

# Movement of Trade Balance and Exchange Rate Sensitivity of Industry Trade Flows

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Rajarshi Mitra  
University of Wisconsin-Milwaukee, U.S.A.

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## Trade Liberalization and India

The twin policies of trade liberalization and floating exchange rate regime, as adopted by the Government of India during the year 1991 and onwards, led to both a surge in India's exports and an improvement in the country's trade balance, with depreciation of the currency being one of the principle contributing factors. Increased foreign capital inflows in recent times, in the form of foreign direct investment flows, portfolio investment flows, external commercial borrowings and investments and remittances under the current flexible exchange rate regime, have transformed Indian macroeconomics, with the appreciation of the rupee having an adverse effect on India's trade balance - the trade deficit in the year 2007 being almost 30 percent higher than in 2006.

## Research Question

This paper attempts to determine the appropriate policy responses to attract foreign capital into India, and answer one of the most important macroeconomic questions prevailing in the country today:

Should India Adopt a Pegged or a Flexible Exchange Rate Regime?

## Research Outline

This paper investigates, using Pesaran et. al.'s (2001) bounds testing approach and annual *disaggregate* trade data between India and the United States from 1972 until 2006 and from 65 Indian industries, the short-run and the long-run effects of changes in India's real exchange rate on:

- The Pattern of Movement of Trade Balance over Time.
- The Sensitivity of Exports and Imports for each of those 65 Indian Industries.

## Movement of Real Exchange Rate Over Time – A Stylized Fact



## The Pattern of Movement of Trade Balance over Time – A Review of the Literature

The study of the pattern of movement of a country's trade balance due to devaluation or depreciation has received considerable attention from international economists. Studies that investigated the impact of the real depreciation of the Indian rupee on India's trade balance produced mixed results:

- Bahmani-Oskooee (1985, 1989) introduced and tested a trade balance model and observed that the real depreciation has neither short-run nor long-run effects.
- A study by Himarios (1989), however, showed that the trade balance, when measured in terms of a foreign currency, did in fact respond to real depreciation. This led to the conclusion that relation between the trade balance and the real exchange rate depends on the units of measurement. This led to the conclusion that relation between the trade balance and the real exchange rate depends on the units of measurement.

## The Pattern of Movement of Trade Balance over Time – A Review of the Literature (continued).

- The results of these studies are considered to have shortcomings since they did not consider either the integrating or even the cointegrating properties of the variables. Although Rose (1990), Bahmani-Oskooee (1991), Bahmani and Alse (1994) and Bulaswar et al. (1996) have all considered cointegration analysis, they were not able to establish cointegration between the Indian trade balance and the real value of the rupee, thereby implying that the real depreciation of the rupee has no long run effect in improving India's trade balance.
- A common feature of the previous studies is that aggregate trade data was used in the analysis.

## The Pattern of Movement of Trade Balance over Time – The Model

The study of the pattern of movement of trade balance over time to changes in India's real income, foreign real income, and real exchange rate in the paper will involve a trade balance model similar to the one considered by Bahmani Oskooee and Brooks (1999), and also used by S. Arora et. al (2003):

$$\ln TB_{i,t} = a + b \ln Y_{IN,t} + c \ln Y_{U.S.,t} + d \ln REX_{i,t} + \varepsilon_t$$



## The Short-Run Dynamics

The application of cointegration and error-correction modelling is required to incorporate short-run dynamics into the trade balance model defined by the above equation. The procedure to be followed for this purpose is the advanced cointegration approach as developed by Pesaran and Shin (1995) and Pesaran et al. (1996), and that requires the trade balance model to be expressed in the following Autoregressive Distributed Lag form:

$$\begin{aligned} \partial \text{LnTB}_{i,t} = & a + \sum_{j=1}^{n1} b_j \partial \text{LnTB}_{i,t-j} + \sum_{j=0}^{n2} c_j \partial \text{LnY}_{IN,t-j} + \sum_{j=0}^{n3} d_j \partial \text{LnY}_{U.S.,t-k} + \sum_{j=0}^{n4} e_j \partial \text{LnREX}_{i,t-j} + \\ & \beta_1 \text{LnTB}_{i,t-1} + \beta_2 \text{LnY}_{IN,t-1} + \beta_3 \text{LnY}_{U.S.,t-1} + \beta_4 \text{LnREX}_{i,t-1} + v_t \end{aligned}$$

## The Long-Run Relation

The null and the alternate hypothesis for the non existence of long-run relationship between the trade balance and the explanatory variables, as per the Pesaran and Shin approach, are defined as:

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$$

$$H_1 : \beta_1 \neq 0, \beta_2 \neq 0, \beta_3 \neq 0, \beta_4 \neq 0$$

## Evidence of Long-Run Relationship

Test Statistic	Critical Value at 10% Level of Significance	Decision Rule	Implication
F	3.52	$F > 3.52$	Existence of Cointegration
LM	3.84	$LM < 3.84$	No Autocorrelation
RESET	3.84	$RESET < 3.84$	No Misspecification Error

## Industries Having Favorable Short-Run Effects of Currency Depreciation

Industries	Short-Run Coefficients			
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$
Crude vegetable materials, nes	-2.82 (2.80)	-1.56 (1.64)	3.33 (3.72)	3.58 (4.62)
Organic chemicals	-6.77 (4.58)	4.27 (3.50)		
Articles of rubber, nes	-6.14 (4.56)	-1.35 (0.83)	1.80 (1.35)	
Text fabrics woven ex narrow, spec,	-3.17 (1.45)	-2.29 (1.22)	0.03 (0.02)	2.15 (1.74)
Special textile fabrics and related	-2.76 (1.30)	1.67 (0.81)	5.01 (2.73)	
Pearls and precious and semi-precio	-0.84 (1.07)	1.85 (2.44)		
Iron and steel bars, rods, angles, sha	-3.57 (1.40)	-1.51 (0.50)	6.28 (2.07)	3.32 (1.98)
Office machines	-4.27 (2.02)	4.77 (1.71)	6.80 (2.99)	3.20 (1.97)
Metalworking machinery	-1.00 (0.60)	-1.76 (1.04)	1.68 (1.11)	3.06 (2.55)
Textile and leather machinery	-2.11 (1.24)	3.65 (1.77)		
Other electrical machinery and appa	-0.72 (0.79)	3.53 (3.01)	3.18 (3.33)	
Photographic and cinematographic su	-8.81 (2.99)	3.02 (1.17)		
Developed cinematographic film	-1.36 (0.65)	0.28 (0.12)	4.66 (2.12)	4.68 (2.62)
Musical instruments, sound recorders	-3.06 (2.40)	3.62 (2.04)	3.93 (2.47)	1.84 (1.41)
Manufactured articles, nes	-4.66 (3.35)	-0.70 (0.41)	3.92 (3.05)	1.57 (1.21)

## Industries in Which Short-Run Effects Last into the Long-Run

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Crude vegetable materials, nes	-2.82 (2.80)	-1.56 (1.64)	3.33 (3.72)	3.58 (4.62)	-40.40 (6.91)
Organic chemicals	-6.77 (4.58)	4.27 (3.50)			-2.17 (3.89)
Articles of artificial plastic mate	1.89 (1.46)	3.01 (1.80)	1.97 (1.40)		-3.00 (2.17)
Other inorganic chemicals	-2.28 (1.77)				-5.72 (1.78)
Synth.organic dyestuffs, natural ind	-2.22 (3.47)				-2.22 (3.47)
Office and stationery supplies, nes	-2.17 (1.79)				-2.81 (1.75)
Chemical materials and products, nes	-4.34 (3.74)	2.17 (1.79)	3.58 (2.87)	-2.04 (2.33)	-2.67 (3.79)
Articles of rubber, nes	-6.14 (4.56)	-1.35 (0.83)	1.80 (1.35)		-3.29 (2.67)
Pearls and precious and semi-precio	-0.84 (1.07)	1.85 (2.44)			-1.24 (1.74)
Iron and steel bars, rods, angles, sha	-3.57 (1.40)	-1.51 (0.50)	6.28 (2.07)	3.32 (1.98)	-10.12 (1.73)
Tubes, pipes and fittings of iron or	1.25 (1.04)	0.61 (0.47)	0.48 (0.42)	-2.09 (2.25)	1.29 (2.39)
Metal containers for storage and tr	2.35 (1.90)				2.35 (1.90)
Office machines	-4.27 (2.02)	4.77 (1.71)	6.80 (2.99)	3.20 (1.97)	-5.04 (5.06)
Manufactured articles, nes	-4.66 (3.35)	-0.70 (0.41)	3.92 (3.05)	1.57 (1.21)	-5.72 (2.17)
Machinery and appliances-non electr	-1.35 (3.91)	-0.99 (2.60)	-0.57 (1.61)	-1.09 (3.52)	1.04 (1.89)

## Industries in Which Short-Run Effects Last into the Long-Run

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Telecommunications apparatus	-5.72 (2.74)	-3.09 (1.55)			-9.59 (3.08)
Other electrical machinery and appa	-0.72 (0.79)	3.53 (3.01)	3.18 (3.33)		-2.96 (5.03)
Photographic and cinematographic su	-8.81 (2.99)	3.02 (1.17)			-7.04 (3.35)
Musical instruments, sound recorders	-3.06 (2.40)	3.62 (2.04)	3.93 (2.47)	1.84 (1.41)	-10.69 (3.49)
Printed matter	0.36 (0.46)	2.54 (2.68)	2.56 (3.60)		-0.83 (2.36)

## Industries in Which the Long-Run Coefficient is Significantly Positive

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \text{LnRE}_t$	$\Delta \text{LnRE}_{t-1}$	$\Delta \text{LnRE}_{t-2}$	$\Delta \text{LnRE}_{t-3}$	$\Delta \text{LnRE}$
Tubes, pipes and fittings of iron or	1.25 (1.04)	0.61 (0.47)	0.48 (0.42)	-2.09 (2.25)	1.29 (2.39)
Metal containers for storage and tr	2.35 (1.90)				2.35 (1.90)
Machinery and appliances-non electr	-1.35 (3.91)	-0.99 (2.60)	-0.57 (1.61)	-1.09 (3.52)	1.04 (1.89)

## Industries in Which the Long-Run Coefficient is Significantly Negative

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Crude vegetable materials, nes	-2.82 (2.80)	-1.56 (1.64)	3.33 (3.72)	3.58 (4.62)	-40.40 (6.91)
Organic chemicals	-6.77 (4.58)	4.27 (3.50)			-2.17 (3.89)
Articles of artificial plastic mate	1.89 (1.46)	3.01 (1.80)	1.97 (1.40)		-3.00 (2.17)
Other inorganic chemicals	-2.28 (1.77)				-5.72 (1.78)
Synth.organic dyestuffs, natural ind	-2.22 (3.47)				-2.22 (3.47)
Office and stationery supplies, nes	-2.17 (1.79)				-2.81 (1.75)
Chemical materials and products, nes	-4.34 (3.74)	2.17 (1.79)	3.58 (2.87)	-2.04 (2.33)	-2.67 (3.79)
Articles of rubber, nes	-6.14 (4.56)	-1.35 (0.83)	1.80 (1.35)		-3.29 (2.67)
Pearls and precious and semi-precio	-0.84 (1.07)	1.85 (2.44)			-1.24 (1.74)
Iron and steel bars, rods, angles, sha	-3.57 (1.40)	-1.51 (0.50)	6.28 (2.07)	3.32 (1.98)	-10.12 (1.73)
Office machines	-4.27 (2.02)	4.77 (1.71)	6.80 (2.99)	3.20 (1.97)	-5.04 (5.06)
Manufactured articles, nes	-4.66 (3.35)	-0.70 (0.41)	3.92 (3.05)	1.57 (1.21)	-5.72 (2.17)
Telecommunications apparatus	-5.72 (2.74)	-3.09 (1.55)			-9.59 (3.08)
Other electrical machinery and appa	-0.72 (0.79)	3.53 (3.01)	3.18 (3.33)		-2.96 (5.03)
Photographic and cinematographic su	-8.81 (2.99)	3.02 (1.17)			-7.04 (3.35)



## Industries in Which the Long-Run Coefficient is Significantly Negative

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta LnRE_t$	$\Delta LnRE_{t-1}$	$\Delta LnRE_{t-2}$	$\Delta LnRE_{t-3}$	$\Delta LnRE$
Musical instruments, sound recorders	-3.06 (2.40)	3.62 (2.04)	3.93 (2.47)	1.84 (1.41)	-10.69 (3.49)
Printed matter	0.36 (0.46)	2.54 (2.68)	2.56 (3.60)		-0.83 (2.36)

## Industries Providing Evidence of Cointegration

Industries	Diagnostic Test F-Statistic
Tobacco, unmanufactured	6.20
Wool and other animal hair	4.65
Crude vegetable materials, nes	19.56
Organic chemicals	4.86
Synth.organic dyestuffs, natural ind	11.72
Medicinal & pharmaceutical products	4.08
Essential oils, perfume and flavour	7.23
Perfumery, cosmetics, dentifrices,	4.52
Chemical materials and products, nes	8.15
Manuf.of leather or of artif.or rec	6.12
Articles of rubber, nes	5.08
Wood manufactures, nes	11.32
Paper and paperboard	6.62
Articles of paper, pulp, paperboard	3.65
Text fabrics woven ex narrow, spec,	5.25

## Industries Providing Evidence of Cointegration

Industries	Diagnostic Test F-Statistic
Tulle, lace, embroidery, ribbons, t	5.24
Special textile fabrics and related	10.25
Made-up articles, wholly or chiefly	9.11
Glass	3.53
Pearls and precious and semi-precio	5.49
Pig iron, spiegeleisen, sponge iron	4.11
Tubes, pipes and fittings of iron or	10.90
Iron steel castings forgings unwork	4.72
Copper	7.90
Finished structural parts and struc	5.12
Metal containers for storage and tr	9.29
Wire products - ex electric - & fen	4.38
Power generating machinery, other t	21.16
Agricultural machinery and implemen	6.42
Office machines	6.90

## Industries Providing Evidence of Cointegration

Industries	Diagnostic Test F-Statistic
Metalworking machinery	6.16
Machines for special industries	6.73
Machinery and appliances-non electr	14.71
Electric power machinery and switch	3.83
Telecommunications apparatus	3.80
Domestic electrical equipment	4.79
Other electrical machinery and appa	15.62
Sanitary, plumbing, heating & lightin	8.52
Clothing except fur clothing	4.92
Scientific, medical, optical, meas./co	7.82
Printed matter	8.34
Articles of artificial plastic mate	8.67
Perambulators, toys, games and sporti	5.90
Office and stationery supplies, nes	4.92
Manufactured articles, nes	5.52

## Exchange Rate Sensitivity of Indian Exports and Imports

The Marshall-Lerner (ML) condition, either currency devaluation under a fixed exchange rate regime or even driving down the value of a currency under managed float can improve trade balance as long as the sum of export and import demand elasticities add up to unity, but absence of price level data at the commodity level rules out the possibility of estimating the ML condition for import and export demand of each commodity. The ML condition is, however, a long-run condition. In recent times, economists have shifted their attention from estimating the ML condition to establishing a direct relation between the trade balance and the real exchange rate, and this direct relation has been used to distinguish the short-run effects of currency devaluation from its long-run effects.

## The Framework

The long-run effects of changes in the real exchange rate on the value of exports and imports of a specific industry are measured using the following two equations:

### The Export Model

$$\text{Ln}VX_{i,t}^{IN} = g + h\text{Ln}Y_{U.S.,t} + j\text{Ln}REX_{i,t} + \theta_{i,t}$$

### The Import Model

$$\text{Ln}VM_{i,t}^{IN} = k + l\text{Ln}Y_{IN,t} + m\text{Ln}REX_{i,t} + \gamma_{i,t}$$

## The Short-Run Dynamics

In order to analyze the short run effects, the two equations will be expressed in an error-correction format that based on Pesaran (2001) bounds-testing approach:

### Export Model

$$\partial \text{LnVX}_{i,t}^{\text{IN}} = g' + \sum_{y=1}^{n1} h'_y \partial \text{LnVX}_{i,t-y}^{\text{IN}} + \sum_{y=0}^{n2} j'_y \partial \text{LnY}_{U.S.,t-y} + \sum_{y=0}^{n3} p'_y \text{LnREX}_{i,t-y} + h \text{LnVX}_{i,t-y}^{\text{IN}} + j \text{LnY}_{U.S.,t-1} + p \text{LnREX}_{t-1} + \lambda_{i,t}$$

### Import Model

$$\partial \text{LnVM}_{i,t}^{\text{IN}} = d' + \sum_{y=1}^{n1} s'_y \partial \text{LnVM}_{i,t-y}^{\text{IN}} + \sum_{y=0}^{n2} t'_y \partial \text{LnY}_{U.S.,t-y} + \sum_{y=0}^{n3} z'_y \text{LnREX}_{i,t-y} + s \text{LnVX}_{i,t-y}^{\text{IN}} + t \text{LnY}_{U.S.,t-1} + z \text{LnREX}_{t-1} + \zeta_{i,t}$$

## Evidence of Long-Run Relationship

Test Statistic	Critical Value at 10% Level of Significance	Decision Rule	Implication
F	4.14	$F > 4.14$	Existence of Cointegration
LM	3.84	$LM < 3.84$	No Autocorrelation
RESET	3.84	$RESET < 3.84$	No Misspecification Error



## Sensitivity Analysis of the Export Model - Empirical Results

### Industries Having Favorable Short-Run Effects of Currency Depreciation

Industries	Short-Run Coefficients			
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$
Other crude minerals	1.34 (1.25)	-1.04 (0.74)	-0.87 (0.70)	2.52 (2.48)
Essential oils, perfume and flavour	-0.88 (0.68)	-1.28 (0.80)	0.96 (0.70)	2.47 (2.14)
Chemical materials and products, nes	3.33 (3.08)	-1.31 (0.88)	-1.15 (0.91)	3.30 (3.19)
Wood manufactures, nes	-0.53 (0.43)	-2.40 (1.48)	-0.21 (0.15)	2.33 (1.99)
Pearls and precious and semi-precio	-0.71 (2.23)	-0.16 (0.40)	1.25 (3.78)	
Tubes, pipes and fittings of iron or	-1.32 (1.75)	-0.15 (0.14)	0.61 (0.70)	1.66 (2.35)
Copper	-4.05 (1.79)	0.02 (0.01)	1.38 (0.48)	4.55 (1.89)
Electric power machinery and switch	-1.95 (1.59)	1.32 (0.81)	3.08 (2.14)	1.60 (1.41)
Sanitary, plumbing, heating & lightin	-4.98 (2.43)	-0.67 (0.29)	-1.53 (0.72)	3.49 (2.10)
Photographic and cinematographic su	5.99 (2.20)	-3.77 (1.37)	3.17 (1.30)	

## Industries in Which Short-Run Effects Last into the Long-Run

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Synth.organic dyestuffs, natural ind	1.54 (2.24)				2.43 (3.77)
Soaps, cleansing & polishing prepara	1.99 (1.95)				3.73 (1.88)
Articles of rubber, nes	2.03 (3.04)				2.98 (3.75)
Textile yarn and thread	-1.44 (1.20)	-3.35 (2.04)	-3.11 (2.32)		3.03 (2.16)
Special textile fabrics and related	0.22 (0.15)	-2.71 (1.39)	-5.39 (3.18)	-3.18 (2.00)	6.54 (3.37)
Musical instruments, sound recorders	-0.51 (0.56)	-4.75 (3.47)	-1.70 (1.42)		6.61 (4.74)
Pig iron, spiegeleisen, sponge iron	5.59 (3.04)				10.31 (2.92)
Tubes, pipes and fittings of iron or	-1.32 (1.75)	-0.15 (0.14)	0.61 (0.70)	1.66 (2.35)	-3.96 (3.56)
Iron steel castings forgings unwork	-2.20 (1.48)	-3.54 (2.17)			1.83 (1.80)
Copper	-4.05 (1.79)	0.02 (0.01)	1.38 (0.48)	4.55 (1.89)	-29.43 (4.00)
Aluminium	2.91 (1.96)	-1.02 (0.51)	-6.01 (3.49)	-3.39 (2.47)	2.43 (1.84)
Finished structural parts and struc	0.32 (0.38)	1.22 (1.10)	0.83 (0.85)	2.53 (3.23)	-2.73 (2.21)
Manufactures of metal, nes	0.28 (0.42)	1.05 (1.15)	1.51 (2.02)	1.26 (2.30)	-2.02 (2.46)
Articles of artificial plastic mate	-1.84 (1.77)				2.81 (2.87)
Agricultural machinery and implemen	-0.09 (0.05)	-4.69 (2.17)	-7.35 (4.16)		3.79 (2.09)

## Industries in Which Short-Run Effects Last into the Long-Run

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Textile and leather machinery	-0.34 (0.40)	-3.38 (3.23)	-2.31 (2.45)		1.74 (2.52)
Other electrical machinery and appa	-0.75 (1.19)	-3.46 (3.64)	-2.76 (3.40)		3.04 (5.51)
Clothing except fur clothing	0.76 (2.22)				1.18 (3.96)

## Industries in Which the Long-Run Coefficient is Significantly Positive

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Synth.organic dyestuffs, natural ind	1.54 (2.24)				2.43 (3.77)
Soaps, cleansing & polishing prepara	1.99 (1.95)				3.73 (1.88)
Articles of rubber, nes	2.03 (3.04)				2.98 (3.75)
Textile yarn and thread	-1.44 (1.20)	-3.35 (2.04)	-3.11 (2.32)		3.03 (2.16)
Special textile fabrics and related	0.22 (0.15)	-2.71 (1.39)	-5.39 (3.18)	-3.18 (2.00)	6.54 (3.37)
Textile and leather machinery	-0.34 (0.40)	-3.38 (3.23)	-2.31 (2.45)		1.74 (2.52)
Pig iron, spiegeleisen, sponge iron	5.59 (3.04)				10.31 (2.92)
Other electrical machinery and appa	-0.75 (1.19)	-3.46 (3.64)	-2.76 (3.40)		3.04 (5.51)
Iron steel castings forgings unwork	-2.20 (1.48)	-3.54 (2.17)			1.83 (1.80)
Clothing except fur clothing	0.76 (2.22)				1.18 (3.96)
Aluminium	2.91 (1.96)	-1.02 (0.51)	-6.01 (3.49)	-3.39 (2.47)	2.43 (1.84)
Musical instruments, sound recorders	-0.51 (0.56)	-4.75 (3.47)	-1.70 (1.42)		6.61 (4.74)
Articles of artificial plastic mate	-1.84 (1.77)				2.81 (2.87)
Agricultural machinery and implemen	-0.09 (0.05)	-4.69 (2.17)	-7.35 (4.16)		3.79 (2.09)

## Industries in Which the Long-Run Coefficient is Significantly Negative

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Tubes, pipes and fittings of iron or	-1.32 (1.75)	-0.15 (0.14)	0.61 (0.70)	1.66 (2.35)	-3.96 (3.56)
Copper	-4.05 (1.79)	0.02 (0.01)	1.38 (0.48)	4.55 (1.89)	-29.43 (4.00)
Finished structural parts and struc	0.32 (0.38)	1.22 (1.10)	0.83 (0.85)	2.53 (3.23)	-2.73 (2.21)
Manufactures of metal, nes	0.28 (0.42)	1.05 (1.15)	1.51 (2.02)	1.26 (2.30)	-2.02 (2.46)

## Industries Providing Evidence of Cointegration

Industries	Diagnostic Test F-Statistic
Organic chemicals	5.70
Other inorganic chemicals	7.12
Synth.organic dyestuffs, natural ind	5.43
Medicinal & pharmaceutical products	4.97
Essential oils, perfume and flavour	11.18
Perfumery, cosmetics, dentifrices,	9.58
Manuf.of leather or of artif.or rec	15.80
Articles of rubber, nes	9.02
Textile yarn and thread	6.12
Text fabrics woven ex narrow, spec,	6.59
Special textile fabrics and related	9.57
Made-up articles, wholly or chiefly	7.21
Glassware	5.92
Pearls and precious and semi-precio	22.96
Iron and steel wire, excluding wire	8.17

## Industries Providing Evidence of Cointegration

Industries	Diagnostic Test F-Statistic
Tubes, pipes and fittings of iron or	5.50
Iron steel castings forgings unwork	11.55
Aluminium	9.81
Finished structural parts and struc	6.03
Metal containers for storage and tr	13.70
Power generating machinery, other t	23.74
Agricultural machinery and implemen	11.85
Textile and leather machinery	7.09
Machines for special industries	5.09
Electric power machinery and switch	4.82
Other electrical machinery and appa	21.78
Musical instruments, sound recorders	6.97
Articles of artificial plastic mate	14.01
Manufactured articles, nes	4.77

## Sensitivity Analysis of the Import Model - Empirical Results

### Industries Having Favorable Short-Run Effects of Currency Depreciation

Industries	Short-Run Coefficients			
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$
Wool and other animal hair	-0.70 (0.26)	0.90 (0.31)	6.72 (2.38)	7.49 (3.30)
Crude vegetable materials, nes	-1.47 (1.35)	-1.15 (0.94)	2.64 (2.46)	2.12 (2.06)
Manuf.of leather or of artif.or rec	2.11 (1.21)	-2.56 (1.29)	0.14 (0.08)	3.37 (2.25)
Photographic and cinematographic su	-0.40 (0.62)	-0.08 (0.09)	1.47 (2.11)	1.01 (1.66)



## Industries in Which Short-Run Effects Last into the Long-Run

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Other inorganic chemicals	-1.71 (1.77)				-4.71 (1.71)
Perfumery, cosmetics, dentifrices,	-1.45 (1.49)	-2.15 (2.13)			0.82 (3.53)
Chemical materials and products, nes	-0.64 (1.99)				-1.13 (2.19)
Wood manufactures, nes	-0.29 (0.14)	0.11 (0.06)	-0.09 (0.05)	-3.11 (1.97)	4.07 (1.78)
Pig iron, spiegeleisen, sponge iron	2.27 (1.87)				2.99 (2.07)
Iron and steel bars, rods, angles, sha	-2.07 (2.25)				-2.51 (2.41)
Metal containers for storage and tr	2.44 (3.50)				2.44 (3.50)
Metalworking machinery	2.13 (2.29)	-2.33 (2.25)	-1.50 (1.63)		1.76 (2.25)
Machines for special industries	-0.82 (2.18)				-1.69 (1.80)
Telecommunications apparatus	-0.94 (2.67)				-0.94 (2.67)
Office and stationery supplies, nes	-0.16 (0.24)	-1.62 (1.91)	-3.10 (4.09)	-1.97 (3.02)	2.04 (3.72)

## Industries in Which the Long-Run Coefficient is Significantly Positive

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Perfumery, cosmetics, dentifrices,	-1.45 (1.49)	-2.15 (2.13)			0.82 (3.53)
Wood manufactures, nes	-0.29 (0.14)	0.11 (0.06)	-0.09 (0.05)	-3.11 (1.97)	4.07 (1.78)
Pig iron, spiegeleisen, sponge iron	2.27 (1.87)				2.99 (2.07)
Metal containers for storage and tr	2.44 (3.50)				2.44 (3.50)
Metalworking machinery	2.13 (2.29)	-2.33 (2.25)	-1.50 (1.63)		1.76 (2.25)
Office and stationery supplies, nes	-0.16 (0.24)	-1.62 (1.91)	-3.10 (4.09)	-1.97 (3.02)	2.04 (3.72)

## Industries in Which the Long-Run Coefficient is Significantly Negative

Industries	Short-Run Coefficients				Long-Run Coefficients
	$\Delta \ln RE_t$	$\Delta \ln RE_{t-1}$	$\Delta \ln RE_{t-2}$	$\Delta \ln RE_{t-3}$	$\Delta \ln RE$
Other inorganic chemicals	-1.71 (1.77)				-4.71 (1.71)
Chemical materials and products, nes	-0.64 (1.99)				-1.13 (2.19)
Iron and steel bars, rods, angles, sha	-2.07 (2.25)				-2.51 (2.41)
Machines for special industries	-0.82 (2.18)				-1.69 (1.80)
Telecommunications apparatus	-0.94 (2.67)				-0.94 (2.67)

## Industries Providing Evidence of Cointegration

Industries	Diagnostic Test F-Statistic
Tobacco, unmanufactured	21.98
Wool and other animal hair	4.80
Crude vegetable materials, nes	9.70
Synth.organic dyestuffs, natural ind	9.78
Perfumery, cosmetics, dentifrices,	13.17
Chemical materials and products, nes	4.23
Wood manufactures, nes	4.51
Paper and paperboard	4.45
Tulle, lace, embroidery, ribbons, t	7.20
Special textile fabrics and related	4.48
Made-up articles, wholly or chiefly	5.27
Glassware	6.36
Pig iron, spiegeleisen, sponge iron	5.77
Iron and steel wire, excluding wire	4.61
Iron steel castings forgings unwork	5.02

## Industries Providing Evidence of Cointegration

Industries	Diagnostic Test F-Statistic
Copper	4.69
Aluminium	4.29
Finished structural parts and struc	4.29
Metal containers for storage and tr	17.04
Wire products - ex electric - & fen	6.72
Power generating machinery, other t	7.71
Metalworking machinery	5.28
Machines for special industries	5.98
Telecommunications apparatus	10.41
Domestic electrical equipment	4.46
Road motor vehicles	5.29
Scientific, medical, optical, meas./co	6.56
Developed cinematographic film	6.12
Office and stationery supplies, nes	9.67

## Conclusion

- It follows from the analysis of the pattern of movement of India's trade balance that, while real depreciation of the rupee has short-run effects on India's trade balance, there is not much evidence of favourable long-run effects. While 41 of the 65 industries studied responded significantly to changes in the real depreciation of the rupee in the short-run, initial deterioration was followed by an improvement in only 15 industries. In case of the long-run effects, the real depreciation of the rupee has favourable effects in only three industries.
- The sensitivity analysis reveals that, while the real depreciation of the rupee has significant short-run effects on the exports (inpayments) of about 60 percent of the industries, it has significant positive effects in the long-run for only 22 percent of the industries.
- The sensitivity analysis of imports (outpayments) reveals that the real depreciation has short-run effects in about 40 percent of the industries, but has favorable effects in the long-run in case of only about 8 percent of the industries.

## Policy Implication

The importance of studying the movement of trade balance over time and exchange rate sensitivity of exports and imports stems from the need to determine the appropriate policy responses to attract foreign capital into India, and policy responses will have to be adjusted according to the specific needs and circumstances prevailing in the country. Although real depreciation of the rupee appears to have significant effects on either the trade balance or on the sensitivity of exports and imports of industries in the short-run, the results seem to be a dismal failure as far as long-run effects are concerned. Thus, a policy of managed float rather than one supporting flexible exchange rate might be effective in realizing the continuing efforts of the Government of India to attract foreign capital in sustainable forms in recent years.