

# The growing impact of US monetary policy on emerging financial markets: Evidence from India

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# Motivation: Spillover Effect of US Monetary Policy

Increasing financial integration of emerging market countries into the global economy.

India:

- ▶ Considered especially vulnerable to international financial flows (“fragile five”)

United States:

- ▶ “Center” country of international monetary system
- ▶ Federal Reserve policy related to global financial cycle

## Existing Work

Large literature on spillover effects of US monetary policy: Focus has mostly been on

- ▶ unconventional monetary policy since the crisis
- ▶ shocks to level of interest rate (first moment shocks)

Recent evidence on importance of second moment shocks

- ▶ Rey (2015)
- ▶ Bruno & Shin (2015)
- ▶ Bhattari, Chatterjee & Park (2018)

# Contribution of This Paper

Estimate US monetary spillover effects on Indian equity markets

- ▶ Use an event-study approach with high-frequency data
- ▶ Use data going back to early 1990s combined with a time-varying parameter approach
- ▶ Study effect of both first moment (MP Surprise) and second moment (MP Uncertainty) shocks
- ▶ Shed light on transmission mechanism using other high-frequency financial variables and firm-level stock prices

## Preview of the Results

Effect of US MP shocks increasing over time

- ▶ MP Surprise shocks significant since early 2000s
- ▶ MP Uncertainty shocks significant since financial crisis

Announcements about Large Scale Asset Purchases (QE)

- ▶ Work largely through MP Uncertainty shocks

Mechanism:

- ▶ No industry level variation in stock price response to US monetary shocks
- ▶ Exchange rate and portfolio decisions of FII have become more sensitive to MP Surprise shocks

# Event-study Approach: FOMC Announcement Days

Measured in daily window around FOMC announcement days

- ▶  $\Delta S_t$ : Nifty 50 stock return
- ▶  $mps_t$  : US MP Surprise
- ▶  $mpu_t$ : US MP Uncertainty

$$\Delta S_t = \alpha + \beta mps_t + \gamma mpu_t + \varepsilon_t$$

Identifying assumption:

- ▶ In the FOMC window, no systematic economic factors driving Indian financial markets (other than FOMC announcement)

## US MP Surprise (first-moment shock)

Estimate surprise from changes in futures rates (Kuttner 2001)

- ▶  $X_t$ : changes in futures rates around FOMC announcement (we use Eurodollar futures 1-8 quarters ahead)
- ▶ Like Nakamura and Steinsson (2018) we use the first principal component of  $X_t$  as MP Surprise
- ▶ First PC explains around 85% of total variation of  $X_t$
- ▶ Scaled to have a 25 basis point increase in 1 year ahead rate

⇒ Captures changes in expected policy rate path

▶▶ Graph

## US MP Uncertainty (second-moment shock)

Following the approach of Bauer, Lakdawala & Mueller (2018)

- ▶ Can use Eurodollar options to construct risk-neutral conditional distribution of the expected future short rate
- ▶ Construct change in the standard-deviation of this distribution around FOMC announcements (based on expected rates at 1 year horizon)
- ▶ Cleansed of “level effect”, i.e. regress on MP Surprise and use residual as measure of MP Uncertainty [▶ Level Effect](#)
- ▶ Scaled to have unit standard deviation

⇒ Captures changes in uncertainty about expected policy rate path

[▶ MP Uncertainty Calculation Details](#)

[▶ Graph](#)



# Indian Financial Market Data

Aggregate Stock Index: Nifty 50

- ▶ 1991 to 2018

Firm-level stock prices: 500 firms in NSE 500

- ▶ 1995 to 2018

Stock returns calculated as daily change on day after FOMC meeting relative to day of FOMC meeting

Other financial market data:

- ▶ USD/INR Exchange Rate (1991 to 2018)
- ▶ 10 year Government bond yield (1999 to 2018)
- ▶ Net equity inflows of Foreign Institutional Investors (FIIs) (1999 to 2018)

# Summary Statistics

Jan 1991 to Jun 2018

|          | FOMC Days |         | Non-FOMC Days |         |
|----------|-----------|---------|---------------|---------|
|          | Mean      | Std Dev | Mean          | Std Dev |
| Nifty 50 | 0.33      | 1.69    | 0.03          | 1.69    |

Jan 1991 to Jan 2000

|          | FOMC Days |         | Non-FOMC Days |         |
|----------|-----------|---------|---------------|---------|
|          | Mean      | Std Dev | Mean          | Std Dev |
| Nifty 50 | 0.20      | 1.83    | 0.03          | 2.04    |

Feb 2000 to Jun 2018

|          | FOMC Days |         | Non-FOMC Days |         |
|----------|-----------|---------|---------------|---------|
|          | Mean      | Std Dev | Mean          | Std Dev |
| Nifty 50 | 0.39      | 1.61    | 0.03          | 1.48    |

►► Detailed Summary Statistics

## Baseline Results

|                     | Nifty 50          |
|---------------------|-------------------|
|                     | 1991 - 2018       |
| U.S. MP Surprise    | -0.870<br>[-1.39] |
| U.S. MP Uncertainty | 0.015<br>[0.12]   |
| Constant            | 0.347<br>[3.47]   |
| Observations        | 234               |
| R-squared           | 0.02              |

(t-statistics based on robust standard errors in parentheses)

# Baseline Results

|                     | Nifty 50        |                   |
|---------------------|-----------------|-------------------|
|                     | 1991 - 2000     | 2000 - 2018       |
| U.S. MP Surprise    | 0.525<br>[0.60] | -2.239<br>[-3.28] |
| U.S. MP Uncertainty | 0.183<br>[0.80] | -0.159<br>[-1.49] |
| Constant            | 0.208<br>[1.07] | 0.468<br>[4.40]   |
| Observations        | 85              | 149               |
| R-squared           | 0.02            | 0.14              |

(t-statistics based on robust standard errors in parentheses)

# Baseline Results

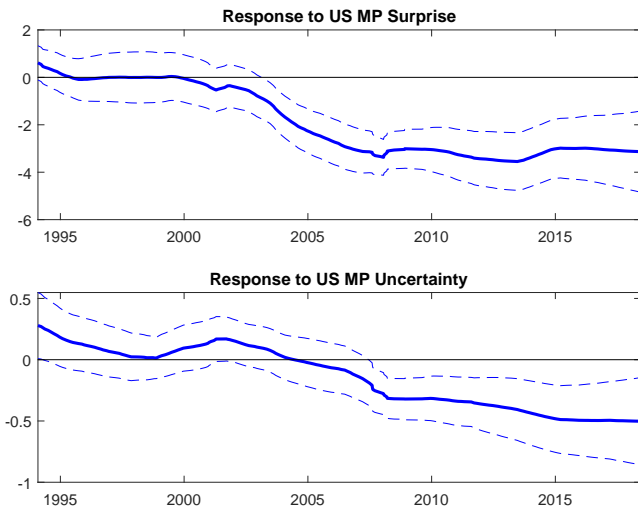
|                     | Nifty 50          |                   |
|---------------------|-------------------|-------------------|
|                     | 2000 to 2008      | 2009 - 2018       |
| U.S. MP Surprise    | -2.010<br>[-2.61] | -2.899<br>[-2.75] |
| U.S. MP Uncertainty | -0.015<br>[-0.10] | -0.265<br>[-2.35] |
| Constant            | 0.721<br>[4.65]   | 0.215<br>[1.66]   |
| Observations        | 77                | 72                |
| R-squared           | 0.14              | 0.16              |

(t-statistics based on robust standard errors in parentheses)

▶▶ Robustness Checks

# Time-Varying Responses of Nifty 50

## Kalman Filter Estimates



» Details of Time-Varying Parameter Specification

## QE Announcement Days

| FOMC Meeting | Program | Nifty 50 | MP Surprise | Raw MP Uncertainty |
|--------------|---------|----------|-------------|--------------------|
| 11/25/2008   | QE1     | 3.57     | -0.16       | -0.12              |
| 12/1/2008    | QE1     | -0.94    | -0.10       | -0.02              |
| 12/16/2008   | QE1     | -2.96    | -0.19       | -0.17              |
| 1/28/2009    | QE1     | -0.90    | 0.02        | -0.02              |
| 3/18/2009    | QE1     | 0.44     | -0.20       | -0.10              |
| 8/12/2009    | QE1     | 3.20     | -0.06       | -0.04              |
| 9/23/2009    | QE1     | 0.33     | -0.05       | -0.05              |
| 11/4/2009    | QE1     | 1.15     | -0.01       | -0.03              |
| 8/10/2010    | QE1     | -0.74    | -0.01       | -0.03              |
| 9/21/2010    | QE2     | -0.30    | -0.05       | -0.05              |
| 11/3/2010    | QE2     | 1.93     | 0.00        | -0.03              |
| 6/22/2011    | QE2     | 0.78     | 0.00        | -0.01              |
| 9/21/2011    | MEP     | -4.26    | 0.03        | 0.02               |
| 6/20/2012    | MEP     | 0.86     | 0.01        | 0.00               |
| 9/13/2012    | QE3     | 2.55     | -0.01       | -0.01              |
| 12/12/2012   | QE3     | -0.62    | 0.01        | 0.00               |
| 6/19/2013    | Taper   | -2.94    | 0.06        | 0.00               |

# Transmission of QE Announcements

|                                  | 2000 - 2018      |
|----------------------------------|------------------|
|                                  | Nifty 50         |
| US MP Surprise                   | -2.97<br>[-3.75] |
| US MP Uncertainty                | -0.42<br>[-2.02] |
| QE Dummy                         | -0.59<br>[-1.19] |
| MP Surprise $\times$ QE Dummy    | 3.43<br>[2.05]   |
| MP Uncertainty $\times$ QE Dummy | -1.05<br>[-2.03] |
| Constant                         | 0.54<br>[4.41]   |
| Observations                     | 157              |
| R-squared                        | 0.24             |

(t-statistics based on robust standard errors in parentheses)



# Understanding the Transmission Mechanism

Various channels of international monetary spillover

- ▶ Financial Flows, Trade, Exchange Rate
- ▶ Portfolio Balance, Information, Uncertainty

# Understanding the Transmission Mechanism

Various channels of international monetary spillover

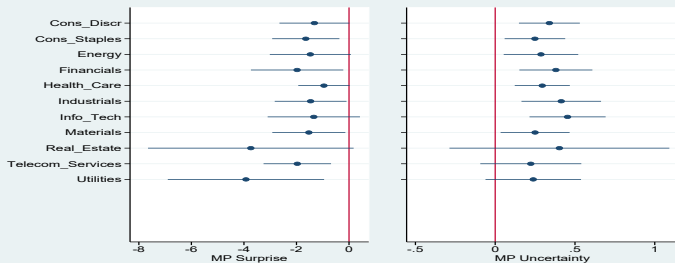
- ▶ Financial Flows, Trade, Exchange Rate
- ▶ Portfolio Balance, Information, Uncertainty

Approach with high-frequency data

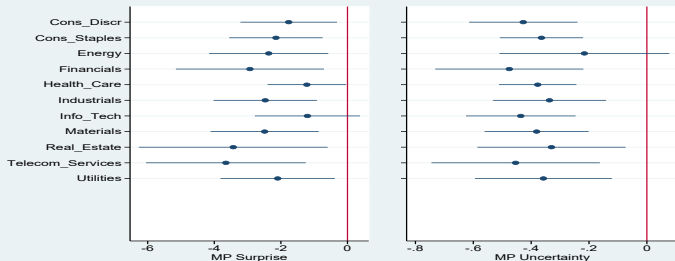
1. Use industry-level stock prices
  - ▶ Investigate if certain sectors have become more/less responsive
2. Use other financial market data to understand transmission
  - ▶ USD/INR Exchange rate
  - ▶ Indian Government Bond Yields (10 year)
  - ▶ Net equity flows of Foreign Institutional Investors (FIIs)

# Industry-Level Regressions

## 1999 to 2008



## 2009 to 2018



# Role of Exchange Rate, FII flows and Bond yields

Baseline Result: US MP shocks  $\Rightarrow$  Indian Stock prices

- ▶ Does this effect work through the financial variables?

Two part approach:

1. Establish that US MP shocks drive these financial variables
2. Extended regressions: Control for these financial variables in baseline specification

Compare coefficients from extended regressions to baseline

# Role of Exchange Rate, FII flows and Bond yields

## Correlation with Stock Market Return

|                         | 1999 to 2008 |         |               |         |
|-------------------------|--------------|---------|---------------|---------|
|                         | FOMC Days    |         | Non-FOMC Days |         |
|                         | Coef         | p-value | Coef          | p-value |
| Corr(USD/INR, Nifty 50) | -0.182       | 0.10    | -0.292        | 0.00    |
| Corr(10yr, Nifty 50)    | -0.289       | 0.01    | -0.077        | 0.00    |
| Corr(FII, Nifty 50)     | 0.022        | 0.84    | 0.282         | 0.00    |

# Role of Exchange Rate, FII flows and Bond yields

## Correlation with Stock Market Return

|                         | 1999 to 2008 |         |               |         |
|-------------------------|--------------|---------|---------------|---------|
|                         | FOMC Days    |         | Non-FOMC Days |         |
|                         | Coef         | p-value | Coef          | p-value |
| Corr(USD/INR, Nifty 50) | -0.182       | 0.10    | -0.292        | 0.00    |
| Corr(10yr, Nifty 50)    | -0.289       | 0.01    | -0.077        | 0.00    |
| Corr(FII, Nifty 50)     | 0.022        | 0.84    | 0.282         | 0.00    |

|                         | 2009 to 2018 |         |               |         |
|-------------------------|--------------|---------|---------------|---------|
|                         | FOMC Days    |         | Non-FOMC Days |         |
|                         | Coef         | p-value | Coef          | p-value |
| Corr(USD/INR, Nifty 50) | -0.709       | 0.00    | -0.450        | 0.00    |
| Corr(10yr, Nifty 50)    | -0.329       | 0.00    | -0.077        | 0.00    |
| Corr(FII, Nifty 50)     | 0.486        | 0.00    | 0.246         | 0.00    |

# US MP Surprise shocks drive Financial Variables

|                     | INR/USD           |                   | 10 year bond      |                   | Net FII         |                   |
|---------------------|-------------------|-------------------|-------------------|-------------------|-----------------|-------------------|
|                     | 1999 - 2008       | 2009 - 2018       | 1999 - 2008       | 2009 - 2018       | 1999 - 2008     | 2009 - 2018       |
| U.S. MP Surprise    | 0.059<br>[0.96]   | 1.356<br>[4.03]   | 0.083<br>[3.49]   | 0.145<br>[3.49]   | 1.468<br>[1.41] | -6.362<br>[-3.49] |
| U.S. MP Uncertainty | 0.026<br>[1.35]   | -0.011<br>[-0.25] | 0.009<br>[1.30]   | -0.001<br>[-0.33] | 0.069<br>[0.43] | -0.249<br>[-0.67] |
| Constant            | -0.019<br>[-1.52] | -0.044<br>[-0.99] | -0.015<br>[-1.69] | -0.008<br>[-1.59] | 0.188<br>[0.79] | 1.122<br>[3.72]   |
| Observations        | 81                | 72                | 81                | 72                | 81              | 72                |
| R-squared           | 0.07              | 0.21              | 0.08              | 0.16              | 0.03            | 0.11              |

# Role of Exchange Rate, FII flows and Bond yields

|                       | Nifty 50    |         |             |         |
|-----------------------|-------------|---------|-------------|---------|
|                       | 1999 - 2008 |         | 2009 - 2018 |         |
| U.S. MP Surprise      | -1.880      | -1.478  | -2.899      | 0.238   |
|                       | [-2.47]     | [-2.07] | [-2.75]     | [0.29]  |
| U.S. MP Uncertainty   | 0.034       | 0.122   | -0.265      | -0.260  |
|                       | [0.22]      | [0.81]  | [-2.35]     | [-4.18] |
| INR/USD Exchange Rate |             | -2.102  |             | -1.968  |
|                       |             | [-1.41] |             | [-6.43] |
| 10 year bond          |             | -4.380  |             | 1.329   |
|                       |             | [-2.91] |             | [0.65]  |
| Net FII flows         |             | 0.059   |             | 0.104   |
|                       |             | [0.79]  |             | [3.81]  |
| Constant              | 0.745       | 0.627   | 0.215       | 0.022   |
|                       | [4.72]      | [3.91]  | [1.66]      | [0.22]  |
| Observations          | 81          | 81      | 72          | 72      |
| R-squared             | 0.12        | 0.20    | 0.16        | 0.61    |

► One at a time results



# Conclusion

Effect of US MP shocks on Indian equity markets:

US MP Surprise Shocks:

- ▶ Important since early 2000s
- ▶ Increasing effects driven through exchange rate and FII portfolio flows

US MP Uncertainty Shocks:

- ▶ Important since the financial crisis
- ▶ Capture important component of QE transmission to Indian markets

# Conclusion

Effect of US MP shocks on Indian equity markets:

US MP Surprise Shocks:

- ▶ Important since early 2000s
- ▶ Increasing effects driven through exchange rate and FII portfolio flows

US MP Uncertainty Shocks:

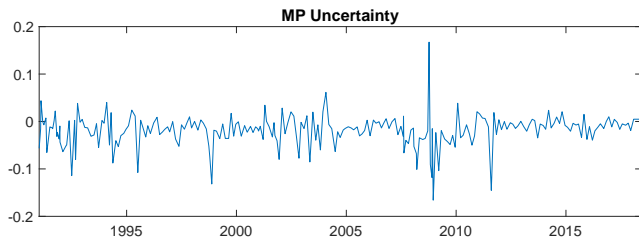
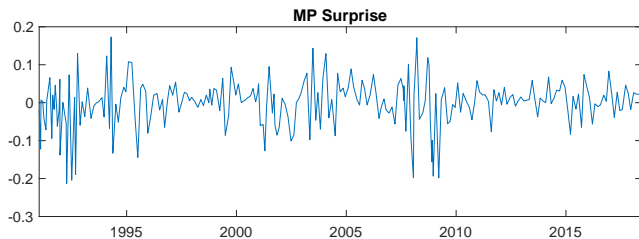
- ▶ Important since the financial crisis
- ▶ Capture important component of QE transmission to Indian markets

Future Work:

- ▶ Extend analysis to macroeconomic variables
- ▶ Use more detailed firm-level data to identify relevant characteristics



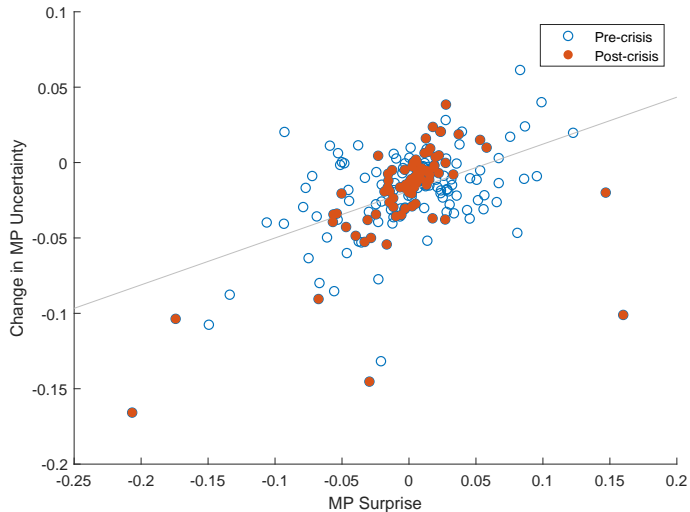
# US MP Shocks



◀ MP Surprise

◀ MP Uncertainty

## Some correlation between $\Delta MPU$ and $MPS$



## How we estimate *MPU*

- ▶ Eurodollar futures
  - ▶ Most-traded interest rate derivative in the world
  - ▶ Underlying is three-month LIBOR,  $L_t$
  - ▶ Quarterly expirations out to  $> 4$  years
- ▶ Options on Eurodollar futures
  - ▶ Essentially options on future LIBOR
  - ▶ Many puts and calls for each trading date and expiration
  - ▶ Sufficiently long history: our sample starts in 1994
- ▶ Calculate **risk-neutral conditional volatility** of future short rates based on Eurodollar option prices...



## How we estimate *MPU*

Risk-neutral conditional volatility of future short rates:

1. Interpolate prices of options with **fixed horizon**  $\tau$ , for example one year (like Wright, 2017)
2. Calculate **model-free implied volatility**  $\sigma_\tau$  from the prices of puts and calls
  - ▶ No assumption of (log-)normality
  - ▶ Britten-Jones and Neuberger (2000), Jiang and Tian (2005)
  - ▶ Similar to VIX, but here underlying is interest rate
3. Conditional volatility of future short rate is

$$MPU_{t,\tau} = F_t \sigma_\tau \sqrt{\tau}$$

(because implied volatility is for annualized asset return)



# Caveats

## LIBOR $\neq$ federal funds rate

- ▶ LIBOR-OIS spread typically small and stable, so
$$\text{Var}_t(\text{FFR}_{t+\tau}) \approx \text{Var}_t(\text{LIBOR}_{t+\tau})$$
- ▶ But spread shot up during the crisis, and somewhat elevated (though stable) more recently
- ▶ Solution: subsamples (and handwaving)

## Risk-neutral $\neq$ real-world distribution

- ▶ Option-implied distributions contain risk adjustment
- ▶ We measure: amount of volatility  $\times$  price of volatility
- ▶ Keep in mind when interpreting results





Sample: Jan 1991 to Jun 2018 (Feb 1995 to Jun 2018 for NSE 500)

|                     | FOMC Days |         |       |      | Non-FOMC Days |         |        |       |
|---------------------|-----------|---------|-------|------|---------------|---------|--------|-------|
|                     | Mean      | Std Dev | Min   | Max  | Mean          | Std Dev | Min    | Max   |
| Nifty 50            | 0.33      | 1.69    | -7.13 | 6.53 | 0.03          | 1.69    | -13.94 | 15.07 |
| NSE 500             | 0.36      | 1.50    | -7.43 | 6.40 | 0.03          | 1.52    | -13.75 | 13.96 |
| U.S. MP Surprise    | 0.00      | 0.25    | -0.85 | 0.69 |               |         | N/A    |       |
| U.S. MP Uncertainty | 0.00      | 1.00    | -4.27 | 5.49 |               |         | N/A    |       |

Sample: Jan 1991 to Jan 2000 (Feb 1995 to Jan 2000 for NSE 500)

|                     | FOMC Days |         |       |      | Non-FOMC Days |         |        |       |
|---------------------|-----------|---------|-------|------|---------------|---------|--------|-------|
|                     | Mean      | Std Dev | Min   | Max  | Mean          | Std Dev | Min    | Max   |
| Nifty 50            | 0.20      | 1.83    | -5.22 | 5.34 | 0.03          | 2.04    | -13.34 | 11.38 |
| NSE 500             | 0.41      | 1.27    | -2.29 | 3.93 | 0.04          | 1.60    | -7.63  | 7.06  |
| U.S. MP Surprise    | -0.02     | 0.27    | -0.85 | 0.69 |               |         | N/A    |       |
| U.S. MP Uncertainty | 0.00      | 1.00    | -4.19 | 2.33 |               |         | N/A    |       |

Sample: Feb 2000 to Jun 2018

|                     | FOMC Days |         |       |      | Non-FOMC Days |         |        |       |
|---------------------|-----------|---------|-------|------|---------------|---------|--------|-------|
|                     | Mean      | Std Dev | Min   | Max  | Mean          | Std Dev | Min    | Max   |
| Nifty 50            | 0.39      | 1.61    | -7.13 | 6.53 | 0.03          | 1.48    | -13.94 | 15.07 |
| NSE 500             | 0.35      | 1.55    | -7.43 | 6.40 | 0.02          | 1.50    | -13.75 | 13.96 |
| U.S. MP Surprise    | 0.01      | 0.23    | -0.79 | 0.68 |               |         | N/A    |       |
| U.S. MP Uncertainty | 0.00      | 1.00    | -4.04 | 5.22 |               |         | N/A    |       |



|                     | Nifty 50               |                   |                            |                   |                            |                   |
|---------------------|------------------------|-------------------|----------------------------|-------------------|----------------------------|-------------------|
|                     | Incl. Financial Crisis |                   | Excl. Unscheduled Meetings |                   | Alt. Futures Data (1 year) |                   |
|                     | 2000 to 2008           | 2009 - 2018       | 2000 to 2008               | 2009 - 2018       | 2000 to 2008               | 2009 - 2018       |
| U.S. MP Surprise    | -2.075<br>[-1.97]      | -2.119<br>[-2.37] | -1.314<br>[-1.74]          | -3.185<br>[-2.76] | -2.353<br>[-3.13]          | -3.969<br>[-2.71] |
| U.S. MP Uncertainty | -0.311<br>[-0.75]      | -0.239<br>[-2.18] | 0.013<br>[0.10]            | -0.265<br>[-2.37] | -0.042<br>[-0.27]          | -0.287<br>[-2.84] |
| Constant            | 0.616<br>[3.23]        | 0.211<br>[1.51]   | 0.521<br>[3.53]            | 0.167<br>[1.33]   | 0.714<br>[4.80]            | 0.287<br>[2.14]   |
| Observations        | 82                     | 76                | 68                         | 72                | 77                         | 72                |
| R-squared           | 0.13                   | 0.11              | 0.05                       | 0.16              | 0.19                       | 0.17              |



# Time-Varying Parameter Specification

$$\Delta S_t = \alpha + \beta_t mps_t + \gamma_t mpu_t + u_t$$

$$\beta_t = \beta_{t-1} + \varepsilon_{\beta,t}$$

$$\gamma_t = \gamma_{t-1} + \varepsilon_{\gamma,t}$$

$$u_t \sim N(0, R)$$

$$\varepsilon_{\beta,t} \sim N(0, Q_\beta)$$

$$\varepsilon_{\gamma,t} \sim N(0, Q_\gamma)$$

- ▶ Use Kalman Filter to evaluate likelihood
- ▶ MLE estimation of parameters



# Summary Statistics

Sample: Aug 1999 to Jun 2018

|            | FOMC Days |         |       |       | Non-FOMC Days |         |       |       |
|------------|-----------|---------|-------|-------|---------------|---------|-------|-------|
|            | Mean      | Std Dev | Min   | Max   | Mean          | Std Dev | Min   | Max   |
| INR/USD    | -0.01     | 0.29    | -1.61 | 1.24  | 0.00          | 0.21    | -2.21 | 2.62  |
| 10 yr bond | -0.01     | 0.07    | -0.48 | 0.21  | 0.00          | 0.06    | -0.77 | 0.80  |
| Net Fil    | 0.55      | 2.44    | -8.62 | 15.58 | 0.38          | 1.63    | -8.53 | 26.00 |

Sample: Aug 1999 to Dec 2008

|            | FOMC Days |         |       |       | Non-FOMC Days |         |       |      |
|------------|-----------|---------|-------|-------|---------------|---------|-------|------|
|            | Mean      | Std Dev | Min   | Max   | Mean          | Std Dev | Min   | Max  |
| INR/USD    | -0.02     | 0.12    | -0.55 | 0.34  | 0.00          | 0.13    | -1.02 | 1.17 |
| 10 yr bond | -0.01     | 0.08    | -0.48 | 0.21  | 0.00          | 0.06    | -0.43 | 0.35 |
| Net Fil    | 0.21      | 2.19    | -8.62 | 14.32 | 0.19          | 1.17    | -8.08 | 9.82 |

Sample: Jul 2009 to Jun 2018

|            | FOMC Days |         |       |       | Non-FOMC Days |         |       |       |
|------------|-----------|---------|-------|-------|---------------|---------|-------|-------|
|            | Mean      | Std Dev | Min   | Max   | Mean          | Std Dev | Min   | Max   |
| INR/USD    | -0.01     | 0.40    | -1.61 | 1.24  | 0.00          | 0.27    | -2.21 | 2.62  |
| 10 yr bond | 0.00      | 0.05    | -0.18 | 0.18  | 0.00          | 0.05    | -0.51 | 0.54  |
| Net Fil    | 0.94      | 2.66    | -4.75 | 15.58 | 0.58          | 1.99    | -8.53 | 26.00 |



# Correlation with Stock Market Return

1999 to 2008

|                         | FOMC Days |         | Non-FOMC Days |         |
|-------------------------|-----------|---------|---------------|---------|
|                         | Coef      | p-value | Coef          | p-value |
| Corr(USD/INR, Nifty 50) | -0.182    | 0.10    | -0.292        | 0.00    |
| Corr(10yr, Nifty 50)    | -0.289    | 0.01    | -0.077        | 0.00    |
| Corr(FII, Nifty 50)     | 0.022     | 0.84    | 0.282         | 0.00    |
| Corr(USD/INR,10yr)      | -0.057    | 0.61    | 0.029         | 0.17    |
| Corr(USD/INR,FII)       | -0.137    | 0.22    | -0.230        | 0.00    |
| Corr(10yr,FII)          | 0.167     | 0.14    | 0.042         | 0.05    |

2009 to 2018

|                         | FOMC Days |         | Non-FOMC Days |         |
|-------------------------|-----------|---------|---------------|---------|
|                         | Coef      | p-value | Coef          | p-value |
| Corr(USD/INR, Nifty 50) | -0.709    | 0.00    | -0.450        | 0.00    |
| Corr(10yr, Nifty 50)    | -0.329    | 0.00    | -0.077        | 0.00    |
| Corr(FII, Nifty 50)     | 0.486     | 0.00    | 0.246         | 0.00    |
| Corr(USD/INR,10yr)      | 0.533     | 0.00    | 0.104         | 0.00    |
| Corr(USD/INR,FII)       | -0.370    | 0.00    | -0.195        | 0.00    |
| Corr(10yr,FII)          | -0.189    | 0.11    | 0.024         | 0.27    |



| Nifty 50              |                   |                   |                   |                   |
|-----------------------|-------------------|-------------------|-------------------|-------------------|
| 1999 - 2008           |                   |                   |                   |                   |
| U.S. Monetary Shock   | -1.880<br>[-2.47] | -1.767<br>[-2.23] | -1.562<br>[-2.21] | -1.965<br>[-2.61] |
| U.S. MP Uncertainty   | 0.034<br>[0.22]   | 0.083<br>[0.57]   | 0.066<br>[0.42]   | 0.030<br>[0.19]   |
| INR/USD Exchange Rate |                   | -1.911<br>[-1.16] |                   |                   |
| 10 year bond          |                   |                   | -3.828<br>[-2.59] |                   |
| Net FII flows         |                   |                   |                   | 0.058<br>[0.78]   |
| Constant              | 0.745<br>[4.72]   | 0.708<br>[4.35]   | 0.687<br>[4.43]   | 0.734<br>[4.56]   |
| Observations          | 81                | 81                | 81                | 81                |
| R-squared             | 0.12              | 0.14              | 0.16              | 0.12              |



|                       | Nifty 50          |                   |                   |                   |
|-----------------------|-------------------|-------------------|-------------------|-------------------|
|                       | 2009 - 2018       |                   |                   |                   |
| U.S. Monetary Shock   | -2.899<br>[-2.75] | -0.061<br>[-0.08] | -2.067<br>[-1.89] | -1.772<br>[-1.99] |
| U.S. MP Uncertainty   | -0.265<br>[-2.35] | -0.289<br>[-5.01] | -0.274<br>[-2.52] | -0.221<br>[-2.47] |
| INR/USD Exchange Rate |                   | -2.093<br>[-7.78] |                   |                   |
| 10 year bond          |                   |                   | -5.723<br>[-1.72] |                   |
| Net FII flows         |                   |                   |                   | 0.177<br>[3.30]   |
| Constant              | 0.215<br>[1.66]   | 0.122<br>[1.22]   | 0.167<br>[1.34]   | 0.016<br>[0.12]   |
| Observations          | 72                | 72                | 72                | 72                |
| R-squared             | 0.16              | 0.56              | 0.21              | 0.31              |

