

Do Central Banks React to the Stock Market?

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Monetary Policy and Asset Prices (I)

- Hot debate among economists about the role of asset price in the conduct of monetary policy

- Among the – related – research questions:
 - Should central banks target asset prices to guarantee financial stability?
 - Should central banks take into account asset prices in a monetary policy reaction function?
 - Which role do asset prices play as leading indicators in the information set monetary policy makers use?
 - How do asset prices react to monetary policy actions?
 - Do central banks react to the stock market?

Monetary Policy and Asset Prices (II)

- General consensus among economists:
 - Behavior of stock prices have implications for things monetary policy are concerned with, i.e., price stability, financial stability, economic growth
 - Stock prices are leading indicators which help predict future behavior of inflation and economic growth to some extent → however, mixed empirical evidence
 - Asset prices should not be targets of monetary policy → no permanent active influence of monetary policy on asset markets → asset prices are no ultimate or intermediate goals
- Nevertheless, under debate: Should stock prices exert a special influence on the conduct of monetary policy? → What did central banks do in the past concerning stock price dynamics?

Monetary Policy and Asset Prices (III)

- Should monetary policy react to daily fluctuations of highly volatile stock prices?
 - Reasons of high volatility of stock prices not well-understood theoretically → quantitatively captured by GARCH type models → however, difficult to draw policy conclusions
 - Argument: daily fluctuations unlikely to have long lasting effects → no reaction
- But, central bankers should worry because:
 - Central banks viewed as guardians of financial system stability → expectation to react to news which might influence financial markets
 - Even one small event can trigger a financial crisis → probability of disastrous consequences for financial system stability → monitoring and reacting to high frequency data

Monetary Policy and Asset Prices (IV)

- Central banks can improve macroeconomic performance by reacting systematically to asset price misalignments above their reaction to expected inflation:
 - Stock price bubbles create distortions in investment and consumption
 - Excessive increases and subsequent reductions in wealth and output
- Avoiding macroeconomic consequences of bursting bubbles: Central banks seeking to smooth output and inflation fluctuations
- Recommendation: Setting interest rates with an eye on asset prices, in particular, on non-fundamental asset price developments

Monetary Policy and Asset Prices (V)

- More precisely, raising (lowering) interest rates modestly in case of non-fundamental asset price increases (declines) → leaning against the wind → reduce the probability of bubbles → contribution to overall macroeconomic stability
- Counter argument relying on possible implications of non-observability of stock price bubbles for monetary policy:
 - Available empirical findings detect stock price bubbles *ex post* but not *ex ante*
 - Start of bubble unknown → possible confusion about fundamental and non-fundamental stock price increases
 - Bubbles not identifiable → inadequate reaction to stock price increases possible

Monetary Policy and Asset Prices (VI)

- Most of the arguments above indicate:
 - Monetary policy should take into account stock market developments
 - Also of interest: Reaction of stock market to monetary policy impulses

- Importance of stock markets for monetary policy makers:
 - Increased visibility given to stock markets' role in the monetary transmission process
 - Stock markets are among the first stages of the transmission process
 - Transmission of monetary policy: Influence of short-term interest rates on asset prices → determination of borrowing costs → changes in wealth → impact on real economic activity → however, picture still incomplete

Monetary Policy and Asset Prices (VII)

- Hence, having reliable estimates of the reaction of asset prices to the monetary policy instrument is a critical step in formulating effective policy decisions
- In addition, quantitative information on responsiveness of asset prices to monetary policy important for financial market participants:
 - Conclusions on effective investment decisions
 - Formulation of appropriate risk management strategies
- Summary: Two dimensions of asset price-monetary policy relationship → reaction of asset prices to monetary policy and reaction of monetary to asset prices → endogeneity problem

Econometric Challenge (I)

- Question under investigation:
 - Reaction monetary policy due to changes in stock prices
 - Monetary policy actions captured by changes in short-term interest rates Δi_t
 - Developments in stock market via stock price changes Δp_t
 - Research question: $\Delta p_t \rightarrow \Delta i_t$

- Endogeneity of both variables:
 - Short-term interest rates influence asset prices and, simultaneously, vice versa
 - Classical solutions (imposing restrictions on parameters, using instrumental variable approach) cannot be used in present context

New Econometric Solution

- Simple idea:
 - Variance of stock market shocks is higher when larger proportion of news hitting asset markets
 - Shift in variance of stock market shocks relative to monetary policy shocks
 - Allows to measure reaction of monetary policy in terms of interest rate changes to asset prices
- New econometric technique: Identification through heteroskedasticity (Rigobon, *RES* 2003, Rigobon and Sack, *QJE* 2003, Rigobon and Sack, *JME* 2004)

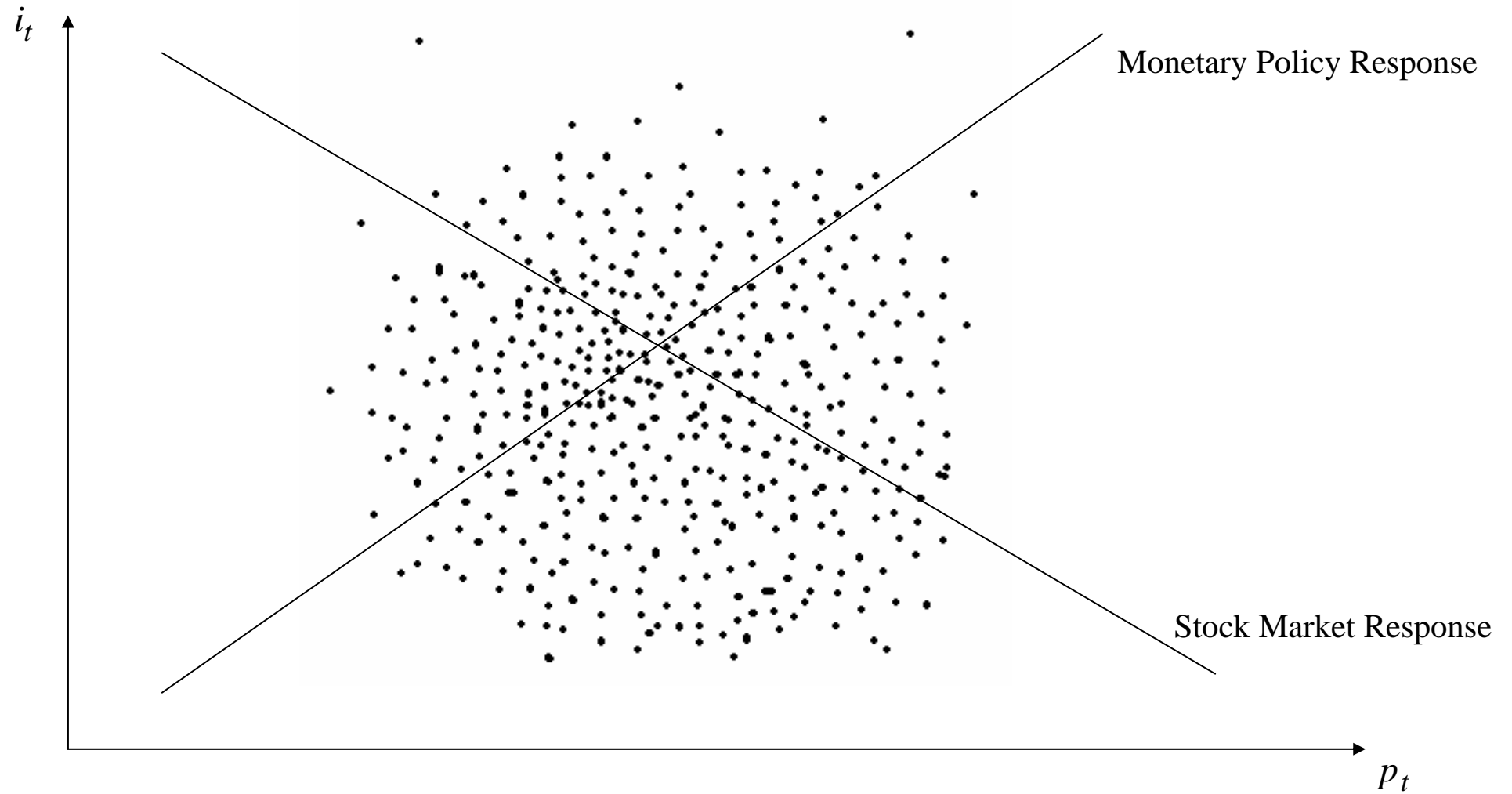
Joint Determination of Interest Rates and Stock Prices (I)

- Negative relationship between interest rate and stock prices:
 - Present value consideration: Current stock prices are discounted value of future stream of dividends or earnings
 - Consequence: Interest rate determines discount rate → higher (lower) discount rate decreases (increases) present value of stock prices → negative relationship
- At the same time, positive relationship between stock prices and interest rates:
 - Central bank may react to stock price developments via interest rate changes
 - Higher (lower) stock prices may induce a restrictive (expansionary) monetary policy and therefore higher (lower) interest rates

Joint Determination of Interest Rates and Stock Prices (II)

- Consequence of analysis above:
 - Stock market response function reflected in a downward sloping schedule and monetary policy reaction function in an upward sloping curve
 - Realizations of stock prices and interest rates cluster around the intersection of both schedules
- Implication of endogeneity for current problem: Monetary policy reaction function is not identifiable

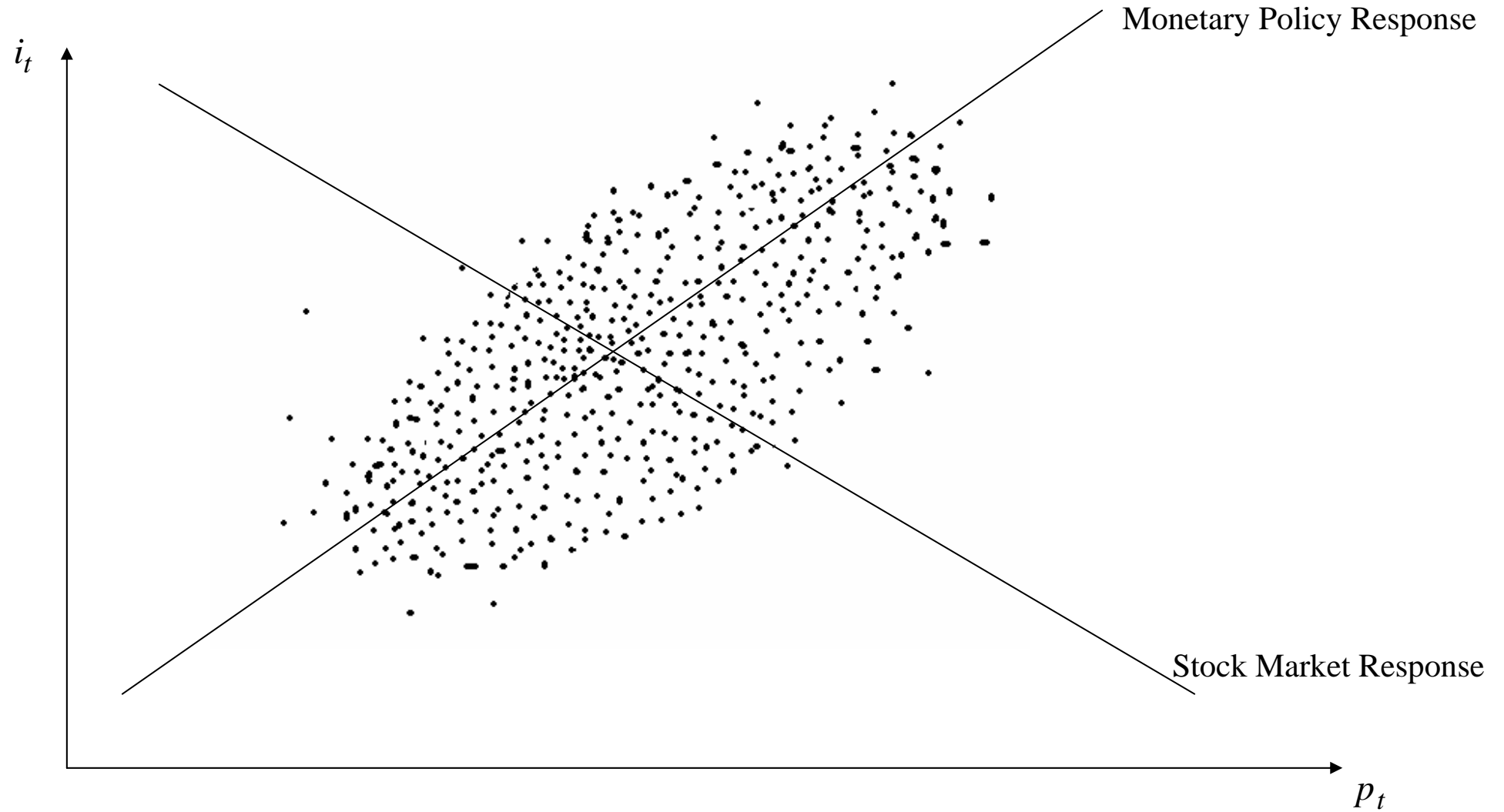
Joint Determination of Interest Rates and Stock Prices (III)



Identification through Heteroskedasticity: Graphical Solution

- Variance of stock market shocks increases and monetary policy shocks remain unchanged:
 - Events inducing higher variance of stock market shocks: stock market crashes with domestic and foreign origin, collapse of communism in Eastern Europe, German unification and accounting scandals
 - Homogeneity of monetary policy shocks: Assumption can be justified by absence of regime shifts in operating procedures and monetary policy strategy
- Increase in variance of stock market shocks → ellipse that enlarges around along monetary policy reaction function → identification of slope of policy reaction function → positive parameter expected

Periods of High Stock Market Volatility



Formal Presentation of the Problem

- System of two equations:

$$\Delta i_t = \beta \Delta p_t + \gamma z_t + \varepsilon_t \quad (1)$$

$$\Delta p_t = \alpha \Delta i_t + z_t + \eta_t \quad (2)$$

$\Delta i_t, \Delta p_t$: Change in short-term interest rate and stock price, respectively

z_t : Other variables influencing Δi_t and Δp_t

ε_t, η_t : Monetary policy shock, stock price shock, respectively

- Economic content of equation system:

→ (1): Monetary policy reaction function → parameter of interest → $\beta > 0$ expected

→ (2): Asset price equation → $\alpha < 0$ expected

Classical Solutions to the Identification Problem

- Imposing restrictions on equation (1) or (2):
 - Exclusion restriction $\beta = 0$: Parameter of interest → estimation of β needed
 - Exclusion restriction $\alpha = 0$: Direct estimation of (1) provides biased estimate of β
- Instrumental variable approach: Variable needed which is highly correlated with change in stock prices without affecting changes in interest rate and available on a daily basis → difficult
- Simultaneous equations problem (1) and (2) cannot be effectively addressed using classical methods → identification through heteroskedasticity technique explained above

Econometric Procedure

- System of equations with unknown parameters to be estimated
- Identification of different volatility regimes → number of volatility regimes bigger than number of unknown parameters → system becomes over-identified → GMM estimation possible

Empirical Findings for the US and Germany

- Empirical results of two studies:
 - Rigobon and Sack (*QJE* 2003) on the US
 - Bohl, Siklos and Werner (*JBF* 2007) on Germany
 - Comparability of empirical results: econometric methods, data sample, data frequency
 - Nevertheless, different central banks and different institutional settings in both countries

- Data and sample periods:
 - US: daily data from March 1985 to December 1999
 - Germany: daily time series covering the period 1 February 1985 to 30 December 1998

Institutional Background for Sample Selection for Germany

- Start of the sample period:
 - 1 February 1985
 - Deutsche Bundesbank changed operating procedure and relied primarily on repurchase agreements → short-term loans supplied to commercial banks at repo-rate
 - Repo-rate moved closely with call money rate → more precise control of call money rate than was previously possible relying on discount and Lombard credits

- End of the sample period:
 - 30 December 1998
 - Sample period before European Central Bank took responsibility for monetary policy

Empirical Findings for the US and Germany

- Estimates for the US:
 - $\beta \approx 0.02$
 - Estimated parameter positive and statistically significant
 - Positive reaction of US monetary policy to the stock market → increase (decrease) in stock returns induces increase (decrease) in short-term interest rate
- Estimates for Germany:
 - $\beta \approx 0.20$
 - Estimated parameter in majority of cases positive but statistically insignificant → Deutsche Bundesbank did not react to stock returns

Possible Explanations for the Discrepancy between US and German Findings (I)

- Differences in the institutional structure of both central banks:
 - Former Federal Reserve Chairman Alan Greenspan in December 1996: Irrational exuberance in stock prices → possibility of a stock market crash after a bubble period → effect on wealth of households and financial stability
 - Stock prices never played a substantial role in German monetary policy during 1985 – 1998 period → relatively small stock market in Germany
 - Different attitudes concerning the role of stock prices in the conduct of monetary policy

Possible Explanations for the Discrepancy between US and German Findings (II)

- Importance of 1987 stock market crash:
 - 19 October 1987: Stock market crash world-wide → about 20% reduction in major stock market indices
 - Reaction of central banks: Loosening monetary policy to provide liquidity
 - Sub-sample analysis indicate a shift in interest rate-stock return link around this time → potential for non-linear model

Summary and Conclusions

- Relatively little empirical evidence on the nature of the relationship between asset price dynamics and monetary policy actions
- Difficult question due to endogeneity between stock prices and interest rates → classical solutions do not work → econometric solution with identification through heteroskedasticity
- Empirical evidence:
 - For the USA: Federal Reserve reacted to stock price developments
 - For Germany: In general, no reaction of the Bundesbank to stock market developments
 - Different attitudes towards stock price movements in both countries