The Transition from Exchange Rate Targeting: The Case of Sri Lanka

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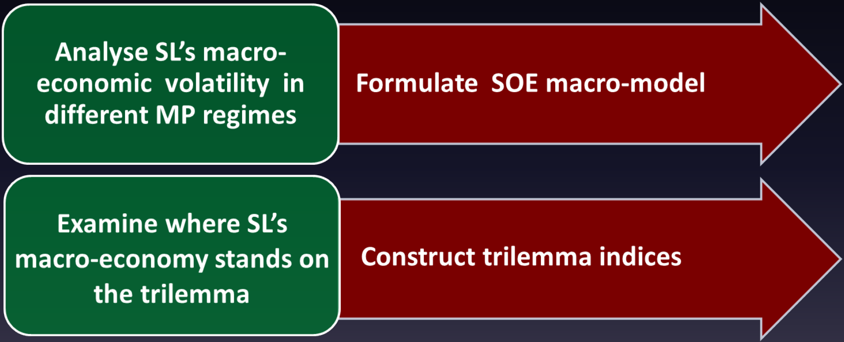
Motivation

Evolution of Monetary & EX Policy Frameworks in SL

Period	Policy changes	MPF
1949	Fixed EX regime	
1968	Dual EX regime	
1977	Introduced open economic policy Managed floating EX regime	E_X
1980s	Established M_T framework	
1991	Liberalised trade & payment systems	
1993	Liberalised CA transactions	M_T
1994	Started to liberalise KA transactions	
2001	Independent floating EX regime	
2003	Established more “active” open market operation	
2015	Established MPF with the features of both M_T & flexible I_T	M_T & FI_T

Research Aims & Approaches



Analyse SL's macro-economic volatility in different MP regimes

Formulate SOE macro-model

Examine where SL's macro-economy stands on the trilemma

Construct trilemma indices

Modelling Approach

- Model: Mundell (1963) – Fleming (1962) type including a Keynesian supply side with
  - exogenous expectations over P, EX, r & the investment yield
- It incorporates two products (differ. as home & foreign) & three primary factors (L, S_K and K) with the CD production technology
- Macro-economy closures
  - Labour markets (W_U & L_D)
  - Fiscal policy (G_N & S_G)
  - Monetary policy targets ($\mathrm{E_X}$, $\mathrm{M_T}$, $\mathrm{Y_N}$, $\mathrm{T_R}$, $\mathrm{I_T}$)
- The simulated economy is not a steady state ($r_c \neq r$)
- Databases: National accounts& international trade & financial data for the SL economy in **2000** and **2015**

Construction of One-SD Shocks: 2015 MD

- Initially, construction of the correlation matrix, $R(\underline{\nu})$ using seasonally adjusted data from 2002Q1 to 2016Q4

Correlation Coefficients & Significance Levels

SV	$R(\underline{\nu})$								
	A	S_K	K	C	Y_D^e	π^e	$p*$	$r*$	e^e
A	1.00								
S_K	0.64*** (0.00)	1.00							
K	0.63*** (0.00)	0.64*** (0.00)	1.00						
C	0.48*** (0.00)	0.44*** (0.00)	0.42*** (0.00)	1.00					
Y_D^e	0.31*** (0.01)	0.41*** (0.00)	0.36*** (0.00)	0.29** (0.03)	1.00				
π^e	-0.22* (0.09)	-0.17 (0.20)	-0.30* (0.02)	-0.37*** (0.00)	-0.38*** (0.00)	1.00			
$p*$	-0.10 (0.46)	-0.11 (0.40)	-0.16 (0.24)	-0.30** (0.02)	0.01 (0.99)	0.34*** (0.01)	1.00		
$r*$	-0.06 (0.62)	0.02 (0.90)	0.03 (0.83)	0.07 (0.57)	-0.24* (0.07)	0.40*** (0.00)	0.12 (0.36)	1.00	
e^e	-0.01 (0.98)	-0.10 (0.43)	-0.18 (0.18)	0.05 (0.72)	-0.34*** (0.01)	0.24** (0.05)	-0.20 (0.13)	0.40** (0.00)	1.00

p values in parentheses ***$p<1\%$ **$p<5\ \%$ *$p<10\%$

Construction of One-SD Shocks: 2015 MD

- Secondly, construction of the variance-covariance matrix, $\Sigma(\underline{\nu})$, based on calibrated correlation matrix, $R'(\underline{\nu})$

Calibrated Correlation Matrix & Variance-covariance Matrix

$R'(\underline{\nu})$

	A	S_K	K	C	Y_D^e	π^e	p^*	r^*	e^e
A	1.0								
S_K	0.6	1.0							
K	0.6	0.6	1.0						
C	0.5	0.4	0.4	1.0					
Y_D^e	0.3	0.4	0.4	0.3	1.0				
π^e	-0.2	0.0	-0.3	-0.4	-0.4	1.0			
p^*	0.0	0.0	0.0	-0.3	-0.1	0.3	1.0		
r^*	0.0	0.0	0.0	0.0	-0.2	0.4	0.0	1.0	
e^e	0.0	0.0	0.0	0.1	-0.3	-0.2	0.0	0.4	1.0

$\Sigma(\underline{\nu})$

	A	S_K	K	C	Y_D^e	π^e	p^*	r^*	e^e
A	2.9								
S_K	1.1	1.2							
K	1.7	1.1	2.7						
C	3.6	1.8	2.9	17.6					
Y_D^e	2.0	1.7	2.7	4.9	15.2				
π^e	-1.8	0.0	-2.7	-8.7	-8.3	28.1			
p^*	0.0	0.0	0.0	-3.9	-1.2	4.9	9.6		
r^*	0.0	0.0	0.0	0.0	-1.6	4.2	0.0	4.0	
e^e	0.0	0.0	0.0	0.7	-2.0	-1.8	0.0	1.4	2.9

Construction of One-SD Shocks: 2015 MD

- Thirdly, calculation of the errors link to each shock considering the individual column vectors of $\Sigma(\underline{\nu})$

Ex: Other shocks link to A

$$\begin{bmatrix} A \\ S_K \\ K \\ \vdots \\ e^e \end{bmatrix} = \begin{bmatrix} A \\ U_2 \end{bmatrix} \text{ where } S_K, K, C, \ldots, e^e = U_2$$

Variance of the vector $[A\ U_2]^T$ can be written as follows;

$$var \begin{bmatrix} A \\ U_2 \end{bmatrix} = \begin{bmatrix} \sigma_A^2 & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{bmatrix} \text{ where } \Sigma_{12} \text{ is } 1\times 8;\ \Sigma_{21} \text{ is } 8\times 1;\ \Sigma_{22} \text{ is } 8\times 8$$

Construction of One-SD Shocks: 2015 MD

Defining the conditional expectation of U_2 given A:

$$E[U_2|A] = \frac{\Sigma_{21}}{\sigma_A^2} A \tag{1}$$

From (1), for $A \epsilon$ [0,σ_A]. Then $E(U_2|A)$=$\left[0, \frac{\Sigma_{21}}{\sigma_A}\right]$

- Finally, construction of the shock vector, ν_A^S, based on other shocks related vector, [Σ_{21}/σ_A], for simultaneous shocks

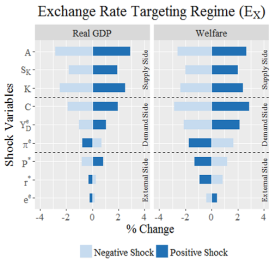
Construction of One-SD Shocks: 2015 MD

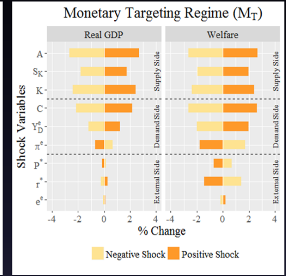
Internal & External Shocks

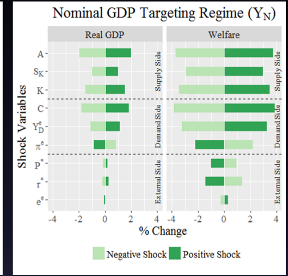
Shock Variable		**One-SD Shocks**								
		A	S_K	K	C	Y_D^e	π^e	$p*$	$r*$	e^e
Supply Side	A	1.7	0.6	0.9	2.2	1.4	-1.1			
	S_K	1.0	1.1	1.0	2.2	1.4				
	K	1.0	0.7	1.7	2.1	1.4	-1.6			
Demand Side	C	0.9	0.6	0.8	4.2	1.0	-1.6	-0.9		0.2
	Y_D^e	0.7	0.4	0.6	1.3	3.9	-1.6	-0.3	-0.4	-0.5
	π^e	-0.3		-0.5	-1.3	-1.0	5.3	0.9	0.8	-0.3
External Side	$p*$				-1.3	-0.4	1.5	3.1		
	$r*$					-0.7	2.1		2.0	0.7
	e^e				0.4	-1.0	-1.1		0.8	1.7

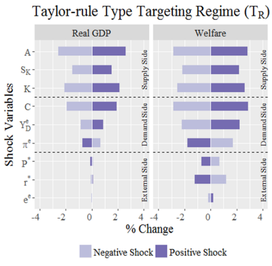
Results: 2015 MD

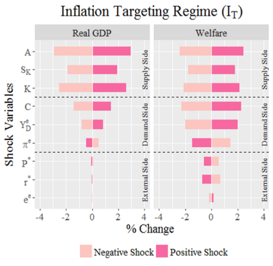
Shocks: with cross correlations


Exchange Rate Targeting Regime (E_X)


Monetary Targeting Regime (M_T)


Nominal GDP Targeting Regime (Y_N)


Taylor-rule Type Targeting Regime (T_R)


Inflation Targeting Regime (I_T)

Construction of One-SD Shocks: 2000 MD

- Seasonally adjusted data from 1995Q1 to 2000Q4

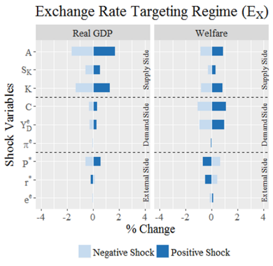
Correlation Coefficients& Significance Levels

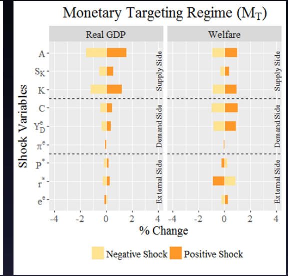
SV	$R(\underline{\nu})$								
	A	S_K	K	C	Y_D^e	π^e	$p*$	$r*$	e^e
A	1.00								
S_K	0.19	1.00							
	(0.37)								
K	0.39*	0.08	1.00						
	(0.06)	(0.71)							
C	0.05	-0.35*	0.14	1.00					
	(0.81)	(0.09)	(0.50)						
Y_D^e	-0.09	-0.38*	-0.30	0.25	1.00				
	(0.68)	(0.07)	(0.16)	(0.24)					
π^e	0.13	0.19	-0.11	-0.12	-0.32	1.00			
	(0.56)	(0.37)	(0.61)	(0.57)	(0.13)				
$p*$	-0.30	-0.05	-0.52*	0.17	0.31	0.38*	1.00		
	(0.15)	(0.83)	(0.06)	(0.43)	(0.13)	(0.07)			
$r*$	-0.01	0.19	-0.12	-0.22	-0.08	0.18	0.24	1.00	
	(0.98)	(0.37)	(0.57)	(0.31)	(0.73)	(0.40)	(0.27)		
e^e	0.17	0.16	0.22	0.14	-0.51*	0.29	-0.29	-0.31	1.00
	(0.43)	(0.44)	(0.31)	(0.52)	(0.06)	(0.16)	(0.17)	(0.13)	

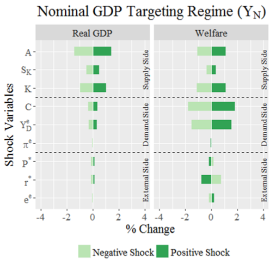
p values in parentheses ***$p<1\%$ **$p<5$ % *$p<10\%$

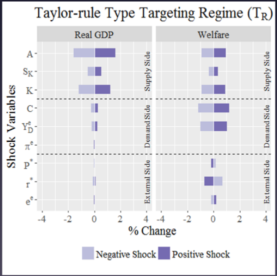
Results: 2000 MD

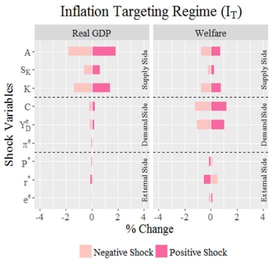
Shocks: without cross correlations











CB Loss Function

Approach: Svensson (1999, 2000, 2003, 2009) & Walsh (2010)

$$L = -[\gamma(\hat{\pi})^2 + (1-\gamma)(\hat{Y}_R)^2] \qquad (2)$$

CB Loss Function: 2015 (with cross correlations)

SV	$\gamma = 0.3$					$\gamma = 0.7$				
	$\mathrm{E_X}$	$\mathrm{M_T}$	$\mathrm{Y_N}$	$\mathrm{T_R}$	$\mathrm{I_T}$	$\mathrm{E_X}$	$\mathrm{M_T}$	$\mathrm{Y_N}$	$\mathrm{T_R}$	$\mathrm{I_T}$
A	-6.4	-6.3	-5.4	-5.7	-6.7	-2.8	-2.7	-7.4	-3.0	-2.9
S_K	-2.3	-2.5	-2.0	-2.2	-2.5	-1.0	-1.1	-3.2	-1.1	-1.1
K	-4.1	-4.5	-3.9	-4.0	-4.7	-1.8	-1.9	-5.9	-2.1	-2.0
C	-3.1	-3.4	-3.3	-2.7	-2.5	-1.4	-1.5	-6.6	-1.4	-1.2
Y_e^D	-0.8	-1.1	-2.7	-0.7	-0.7	-0.4	-0.7	-6.3	-0.3	-0.3
π^e	-0.5	-0.5	-1.5	-0.5	-0.6	-0.3	-0.5	-3.3	-0.4	-0.2
$P*$	-1.5	-0.2	-0.3	-0.1	-0.0	-3.1	-0.1	-0.7	-0.1	-0.0
$r*$	-0.1	-0.6	-0.6	-0.2	-0.0	-0.1	-1.3	-1.3	-0.4	-0.0
e^e	-0.2	-0.0	-0.0	-0.0	-0.0	-0.4	-0.0	-0.1	-0.0	-0.0

CB Loss Function

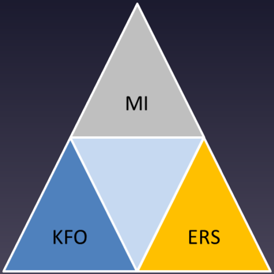
CB Loss Function: 2015 (with cross correlations)

SV	$\gamma = 0.5$				
	E_X	M_T	Y_N	T_R	I_T
A	-4.6	-4.5	-6.4	-4.3	-4.8
S_K	-1.7	-1.8	-2.6	-1.6	-1.8
K	-3.0	-3.2	-4.9	-3.0	-3.4
C	-2.2	-2.4	-5.0	-2.0	-1.9
Y_e^D	-0.6	-0.9	-4.5	-0.5	-0.5
π^e	-0.4	-0.5	-2.4	-0.5	-0.4
$P*$	-2.3	-0.1	-0.5	-0.1	-0.0
$r*$	-0.1	-1.0	-0.9	-0.3	-0.0
e^e	-0.3	-0.0	-0.0	-0.0	-0.0

Trilemma Configuration in SL

- Managing trilemma indices are one of the key challenges that any CB would have to overcome as it moves towards different MP regimes
- The CBSL expects to formalise flexible I_T regime, therefore it is important to know where SL's macro-economy stands on the trilemma

- Sample period from 1990-2015
  - 1990-2000: M_T (with "managed" floating EX)
  - 2001-11: M_T (with "Independent floating" EX)
  - 2012-15: M_T (with "floating" EX)



Trilemma Configuration in SL

Construction of trilemma indices for SL

Approach: Aizenman et.al (2008, 2010a b) - for I^{M} & I^{ER}

$$I_t^M = 1 - \left[\frac{corr(i_i, i_j) - (-1)}{1 - (-1)} \right] \tag{3}$$

Quarterly correlation of the monthly interest rate on 91-day government securities between SL & the US

$$I_t^{ER} = \frac{0.01}{0.01 + SD[\Delta log\{E_{US}\}]} \tag{4}$$

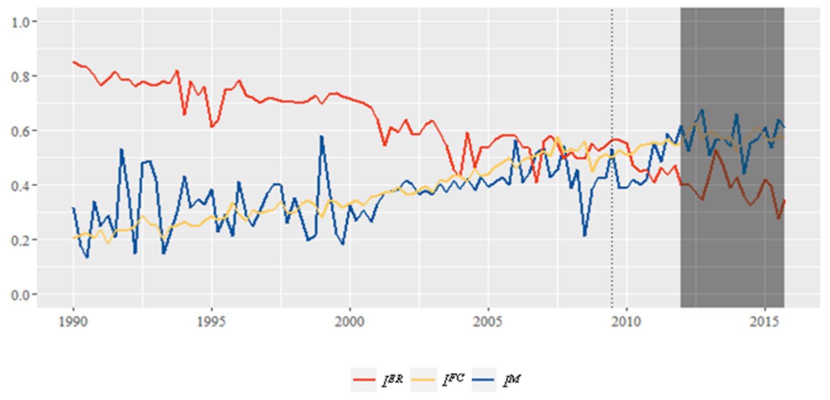
Quarterly SD of the monthly log-change in the EX between LKR & the US$

$$I_{it}^{FC} = \frac{|NKF|}{GDP} \tag{5}$$

Financial capital flows: BMM flows, PDE flows, Changes in R & FDI

Trilemma Configuration in SL

The Financial Trilemma Evolution



Trilemma Configuration in SL

Soundness of trilemma framework in SL

$$2 = \alpha I_t^{M} + \beta I_t^{ER} + \gamma I_{it}^{FC} + \varepsilon_t \tag{6}$$

Testing Validity & Contributions of the Trilemma Framework

		1990-2000	2001-2011	2012-2015
Mean:	I^M	0.31	0.43	0.58
	I^{ER}	0.74	0.54	0.39
	I^{FC}	0.28	0.47	0.57
Coefficients:	I^M	0.22*	0.44*	0.60**
		(0.12)	(0.25)	(0.26)
	I^{ER}	1.93***	1.96***	1.52***
		(0.08)	(0.14)	(0.28)
	I^{FC}	1.76***	0.159***	1.83***
		(0.21)	(0.23)	(0.32)
Observations		44	44	16
R^2		0.998	0.997	0.998
Contributions:	I^M	0.07	0.19	0.35
	I^{ER}	1.41	1.05	0.59
	I^{FC}	0.49	0.75	1.06
Sum of contributions		1.97	1.99	1.96

Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Summary

Shocks analysis

- Faced with the supply-side shocks
  - nominal GDP targeting regime most stable output path
  - but, the corresponding welfare measure is best stabilised by I_T
- I_T performs most consistently in controlling output & welfare volatility in the face of demand & external side shocks
- Demand and external shocks record less welfare loss in the CB loss function in I_T and T_R regimes. Supply side shocks
  - if $\gamma = 0.3$, less loss under the Y_N regime
  - if $\gamma = 0.5$, less loss under the T_R regime
  - if $\gamma = 0.7$, less loss under the E_X & M_T regimes

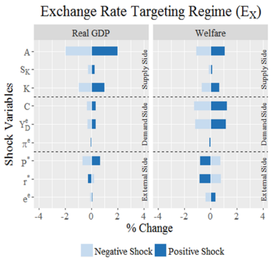
Trilemma analysis

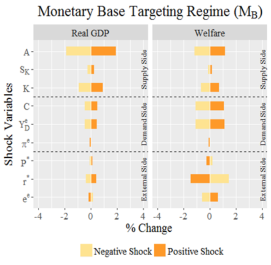
The CBSL is gaining greater MI and EX flexibility in recent years, places the CBSL in a reasonably good position to move toward inflation anchored MP regime

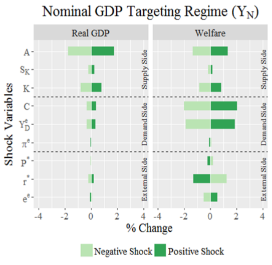
Thank you for your attention

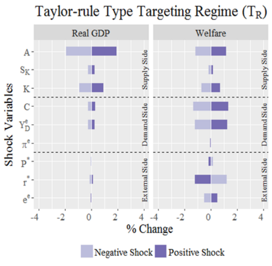
Results: 2015 MD

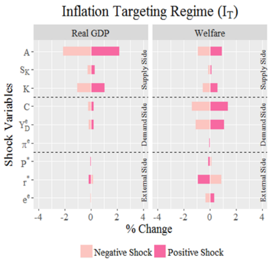
Shocks: without cross correlations











CB Loss Function

CB Loss Function: 2015 (without cross correlations)

SV	$\gamma = 0.3$					$\gamma = 0.7$				
	E_X	M_T	Y_N	T_R	I_T	E_X	M_T	Y_N	T_R	I_T
A	-2.9	-2.8	2.7	-2.8	-3.3	-1.0	-1.6	-2.1	-1.6	-1.4
S_K	-0.1	-0.1	-0.1	-0.1	-0.1	-0.0	-0.0	-0.0	-0.0	-0.0
K	-0.7	-0.7	-0.7	-0.7	-0.8	-0.3	-0.4	-0.7	-0.4	-0.3
C	-0.1	-0.4	-1.2	-0.1	-0.0	-0.2	-0.6	-2.6	-0.1	-0.0
Y_D^e	-0.1	-0.4	-1.0	-0.1	-0.0	-0.1	-0.5	-2.2	-0.0	-0.0
π^e	-0.2	-0.2	-0.3	-0.2	-0.1	-0.2	-0.2	-0.3	-0.2	-0.0
$P*$	-1.8	-0.2	-0.2	-0.0	-0.0	-3.7	-0.3	-0.2	-0.0	-0.0
$r*$	-0.1	-1.1	-0.5	-0.3	-0.0	-0.1	-2.3	-1.1	-0.6	-0.0
e^e	-0.0	-0.0	-0.1	-0.1	-0.0	-0.0	-0.0	-0.2	-0.1	-0.0

CB Loss Function

CB Loss Function: 2015 (without cross correlations)

SV	$\gamma = 0.5$				
	$\mathrm{E_X}$	$\mathrm{M_T}$	$\mathrm{Y_N}$	$\mathrm{T_R}$	$\mathrm{I_T}$
A	-2.2	-2.2	-2.4	-2.2	-2.4
S_K	-0.0	-0.0	-0.0	-0.0	-0.0
K	-0.5	-0.5	-0.7	-0.5	-0.6
C	-0.1	-0.5	-1.9	-0.1	-0.0
Y_D^e	-0.1	-0.4	-1.6	-0.1	-0.0
π^e	-0.2	-0.2	-0.3	-0.2	-0.1
$P*$	-2.8	-0.2	-0.2	-0.0	-0.0
$r*$	-0.1	-1.7	-0.8	-0.5	-0.0
e^e	-0.0	-0.0	-0.1	-0.1	-0.0

CB Loss Function

CB Loss Function: 2000 (without cross correlations)

SV	$\gamma = 0.3$					$\gamma = 0.7$				
	E_X	M_T	Y_N	T_R	I_T	E_X	M_T	Y_N	T_R	I_T
A	-2.0	-1.9	1.8	-1.9	-2.4	-1.0	-1.1	-1.5	-1.1	-1.0
S_K	-0.2	-0.2	-0.2	-0.2	-0.3	-0.1	-0.1	-0.2	-0.1	-0.1
K	-1.2	-1.2	-1.1	1.1	-1.4	-0.6	-0.6	-1.2	-0.6	-0.6
C	-0.1	-0.3	-1.0	-0.1	-0.0	-0.1	-0.4	-2.1	-0.0	-0.0
Y_D^e	-0.1	-0.2	-0.7	-0.0	-0.0	-0.1	-0.3	-1.6	-0.0	-0.0
π^e	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.0
$P*$	-1.2	-0.0	-0.0	-0.0	-0.0	-2.4	-0.1	-0.0	-0.0	-0.0
$r*$	-0.1	-0.4	-0.2	-0.1	-0.0	-0.1	-0.9	-0.4	-0.2	-0.0
e^e	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1	-0.0	-0.0	-0.0

CB Loss Function

CB Loss Function: 2000 (without cross correlations)

SV	$\gamma = 0.5$				
	$\mathrm{E_X}$	$\mathrm{M_T}$	$\mathrm{Y_N}$	$\mathrm{T_R}$	$\mathrm{I_T}$
A	-1.5	-1.5	-1.6	-1.5	-1.7
S_K	-0.2	-0.2	-0.2	-0.2	-0.2
K	-0.9	-0.9	-1.1	-0.9	-1.0
C	-0.1	-0.3	-1.5	-0.0	-0.0
Y_D^e	-0.1	-0.2	-1.1	-0.0	-0.0
π^e	-0.1	-0.1	-0.1	-0.1	-0.1
$P*$	-1.8	-0.1	-0.0	-0.0	-0.0
$r*$	-0.1	-0.7	-0.3	-0.2	-0.0
e^e	-0.0	-0.1	-0.0	-0.0	-0.0

Extensions

- **Trilemma analysis**

Testing Validity & Contributions of the Trilemma Framework

	1990-2000	2001-2011	2012-2015	2012-2016
Observations	44	44	16	20
R^2	0.998	0.997	0.998	0.996
Contributions: I^M	0.07	0.19	0.35	0.33
I^{ER}	1.41	1.05	0.59	0.58
I^{FC}	0.49	0.75	1.06	1.03