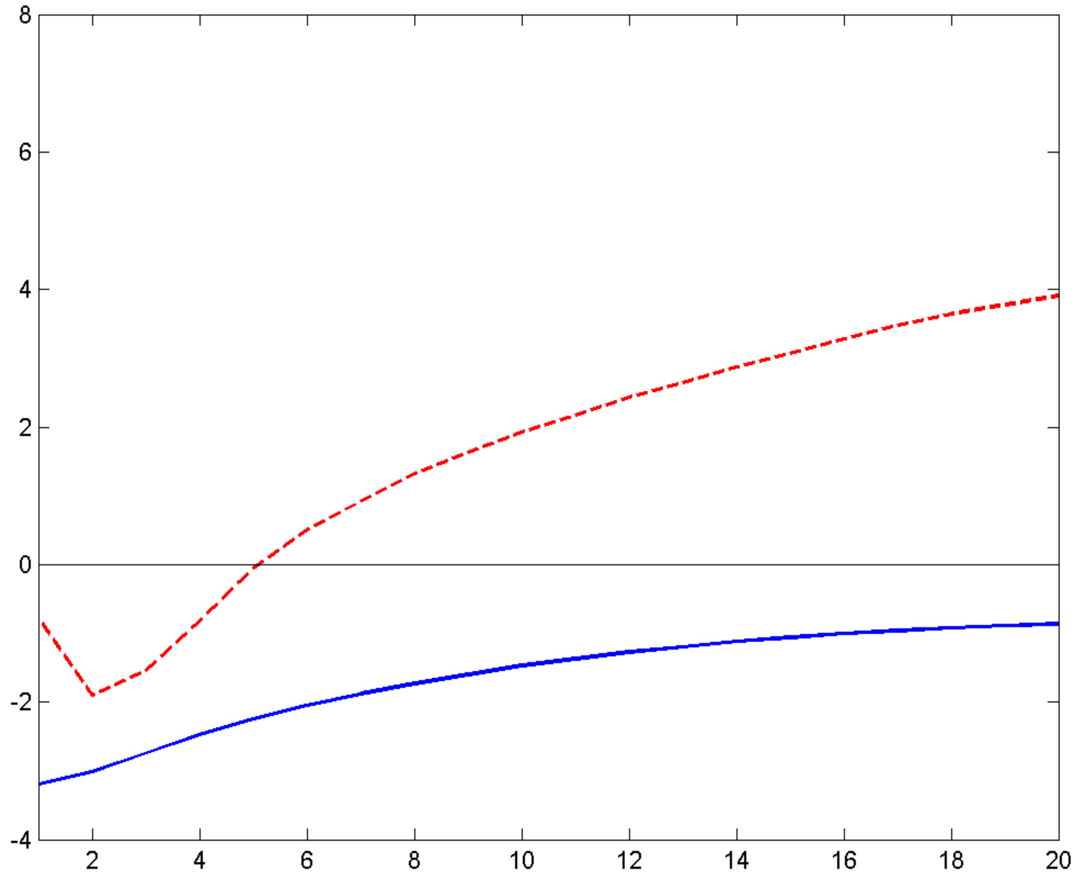
Fundamental: blue, solid   Observed: red, dotted

Figure 5.b : Estimated Responses to Monetary Policy Shock: TVC-VAR
Observed vs. Fundamental Stock Price: 1976Q1-1978Q4



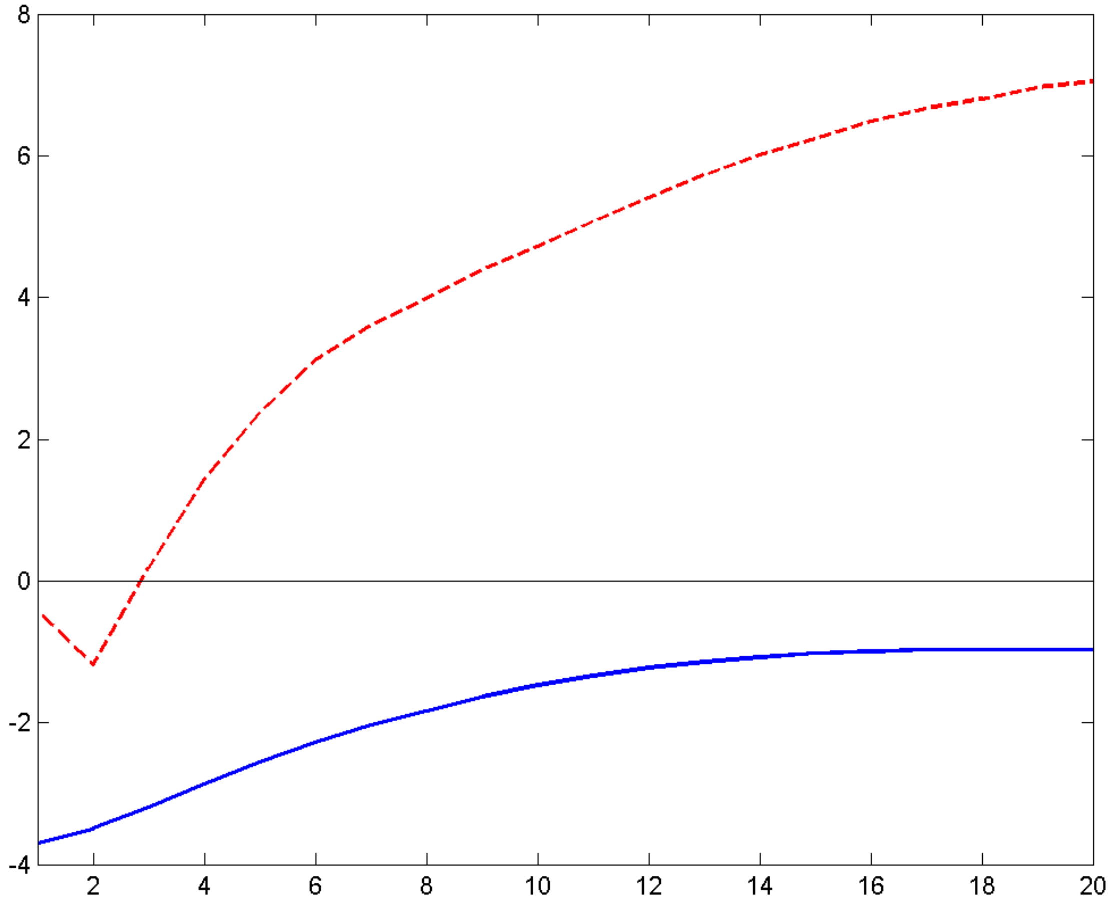
Fundamental: blue, solid Observed: red, dotted

Figure 5.c : Estimated Responses to Monetary Policy Shock: TVC-VAR
Observed vs. Fundamental Stock Price: 1984Q4-1987Q3



Fundamental: blue, solid Observed: red, dotted

Figure 5.d : Estimated Responses to Monetary Policy Shock: TVC-VAR
Observed vs. Fundamental Stock Price: 1997Q1-1999Q4



Fundamental: blue, solid   Observed: red, dotted

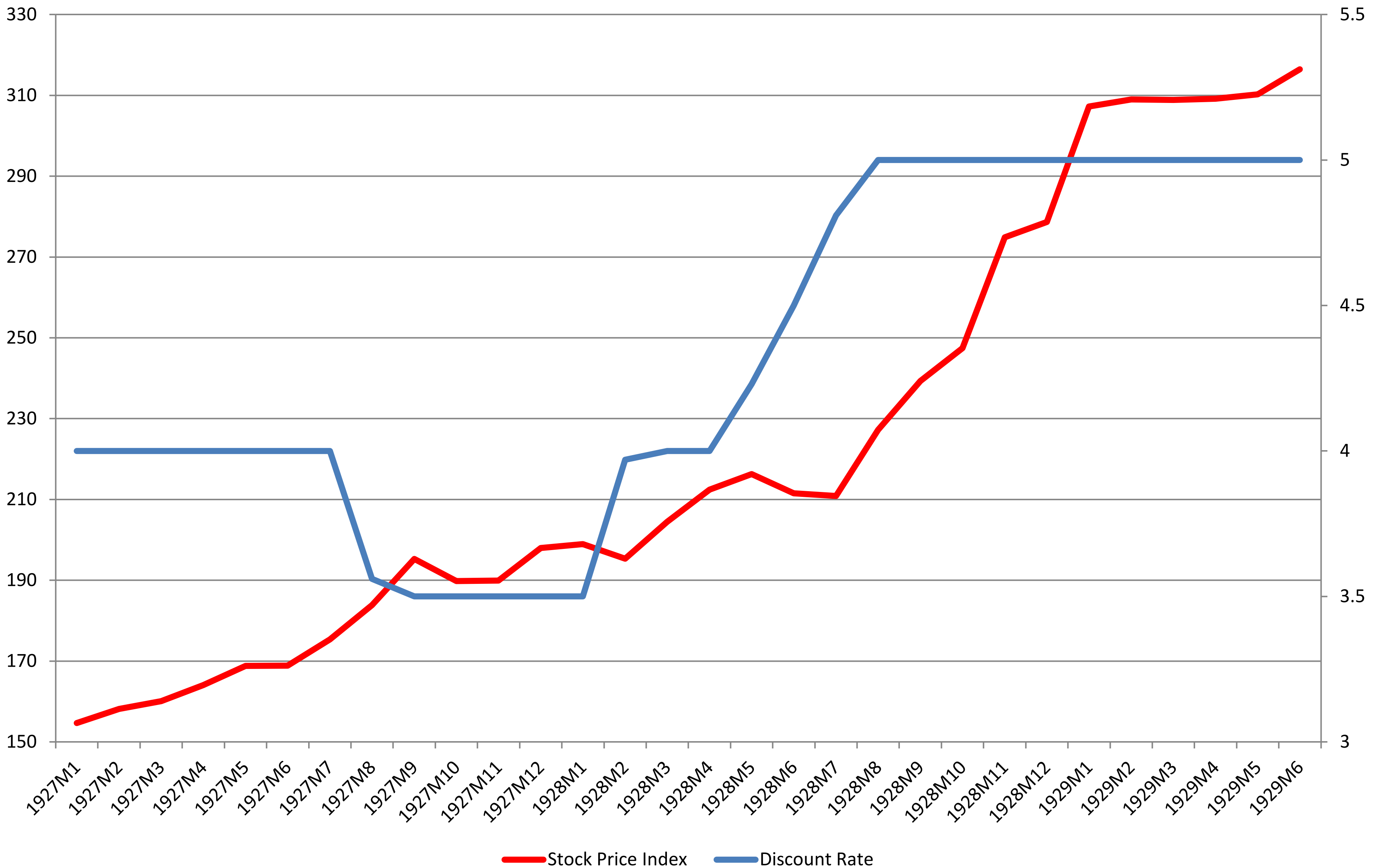
Concluding Remarks

- Maintained assumption in the case for "leaning against the wind" policies: higher interest rates reduce the size of asset price bubbles
- Theoretical foundations: at best, fragile.
- Empirical evidence:

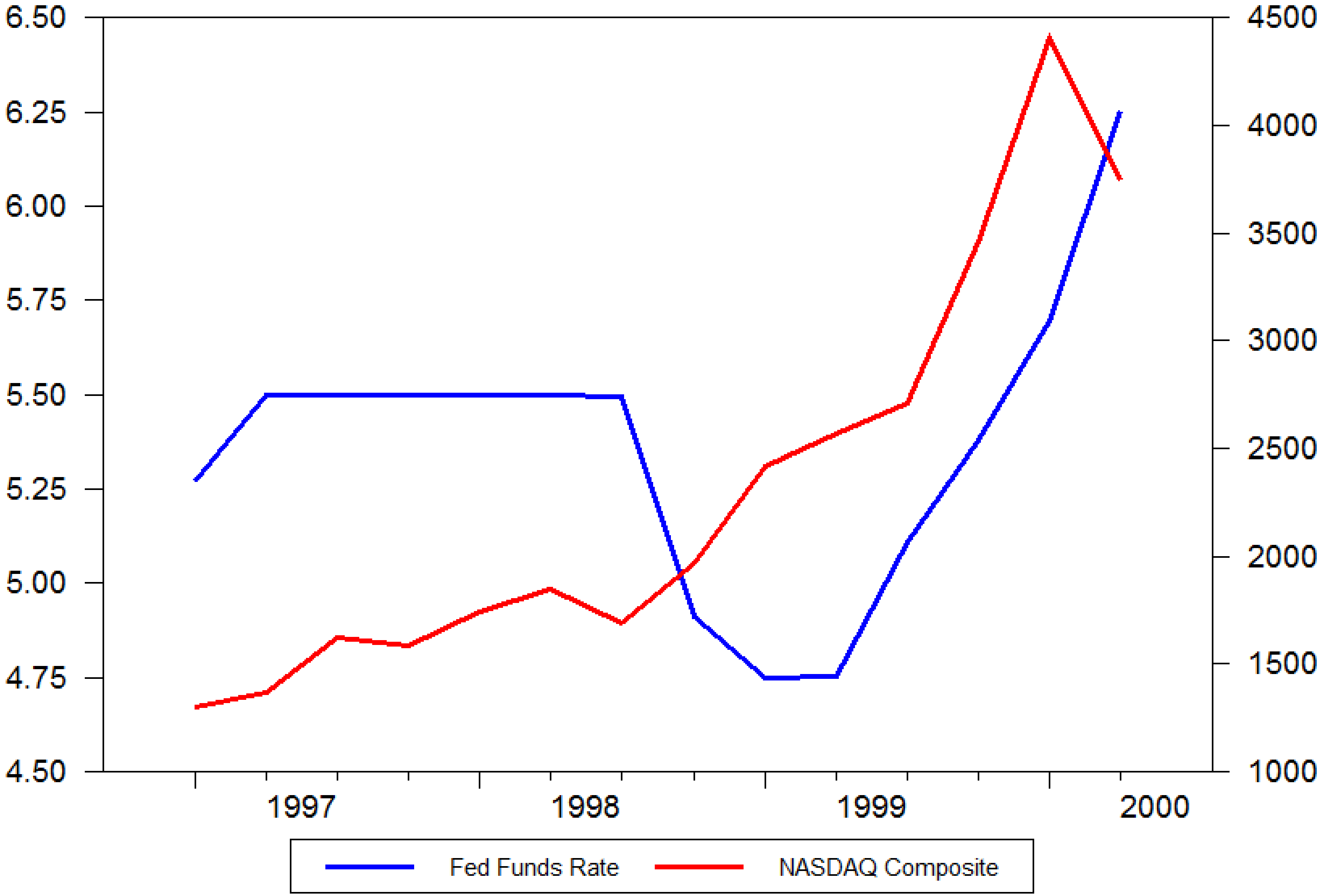
- no clear support for the conventional view
- consistent with the possibility of *destabilizing* "leaning against the wind" policies emphasized in Galí (2013)

- Need to understand better how monetary policy affects asset prices before such policies are adopted

Monetary Policy and the 1928-29 Stock Market Bubble



Monetary Policy and the Dotcom Bubble



Monetary Policy and the Housing Bubble