India's Trilemma: Financial Liberalization, Exchange Rates and Monetary Policy

Michael Hutchison, Rajeswari Sengupta and Nirvikar Singh

Department of Economics

and

Santa Cruz Institute for International Economics

University of California, Santa Cruz

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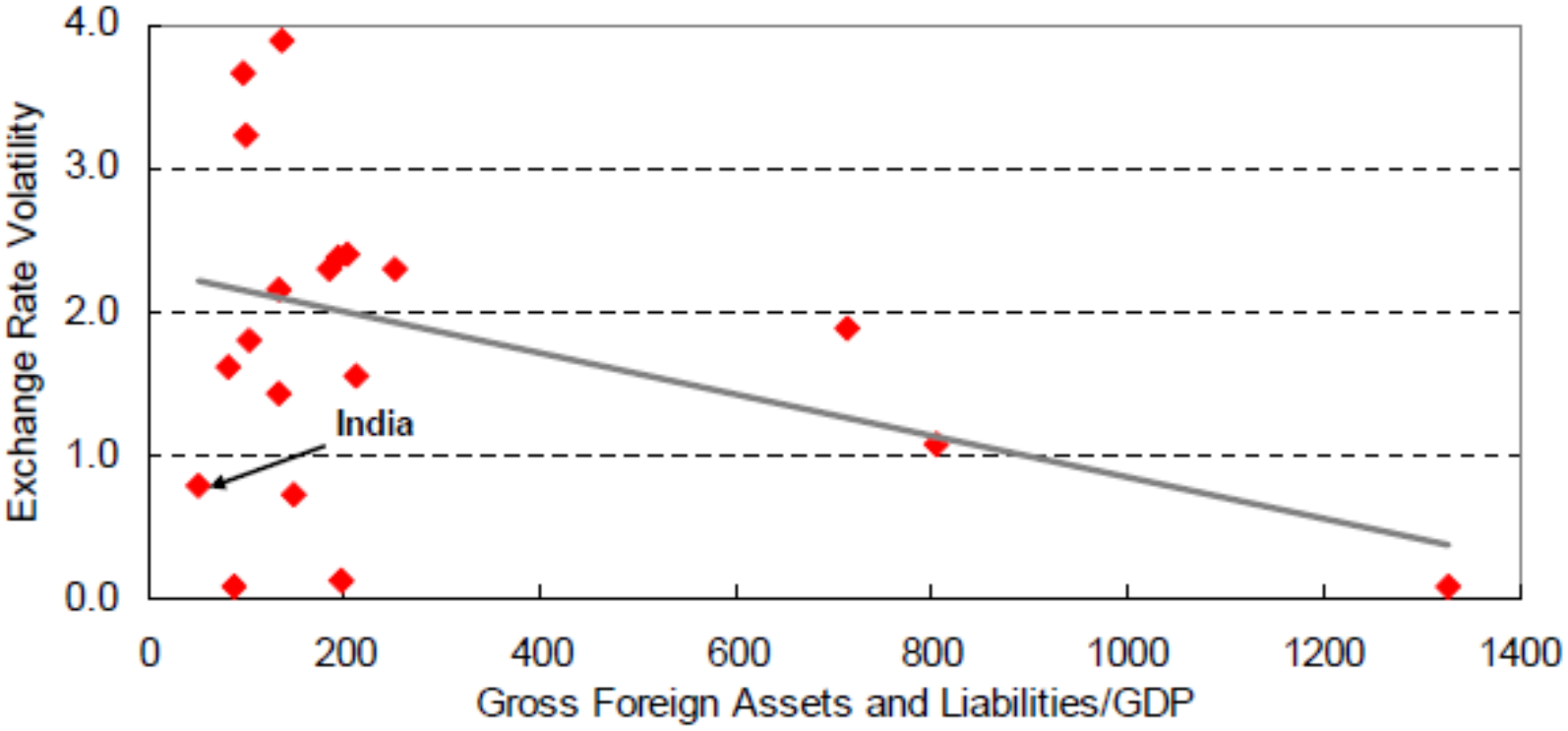
Introduction

- Open Economy Trilemma
  - Key challenge for macroeconomic policy in open economies is how to simultaneously manage exchange rates, interest rates and capital account openness
- Most emerging markets operate in the range of partial financial integration with regulations restricting the flow of funds and 'managed' floating regimes with central banks actively intervening in foreign currency markets
- Trilemma principle predicts that India's experience with increasing financial integration would likely have been accompanied, *ceteris paribus*, by a loss of monetary independence and/or loss of exchange rate stability
- We measure the tradeoff between financial integration, exchange rate stability and monetary independence in India

Indian Experience

- Gradual financial liberalization, first domestic, then foreign
- More market-determined exchange rate system and current account convertibility
- Slow and incomplete capital account liberalization
  - "Complex, discretionary and fragmented" controls
- De facto liberalization – increased capital flows
- Evolution of monetary policy conduct

Figure 1: Financial Openness and Exchange Rate Volatility in India



India: Reserves and Foreign Exchange Intervention

- Active intervention in foreign exchange market
- Accumulation of reserves
- Replacement of Net Domestic Assets by Net Foreign Assets in monetary base
- Sterilization more successful 1996Q2 to 2005Q1, less so from 2005Q2 to 2009Q3

Figure 2: Foreign Exchange Market Intervention

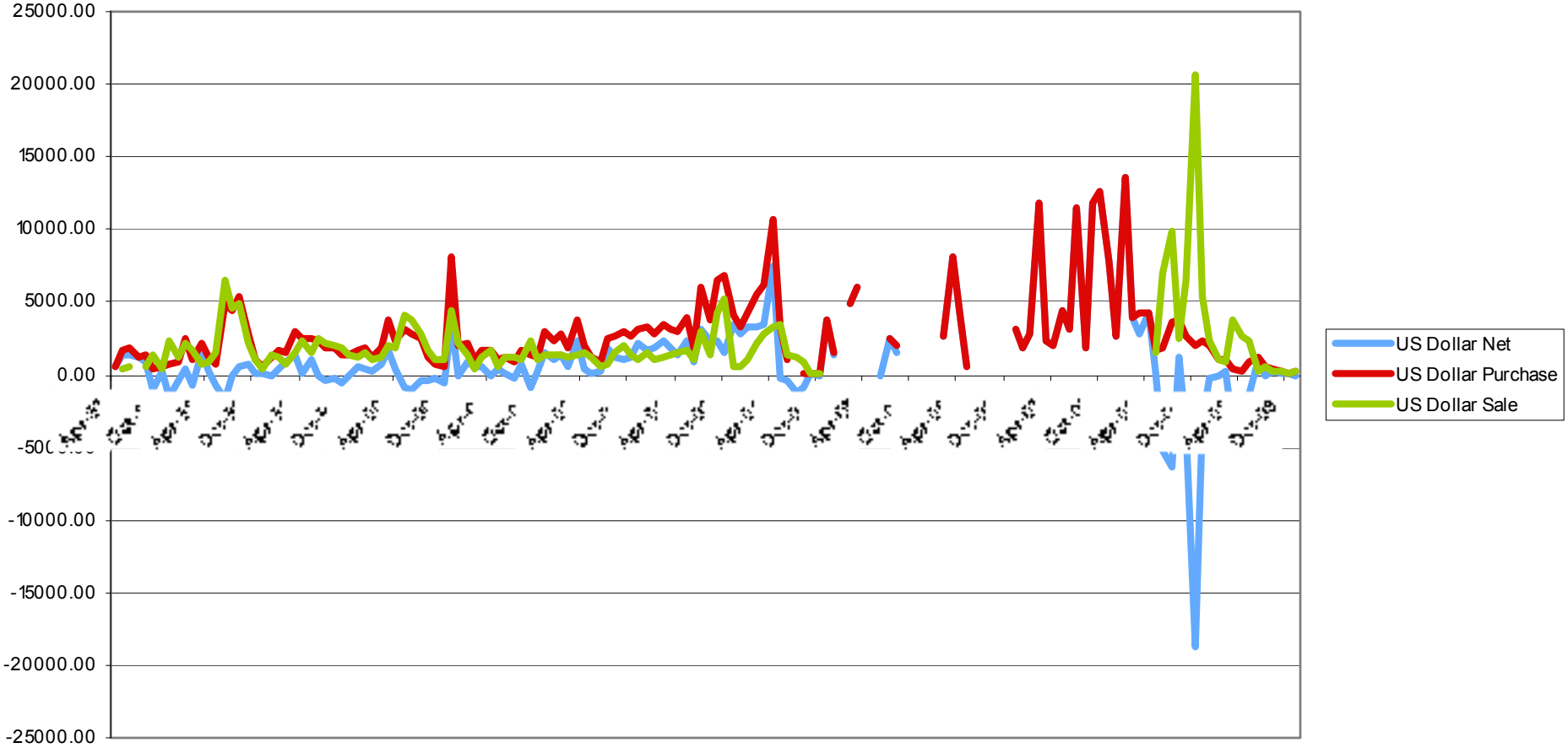


Figure 3: Evolution of Monetary Base

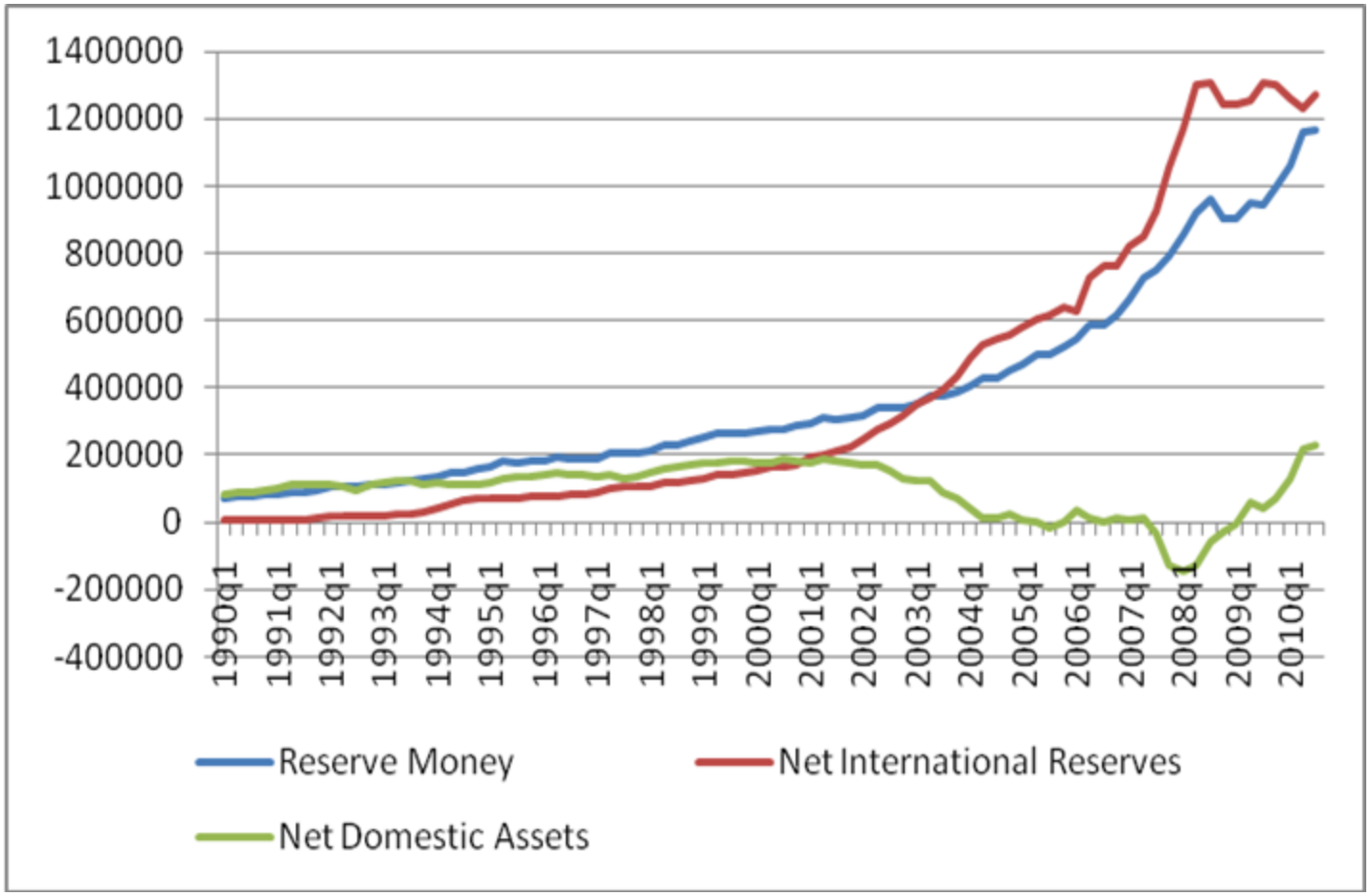


Table 1: Effect of Net Foreign Assets (NFA) on Net Domestic Assets (NDA)

(Dependent variable: Change in NDA)

Variables	**1996Q2-2000Q3**	**2000Q4-2005Q1**	**2005Q2-2009Q3**
Change in NFA	-0.768385*** (0.259622)	-0.867774*** (0.260602)	-0.443428*** (0.181335)
Lagged change in NDA	0.663150*** (0.199194)	-0.214493 (0.225896)	0.047067 (0.249181)
Change in log of IP	-14803.59*** (4816.056)	-18653.10* (10987.70)	-15150.19 (38005.97)
Constant	4865.866*** (1578.655)	7989.290 (5638.952)	19861.67* (10865.56)
Adj R squared	0.463650	0.444902	0.275034

*, **, *** denote statistical significance at 10%, 5% and 1% levels respectively. Standard errors are denoted in parentheses.

Data

- Quarterly data
- Sample period: 1996q1 to 2009q3
- GDP, foreign investment inflows and outflows, reserves, changes in reserves
  - RBI website
- Inflation: weekly WPI, averaged to quarterly
  - RBI website
- Interest rates: weekly 90-day government security yields
  - Global Financial Database
- Exchange rate: weekly nominal rupee-dollar exchange rate
  - Global Financial Database

Methodology

- Trilemma component indices
- Trilemma contributions

$$2 = aMI + bES + cKO + \varepsilon$$

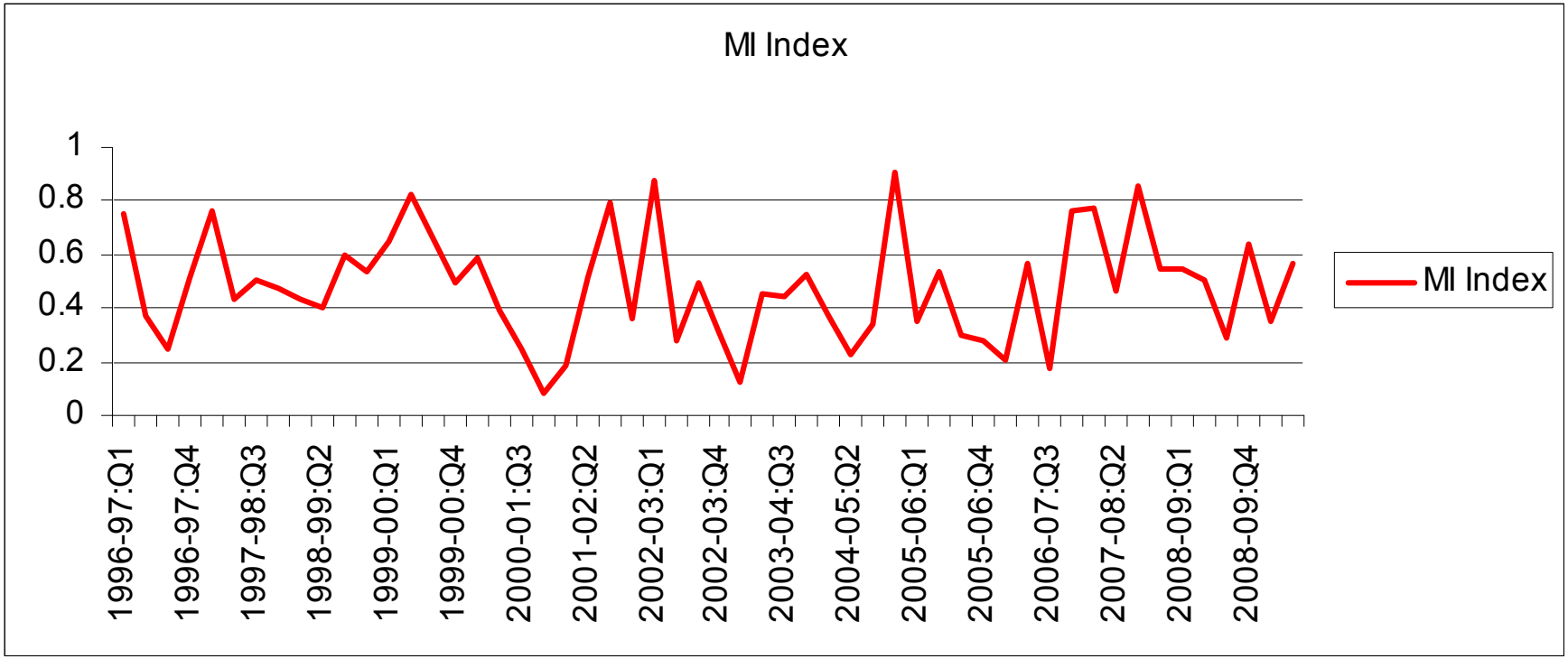
$$\hat{a}MI, \hat{b}ES, \hat{c}KO$$

Monetary Independence (MI) Index

- Reciprocal of the correlation of interest rates in the home country (India) and the base country (United States)
- Quarterly correlations calculated using weekly interest rate data

$$MI = 1 - \frac{corr(i_i, i_j) - (-1)}{1 - (-1)}$$

Figure 4: Monetary Independence Index

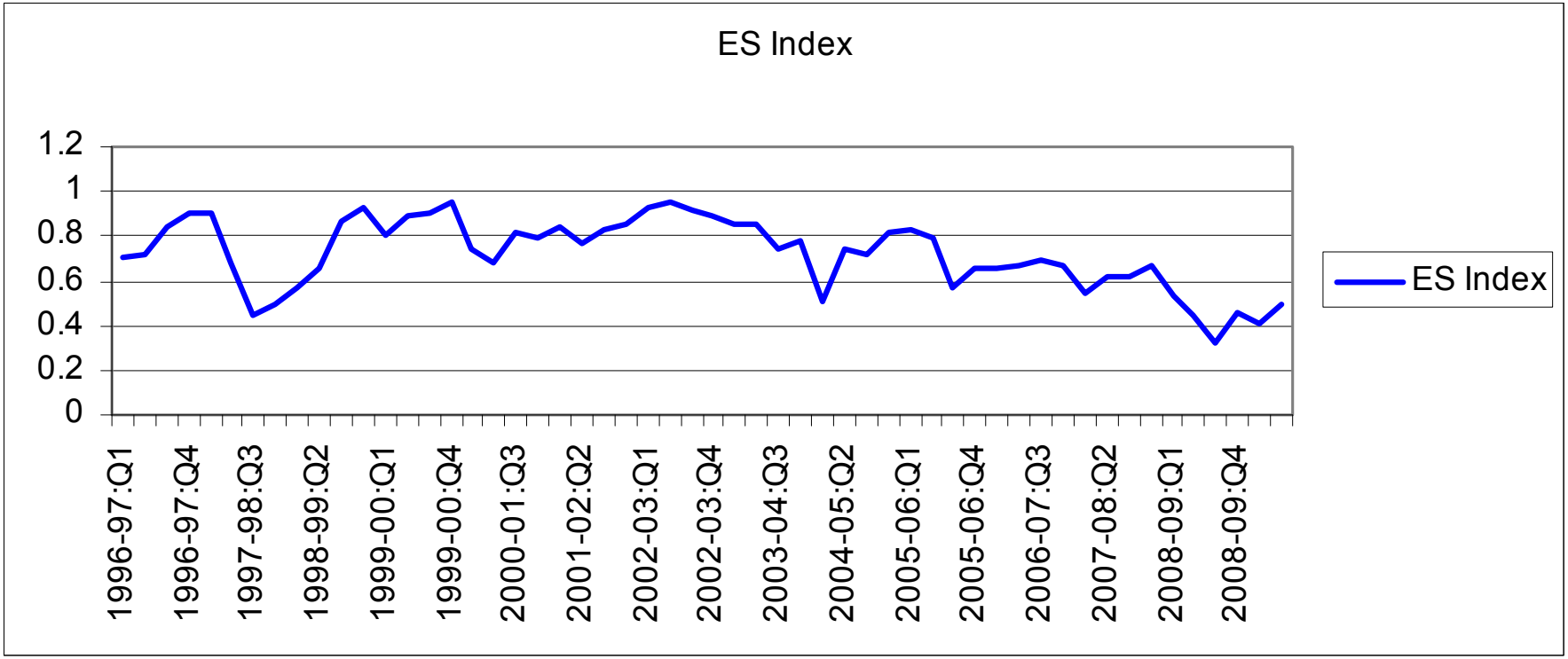


Exchange Rate Stability (ES) Index

- Quarterly standard deviations of the change in the log of the Rupee-US dollar exchange rate

$$ERS = \frac{0.01}{0.01 + stdev(\Delta(\log(exch\_rate))}$$

Figure 5: Exchange Rate Stability Index

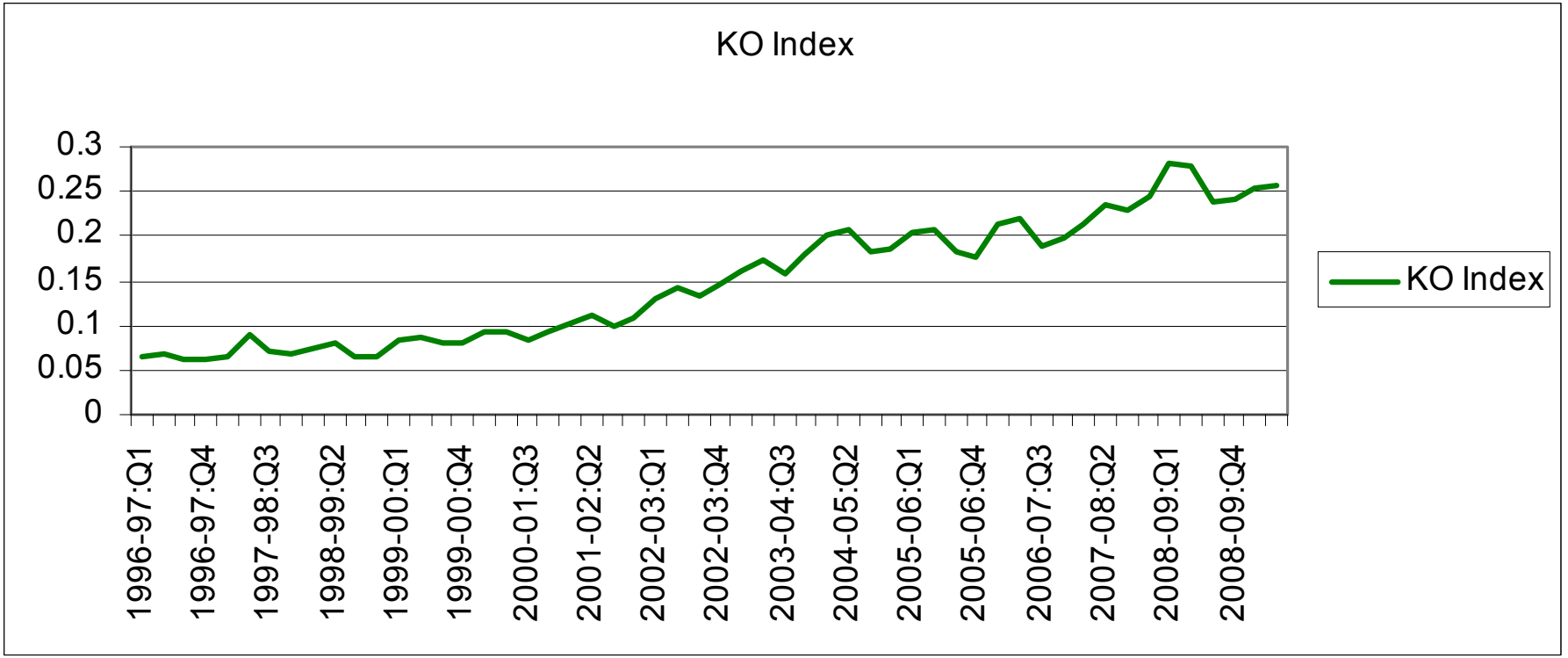


Capital Account Openness (KO) Index

- Sum of quarterly foreign investment inflows and outflows as ratio to GDP

$$\frac{(|FI\ Inflow| + |FI\ Outflow|)}{GDP}$$

Figure 6: Capital Account Openness Index



Empirical Results: Policy Stance

- Measuring trilemma policy configuration
- Trilemma policy stance and reserve accumulation

Table 2A: Trilemma Indices for India, 1996 – 2010

		1996-97:Q1 to 2000-01:Q2	2000-01:Q3 to 2004-05:Q4	2005-06:Q1 to 2009-10:Q2
	MI	0.5348	0.4197	0.4828
Means	ES	0.7601	0.8107	0.5901
	KO	0.0385	0.0788	0.3140
	MI	0.8107	-0.1793	0.4649
Coefficients	ES	1.7075***	2.0412***	2.1369***
	KO	5.3987	5.2079***	1.4644*
R-squared		0.9697	0.9950	0.9727

Table 2B: Trilemma Contributions

		1996-97:Q1 to 2000-01:Q2	2000-01:Q3 to 2004-05:Q4	2005-06:Q1 to 2009-10:Q2
	MI	0.4335	-0.0752	0.2245
Contributions	ES	1.2978	1.6548	1.2611
	KO	0.2081	0.4105	0.4598
Sum of contributions		1.9395	1.9900	1.9454

Interpretation

- Exchange rate stability receives high policy weight throughout the entire 13.5 year period.
- In sub-period 2, as capital openness increases, monetary independence is completely lost, whereas there is an attempt to retain, or even strengthen, exchange rate stability
- In sub-period 3, as capital openness continues to increase, some exchange rate stability is sacrificed to recover some monetary independence
- The final configuration involves less monetary independence and greater financial integration, as compared to sub-period 1

Figure 8: Reserves-GDP Ratio

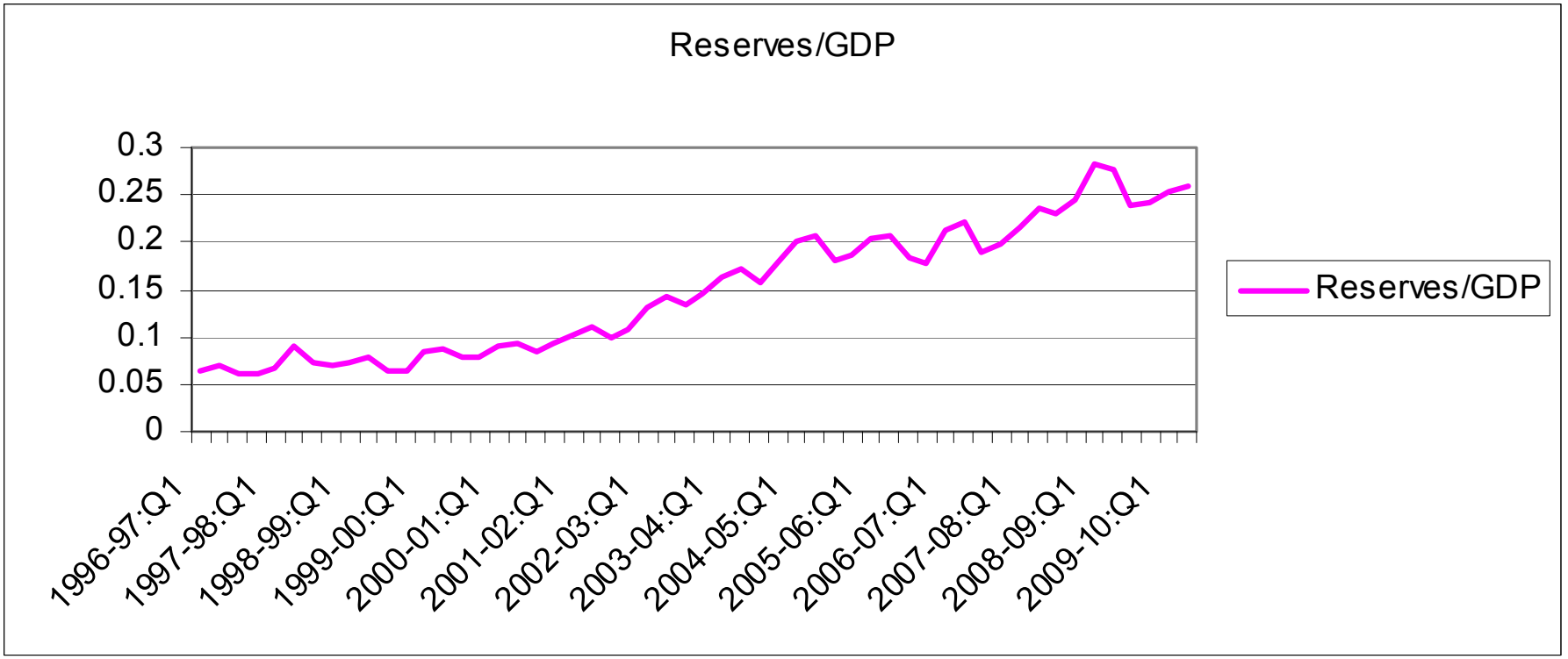
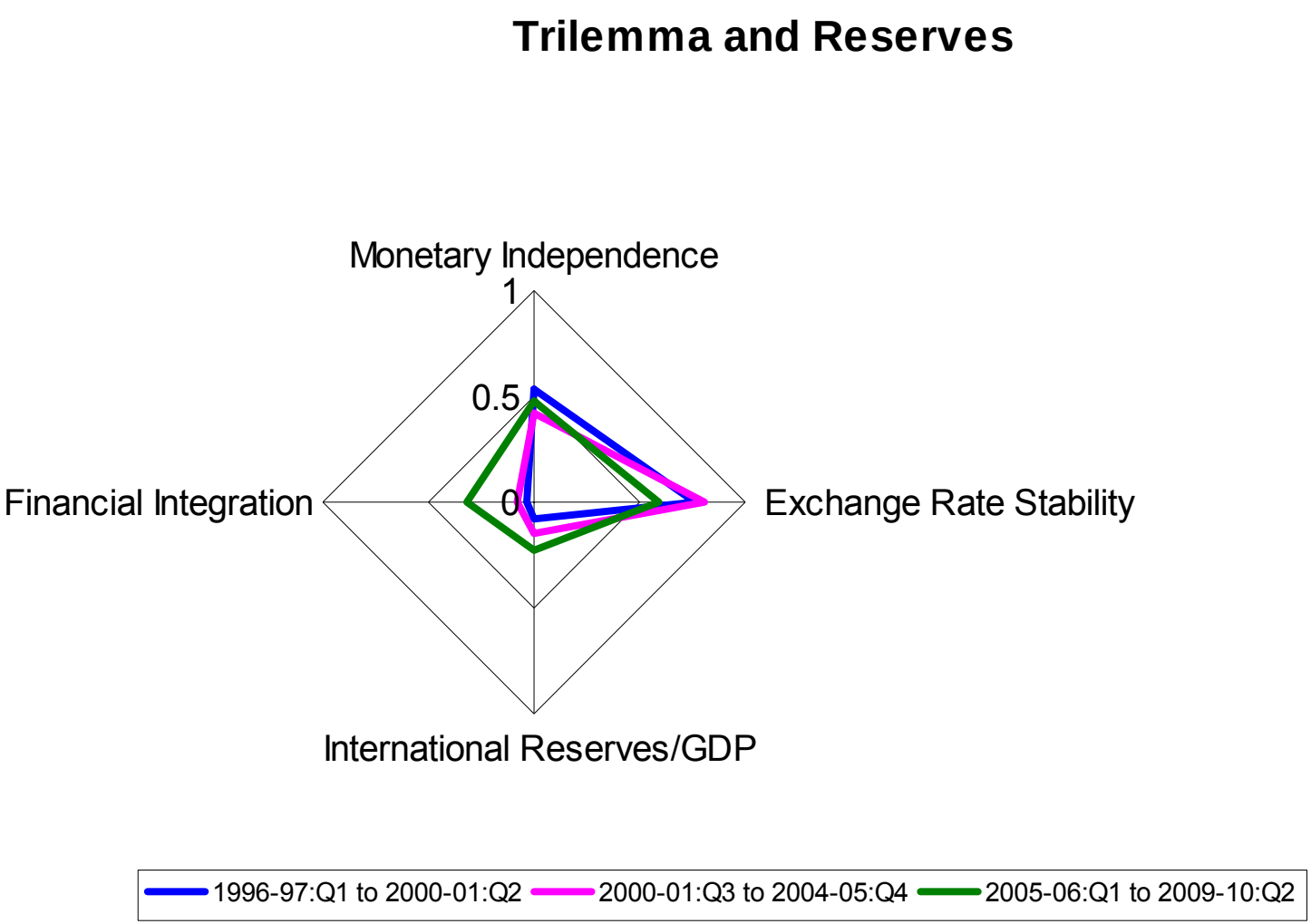


Figure 7: The Trilemma and Reserve Accumulation



Empirical Results: Policy Outcomes

- Inflation volatility
- Inflation level

Table 3a: Inflation volatility, trilemma configuration and reserves

	1996-97:Q1 to 2000-01:Q2		**2000-01:Q3 to 2004-05:Q4**		**2005-06:Q1 to 2009-10:Q2**	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	0.0778	0.0329	0.0255	0.0438	0.0537	0.0838
MI	0.0331	0.0265	-0.0103	0.0130	0.0440	0.0728
ES	-0.1184**	0.0487	-0.0201	0.0551	-0.1454	0.1339
Res/GDP	-1.0215**	0.4448	-0.0626	0.2428	-0.1404	0.3600
MI*Res	-0.5574	0.3750	0.0453	0.0895	-0.2354	0.3413
ES*Res	1.7336**	0.6880	0.0573	0.3121	0.5809	0.5949

Table 3b: Inflation volatility, trilemma configuration and reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	0.0174	0.0463	-0.0075	0.0674	0.0731	0.0983
KO	0.3067	0.4271	0.3507	0.2931	0.0259	0.1522
ES	-0.0320	0.0478	-0.0135	0.0697	-0.1639	0.1432
Res/GDP	-0.2164	0.6183	0.1923	0.3691	-0.2263	0.4163
KO*Res	-3.7099	4.8670	-2.2180	1.6243	-0.1776	0.6685
ES*Res	0.4843	0.6597	-0.0383	0.3874	0.6636	0.6364

Table 3c: Inflation volatility, trilemma configuration and reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	-0.0114	0.0190	-0.0079	0.0187	-0.0625	0.0519
MI	-0.0057	0.0258	-0.0054	0.0150	0.0343	0.0826
KO	0.5534	0.3775	0.2395	0.2609	0.0882	0.1629
Res/GDP	0.2053	0.2504	0.0792	0.1128	0.3359	0.2388
MI*Res	0.0510	0.3436	0.0027	0.1075	-0.1825	0.3851
KO*Res	-6.4208	4.3087	-1.2308	1.4355	-0.4131	0.7148

Interpretation

- Exchange rate stability appears to dampen inflation volatility: the coefficient is always negative
- Increased capital account openness seems to be weakly associated with higher inflation volatility
- In both cases, interaction terms of trilemma indices with reserves-GDP ratio are of the opposite signs
  - Suggests that accumulation of reserves softens impact of trilemma policy stance
- Patterns with respect to monetary independence are less clear-cut
- Direct impact of reserve accumulation on inflation volatility is also somewhat mixed

Table 4a: Inflation, trilemma configuration and reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	-0.3360	0.1749	0.5480	0.1678	-0.3762	0.5114
MI	0.0302	0.1406	-0.0872	0.0498	0.0022	0.4447
ES	0.4792*	0.2586	-0.5847**	0.2110	0.6269	0.8175
Res/GDP	5.3884**	2.3640	-2.4370**	0.9303	1.8456	2.1979
MI*Res	-0.5682	1.9927	0.3396	0.3429	-0.0242	2.0838
ES*Res	-6.6584*	3.6561	2.9826**	1.1959	-2.7331	3.6326

Table 4b: Inflation, trilemma configuration and reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	-0.2731	0.1910	0.8658	0.3516	-0.2068	0.5808
KO	-0.7058	1.7636	-1.4734	1.5296	-0.6762	0.8990
ES	0.4882**	0.1972	-0.9030**	0.3637	0.7300	0.8461
Res/GDP	4.4688	2.5533	-4.2087**	1.9261	1.0966	2.4591
KO*Res	12.0971	20.0985	7.9661	8.4759	3.0958	3.9492
ES*Res	-6.9536**	2.7242	4.7011**	2.0216	-3.3030	3.7596

Table 4c: Inflation, trilemma configuration and reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	0.0874	0.0809	0.0799	0.0762	0.1575	0.2948
MI	0.1444	0.1099	-0.0603	0.0612	0.1098	0.4694
KO	-2.6536	1.6085	0.2136	1.0644	-0.7314	0.9250
Res/GDP	-0.3269	1.0668	-0.2947	0.4600	-0.4362	1.3564
MI*Res	-2.3020	1.4640	0.0329	0.4386	-0.5604	2.1875
KO*Res	33.8496*	18.3572	1.5995	5.8562	3.1858	4.0600

Interpretation

- Some striking differences from results for inflation volatility
- Increased financial integration does not appear to increase the level of inflation – coefficients are mostly negative
- Monetary independence does not seem to matter for the level of inflation
- Exchange rate stability, level of reserves, and their interaction:
  - In first sub-period, both these factors seem to increase the level of inflation, though these positive effects are muted by the interaction of the two variables
  - In second sub-period, impacts are exactly reversed
  - First sub-period is inconsistent with the typical findings for different cross-country regressions in ACI. (Also the one in which exchange rate stability and reserves have the strongest negative impacts on inflation volatility)
  - Suggests a trade-off between the two objectives in this time frame
  - It is possible that the result is also related to transition in the conduct of monetary policy that took place during this period of the late 1990s

Table 5a: Inflation volatility, trilemma configuration and changes in reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	0.0036	0.0039	-0.0041	0.0238	0.0139	0.0097
MI	-0.0023	0.0062	-0.0038	0.0075	0.0137	0.0134
ES	0.0033	0.0067	0.0134	0.0317	-0.0220	0.0121
ΔRes/GDP	0.1032	0.1972	-0.4435	0.5005	0.2083	0.1787
MI*ΔRes	-0.0346	0.3736	0.0335	0.1711	0.1983	0.2132
ES*ΔRes	-0.1029	0.2840	0.5292	0.6666	-0.4727	0.3609

Table 5b: Inflation volatility, trilemma configuration and changes in reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	0.0030	0.0027	0.0100	0.0336	0.0212	0.0126
KO	-0.0170	0.0265	-0.0221	0.0835	-0.0059	0.0241
ES	0.0043	0.0041	-0.0036	0.0363	-0.0207	0.0141
ΔRes/GDP	0.1497	0.1244	-0.1781	0.6539	0.2261	0.1783
KO*ΔRes	-5.9355***	1.6765	-0.1921	1.5793	-0.3065	0.3245
ES*ΔRes	0.1140	0.1771	0.2455	0.7166	-0.1645	0.2983

Table 5c: Inflation volatility, trilemma configuration and changes in reserves

	1996-97:Q1 to 2000-01:Q2		**2000-01:Q3 to 2004-05:Q4**		**2005-06:Q1 to 2009-10:Q2**	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	0.0052	0.0022	0.0095	0.0064	0.0018	0.0071
MI	0.0005	0.0037	0.0001	0.0063	0.0126	0.0121
KO	-0.0081	0.0261	-0.0466	0.0611	0.0072	0.0218
ΔRes/GDP	0.1558	0.1281	0.0948	0.1370	0.1315	0.1153
MI*ΔRes	0.0843	0.2238	0.2378	0.1646	0.1945	0.2125
KO*ΔRes	-5.6424***	1.6411	-2.1651	1.3795	-0.3952	0.3671

Interpretation

- None of the trilemma indices have statistically significant coefficients in any of the three sub-periods
- Signs for the capital openness index are predominantly negative, which would imply that capital openness is associated with lower inflation volatility (but weak evidence)
- Increases in reserves mostly associated with increases in inflation volatility (again not statistically significant)
- Interaction of increased capital openness and reserve accumulation (positive changes in the level of reserves) is associated with reductions in inflation volatility
  - This relationship is statistically significant in the first sub-period

Table 6a: Inflation, trilemma configuration and changes in reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	0.0638	0.0193	0.1641	0.1029	0.0025	0.0522
MI	-0.0628*	0.0310	-0.0910**	0.0326	0.0825	0.0718
ES	0.0265	0.0334	-0.0864	0.1373	0.0173	0.0652
ΔRes/GDP	0.6824	0.9859	1.1375	2.1689	1.7255*	0.9602
MI*ΔRes	-2.4189	1.8682	-1.4862*	0.7415	0.9982	1.1455
ES*ΔRes	1.0092	1.4202	-0.4191	2.8888	-3.3214	1.9396

Table 6b: Inflation, trilemma configuration and changes in reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	0.0559	0.0203	0.2682	0.1724	-0.0566	0.0631
KO	0.1970	0.2006	0.0847	0.4290	0.2314*	0.1202
ES	-0.0261	0.0311	-0.2671	0.1864	0.0789	0.0707
ΔRes/GDP	-0.0348	0.9417	4.0739	3.3607	1.0757	0.8907
KO*ΔRes	15.9944	12.6942	-1.4020	8.1170	2.2183	1.6207
ES*ΔRes	-0.9507	1.3406	-4.6372	3.6829	-2.3226	1.4900

Table 6c: Inflation, trilemma configuration and changes in reserves

	1996-97:Q1 to 2000-01:Q2		2000-01:Q3 to 2004-05:Q4		2005-06:Q1 to 2009-10:Q2	
	Coefficients	*Standard Error*	*Coefficients*	*Standard Error*	*Coefficients*	*Standard Error*
Intercept	0.0680	0.0135	0.0905	0.0258	0.0159	0.0387
MI	-0.0547**	0.0230	-0.0807***	0.0255	0.0023	0.0658
KO	0.1899	0.1620	0.0569	0.2471	0.1473	0.1180
ΔRes/GDP	0.4455	0.7963	1.0890*	0.5540	-0.0607	0.6247
MI*ΔRes	-2.0319	1.3910	-0.6641	0.6658	-0.2259	1.1517
KO*ΔRes	16.2849	10.1976	-6.2057	5.5787	1.4725	1.9900

Interpretation

- Strong negative relationship between monetary independence and the level of inflation in first two sub-periods
- Increases in the level of reserves mostly have positive effects on the level of inflation
  - In a couple of cases, the impact is statistically significant
- In the first two sub-periods, the interaction term of the monetary independence index and changes in the level of reserves is negative (and significant in one case)
  - Suggests that increases in reserves when combined with increased monetary autonomy tend to dampen inflation

Conclusions

- Using quarterly data from 1996 to 2009, we construct trilemma indices for each of the three policy objectives: monetary independence, exchange rate stability and capital account openness
- Increase in financial integration has changed the policy trade offs facing India
- Increase in capital account openness has come at the cost of reduction in monetary policy independence or of limitations on exchange rate stability
- In some cases, greater financial integration and the corresponding loss of monetary autonomy and exchange rate stability has influenced inflation and inflation volatility outcomes
- International reserves accumulation has played a role in managing the trilemma

Thank You