

### Estimation of Threshold Inflation

#### Estimates of Threshold Inflation from Past Empirical Studies

Study	Period	Threshold Inflation (Per cent)	Methodology
Chakravarty Committee Report (1985)#		4	
Rangarajan (1998)*		6	Macro Econometric Model
Kannan and Joshi (1998)	1981-96	6-7	
Vasudevan, Bhoi and Dhal (1998)	1961-98	5-7	Correlation/regression
Samantaraya and Prasad (2001)	1970-99	6.5	
Report on Currency and Finance (2001)	1970-2000	5	Sarel's Spline Method
Singh and Kalirajan (2003)	1971-98	No Threshold	Spline regression
Bhanumurthy and Alex (2010)**	1975-2005	5 - 5.5	Spline regression
Singh, Prakash (2010)	1970-2009	6	Spline regression
RBI Annual Report 2010-11		4 - 6	Spline regression, non-linear least squares and Logistic Smooth Transition Regression (LSTR) model.
Pattanaik and Nadhanael (2013)	1972-2011	6	Spline regression, non-linear approach, vector auto regression (VAR)
IMF (2012)	1996-2012	5-6	
Mohanty et al (2011)	1996-2011	4-5.5	Spline regression, non-linear least squares and Logistic Smooth Transition Regression (LSTR) model.
Subbarao (2013)	1996-2012	4.4-5.7	Spline regression, non-linear least squares and Logistic Smooth Transition Regression (LSTR) model.

# cited as accepted rate of rise in prices

\* Rangarajan(1996) observed that the objective of policy should be to keep inflation rate around 6 per cent.

\*\*Using monthly data for January 2000 to April 2007, they suggested 4-4.5 per cent as the threshold.

## 1. Univariate approach

A Logistic Smooth Transition Regression (LSTR) model proposed by Teräsvirta (1994<sup>1</sup>; 1998<sup>2</sup>) is used to estimate the inflation threshold (Espinoza et al. (2010)<sup>3</sup>)

The model specification is as proposed by McAleer & Medeiros (2008)<sup>4</sup> which employs a quasi maximum likelihood (QML) estimator of smooth transition regression with multiple regimes.<sup>5</sup>

$$\Delta y = \alpha + \beta_0 \pi + \sum_{i=1}^M \beta_i W_i (\pi - \pi^*) + \Theta' X + e;$$

$$\text{where } W_i = \frac{1}{(1 + e^{(-\gamma_i (\pi - \pi^*)})})}$$

Quarterly data from 1996-97 to 2012-13 is used in the analysis. Apart from inflation and lagged values of GDP growth, a control variable capturing world GDP growth is also used. GDP growth for OECD countries is used as proxy for world GDP data. The impact of domestic factors is controlled using GDP lags.

### LSTR coefficients of Regression

Parameters	WPI as measure of inflation	CPI -C as measure of inflation
$\alpha$	-0.63 (1.25)	2.13 (1.09)
$\beta_0$	1.72 (0.56)	0.59 (0.20)
$\beta_1$	-1.39 (1.42)	-0.35 (0.47)
$\vartheta_1 (\Delta y_{t-1})$	0.23 (0.13)	0.17 (0.12)
$\vartheta_2 (\Delta y_{t-4})$	0.20 (0.13)	0.14 (0.12)
$\vartheta_3 (\Delta W\_GDP_{t-1})$	0.36 (0.29)	0.16 (0.24)
<b>Inflation threshold</b>	<b>5.8 (0.61)</b>	<b>6.7 (0.20)</b>

**Note :** Figures in parentheses denote standard errors.

<sup>1</sup> Teräsvirta, T. (1994) "Specification, Estimation, and Evaluation of Smooth Transition Autoregressive Models," *Journal of the American Statistical Association*, Vol. 89, pp. 208–218.

<sup>2</sup> Teräsvirta, T. (1998) "Modelling Economic Relationships with Smooth Transition Regressions," in *Handbook of Applied Economic Statistics*, ed. by A. Ullah and D.E. Giles, pp. 507-552, New York: Marcel Dekker.

<sup>3</sup> Espinoza, R., Leon, H., & Prasad, A. (2010) "Estimating the Inflation-Growth Nexus – A Smooth Transition Model" *IMF Working Paper*, WP/10/76

<sup>4</sup> McAleer M., & Medeiros, M.C. (2008). "A multiple regime smooth transition Heterogeneous Autoregressive model for long memory and asymmetries" *Journal of Econometrics* 147, pp 104-119

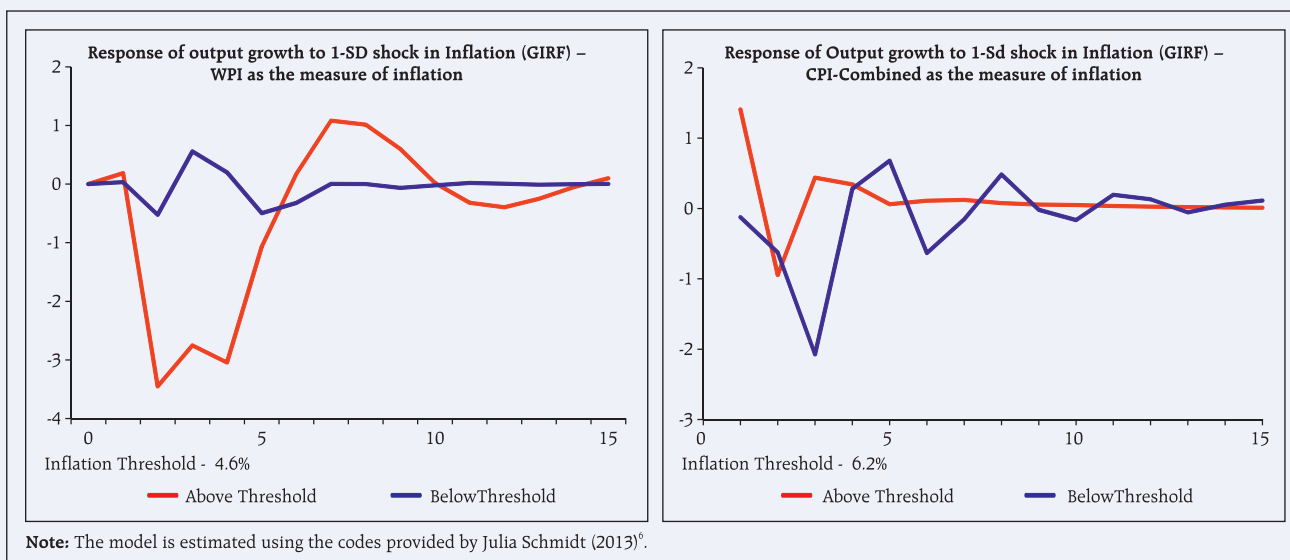
<sup>5</sup> Matlab codes developed by Marcelo C. Medeiros available at <http://sites.google.com/site/marcelocmedeiros/Home/codes>

## 2. Multivariate Approach

A Threshold Vector Auto Regression (TVAR) is a non-linear multivariate system of equations. TVARs approximate the non-linear relationship by several regime-dependent formulations which are linear. Each regime is defined in terms of threshold values and coefficients of the VAR system are specific to each regime. The system of equations that is estimated for the reduced-form VAR with one threshold is given by

$$Y_t = C_1 + \Phi_1(L)Y_t + (C_2 + \Phi_2(L)Y_t) I(\pi_d > \gamma) + \varepsilon_t$$

Where  $Y = \{\pi, GDP, Call, USD\}$  and  $\gamma$  is the inflation threshold.  $\pi$ ,  $GDP$ , and  $USD$  are annualized month-on-month seasonally adjusted growth rates in the price index (WPI or CPI), real GDP and Re/\$ exchange rate, respectively.  $Call$  is the weighted average call money rate representing monetary policy. The estimation is done using quarterly data from 1996-97 to 2012-13.



The chart indicates that in the case of both WPI and CPI-Combined, inflation above threshold reduces output growth.

Cross-country Threshold Inflation Rates			
Country	Threshold Inflation (Per cent)	Country	Threshold Inflation (Per cent)
Armenia	4.5	New Zealand	3
China	2.5	Nigeria	11.2-12
Ghana	11	South Africa	4
Indonesia	8.5- 11	USA	2.5
Mexico	9	India	4-6

**Source:** Compiled from different empirical studies.

<sup>6</sup> Julia Schmidt (2013) "Country risk premia, endogenous collateral constraints and non-linearities: A Threshold VAR approach"