

ADR pricing under market segmentation: An exploration

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Background on Indian DRs and ADRs

- ▶ Indian firms have been a significant part of the GDR and ADR market
- ▶ In the early 1990s: a way around the malfunctioning domestic stock market
- ▶ From the late 1990s onwards: significant liquidity with ADRs.

Law of one price deviations?

The ADR is identical to the local share, except for:

- ▶ Capital controls
- ▶ Bid-offer spreads and other costs incurred in transacting – exacerbated by timezone effects

Arbitrage when the ADR is cheap

1. Buy the ADR
2. Convert it into Indian shares
3. Sell them in India and profit
4. (Only registered FII's can do this)
5. For the rest, this works quite well.

Arbitrage when the ADR is costly

1. Buy Indian shares
2. Convert them into ADRs
3. Sell them in the US and profit

Old capital control: This is forbidden.

New capital control (post-2002) : Can only be done within the size of the original ADR issue.

When this constraint binds, the two markets are decoupled.

Interpreting pricing differences

Analogy: spot and futures.

- ▶ If arbitrage works perfectly, there is nothing interesting in the futures price.
- ▶ When arbitrage is imperfect, $F - S$ might convey something interesting.
- ▶ Useful to ask: What causes fluctuations in $F - S$, and what are its consequences?

Dataset

Top 5 ADRs from three countries:

Cemex

America Movil

Telefonos de Mexico

Fomento Economico Mexicano

Homex Development Corp.

Companhia Vale

Petroleo Brasileiro

Banco Bradesco S.A

Banco Itau Holding Financeira S.A.

Gerdau S.A.

Satyam

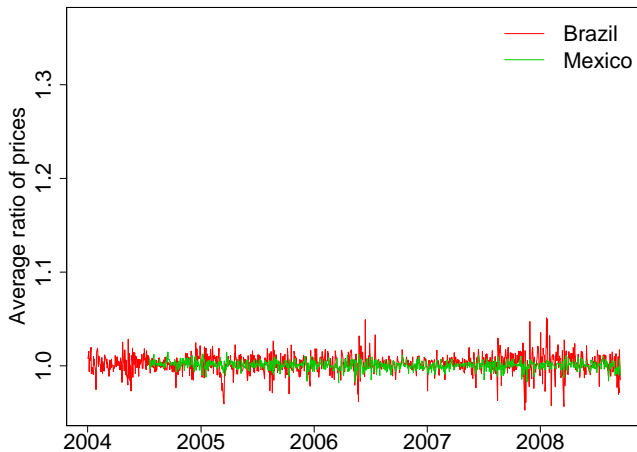
Infosys

Dr. Reddy

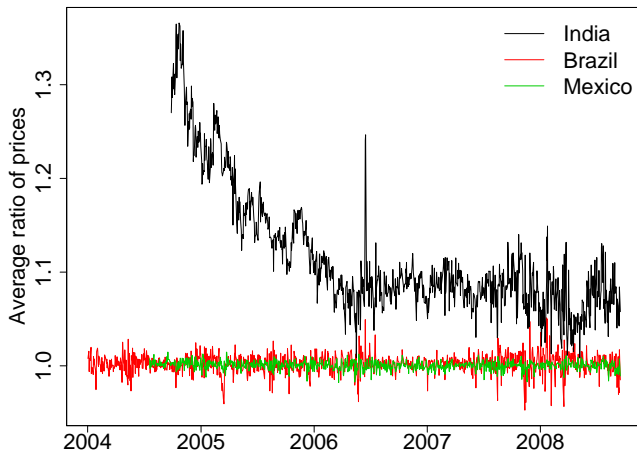
Tata Motors

Wipro

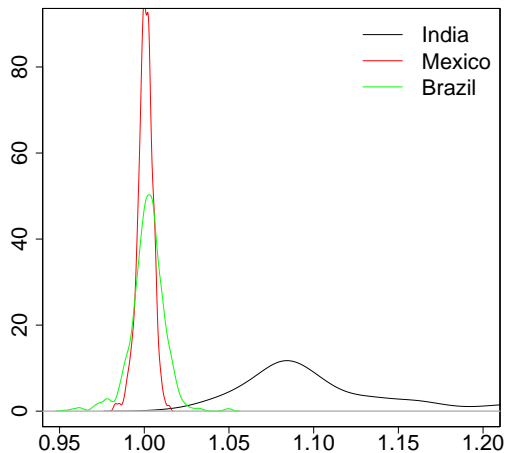
Average ADR premia by country



Average ADR premia by country



Density of country-average premium time-series



The extraordinary premia on Indian ADRs

	IN	BR	MX
%<1	0.0000	37.5000	43.0000
Mean	1.1170	1.0020	1.0010
Median	1.0940	1.0020	1.0010
Q3-Q1	0.0640	0.0108	0.0049
Skew	1.4321	-0.3961	-0.4402

- ▶ If transactions costs were the problem, this would hinder arbitrage when premium < 1 also.
- ▶ The market seems to be doing fine on arbitraging away those errors.
- ▶ So we cannot ascribe substantial explanatory power to bid-offer spreads, timezone effects, etc.

The question

- ▶ A few other researchers have noticed these unusual premia on Indian ADRs also.
- ▶ The question: What are the causes and consequences of premium fluctuation?

Disentangling what is at work

- ▶ Microeconomic factors can affect one ADR at a time
- ▶ Liquidity premia, differences in liquidity do matter.
- ▶ By taking the average of the top n highly liquid ADRs, we shift to a macroeconomic perspective
- ▶ These are extremely liquid, in NY and at home
- ▶ Averaging across individual stocks focuses on *country* characteristics.

Part I

Analysis of average ADR premium as a macroeconomic time-series

A story

- ▶ ADR gives convenient local market access
- ▶ When investor perception about India in the US improves/worsens, this shows up first as buying/selling pressure on the ADR
- ▶ It would also show up as money going into emerging market funds or India funds in the US
- ▶ With a lag, this would show up as enhanced purchases of shares by foreigners (“FIIs”) in India
- ▶ If this is true, innovations in the ADR premium should predict enhanced FII equity purchases

Vector autoregression analysis

A VAR involving:

1. Indian Nifty index returns
2. US S&P 500 index returns
3. Average ADR premium
4. INR/USD exchange rate returns
5. Net FII purchase of equity (rescaled by trading volume of Indian equity spot market).

What does the impulse response function say?

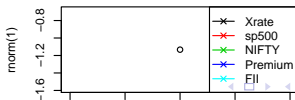
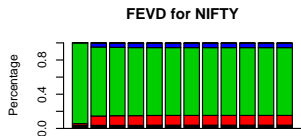
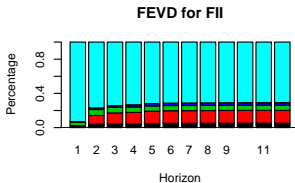
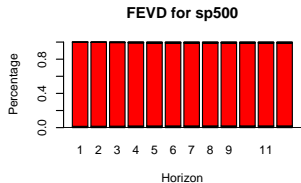
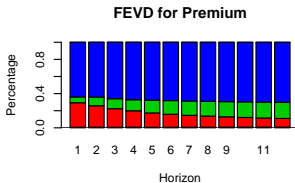
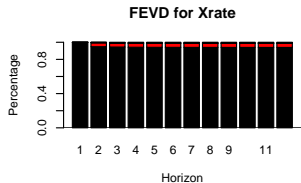
	INR/USD	S&P 500	Nifty	ADR Premium	Net FII
Impact of:					
INR/USD		-	-	-	-
S&P 500	-		+	+	+
Nifty				-	+
Premium			+		+
Net FII					

A robust set of results

- ▶ Did a 4-variable VAR (dropped net foreign purchase)
- ▶ Mean ADR Premium might be $I(1)$, replaced by first differences
- ▶ Changed ordering of the variables
- ▶ Repeated with subsamples
- ▶ Switched from top-5 Indian ADRs to all 11

Basic results hold.

How much are we explaining? The forecast error variance decomposition



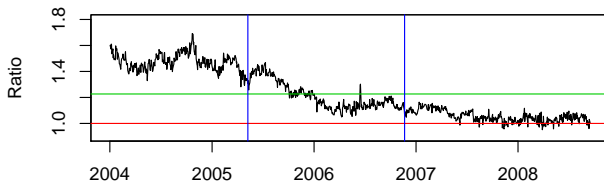
Part II

Microeconomic aspects – one ADR at a time

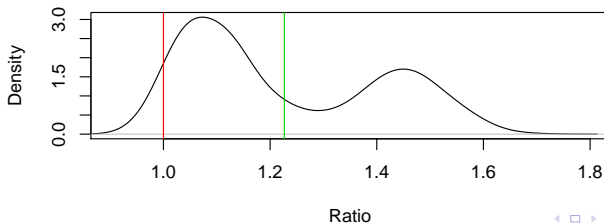
Microeconomic analysis of ADR premium

- ▶ Turn from the macroeconomic ADR premium series to individual stocks
- ▶ Some econometrics, some anecdotes
- ▶ The biggest problem: 'headroom' is unobserved; sometimes arbitrage is feasible when $\text{premium} > 0$ and sometimes it is not.

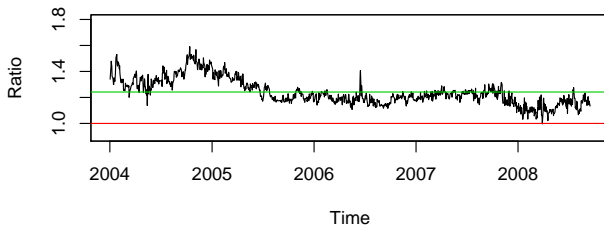
The Infosys premium; the role of 'sponsored ADRs'



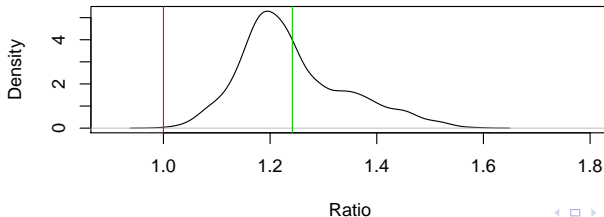
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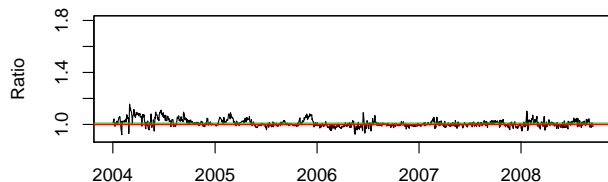
A peer – Wipro – persistent premium all through



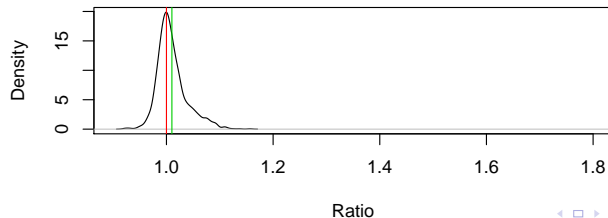
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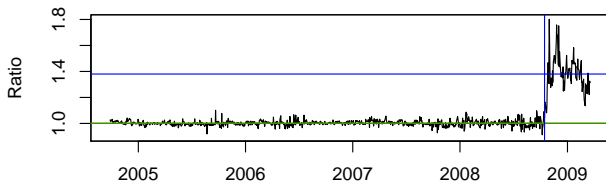
Dr. Reddy's: no significant premia all through



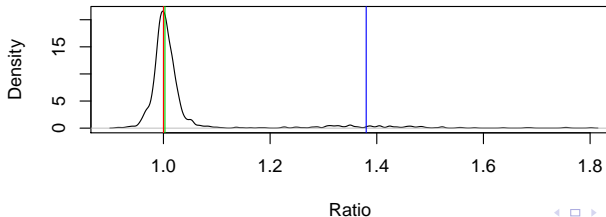
`density.default(x = rdy[, 6])`



Tata Motors



`density.default(x = ttm[, 4])`



Threshold cointegration analysis

Theory predicts transactions costs hamper arbitrage. This suggests a model where arbitrage kicks in when pricing errors are large enough:

$$x_t = \begin{cases} \alpha_L + \rho_1^L x_{t-1} + \dots + \rho_p^L x_{t-p} + \varepsilon_t & \text{if } x_{t-1} \leq \theta_L \\ \alpha_M + \rho_1^M x_{t-1} + \dots + \rho_p^M x_{t-p} + \varepsilon_t & \text{if } \theta_L < x_{t-1} < \theta_H \\ \alpha_H + \rho_1^H x_{t-1} + \dots + \rho_p^H x_{t-p} + \varepsilon_t & \text{if } x_{t-1} \geq \theta_H \end{cases}$$

Theoretical predictions:

- ▶ Two thresholds effects: three regimes
- ▶ $\rho_M = 1$ No arbitrage band as random walk
- ▶ $\rho_L, \rho_H < 1$ Error correction mechanisms
- ▶ Two different thresholds, permits different costs of harnessing two different kinds of mispricings

Stationarity

- ▶ Mexico: yes
- ▶ Brazil: yes
- ▶ India: no, but:
 - ▶ Unit root rejected on second subsample (July 2006)
 - ▶ Unit root rejected when alternative is stationnary SETAR

Threshold effects?

We use the test of Hansen (1999) for the number of thresholds. P-values are obtained with residual bootstrap under homoscedasticity and without autocorrelation.

- ▶ Mexico: only 1 threshold, below 1
- ▶ Brazil: only 1 threshold, below 1
- ▶ India: only 1 threshold, below 1

Measures of persistence

We compute half-lives (HL) on both linear and SETAR models:

	HL Linear	HL Symetric Setar	No arbitrage band
Mexico	0.488	0.473	0.00414
Brazil	0.504	0.494	0.01562
India	27.059	25.280	0.03388

This is computed from $\frac{\ln 0.5}{\ln(1+\phi)}$ in the alternative model specification:

$$\Delta x_t = \alpha_L + \phi x_{t-1} + \Delta \zeta_1 x_{t-1} + \dots + \Delta \zeta_p x_{t-p} + \varepsilon_t$$

Summary

- ▶ Indian ADR premia are an interesting problem
- ▶ Foundation: a unique kind of capital control
- ▶ We propose interpreting the mean of ADR premia for liquid ADRs as a macroeconomic series
- ▶ Story: News/perceptions in the US show up first in the ADR premium
- ▶ VAR explains roughly half the forecast variance of this series
- ▶ Firm level: much more complicated
- ▶ Lack of support for threshold model.

Thank you.