

The impact of inflation targeting on inflation volatility

Presenter
SALIMOV Muhammad
51218628

Motivation

2

- Overall inflation rates has been reduced , especially in Advanced Economies
- Inflation still and issue in Developing Economies
- Tajikistan has been concerning to shift towards Inflation targeting regime
- Inflation causes a lot of costs to the economy: uncertainty, resource allocation, speculation;

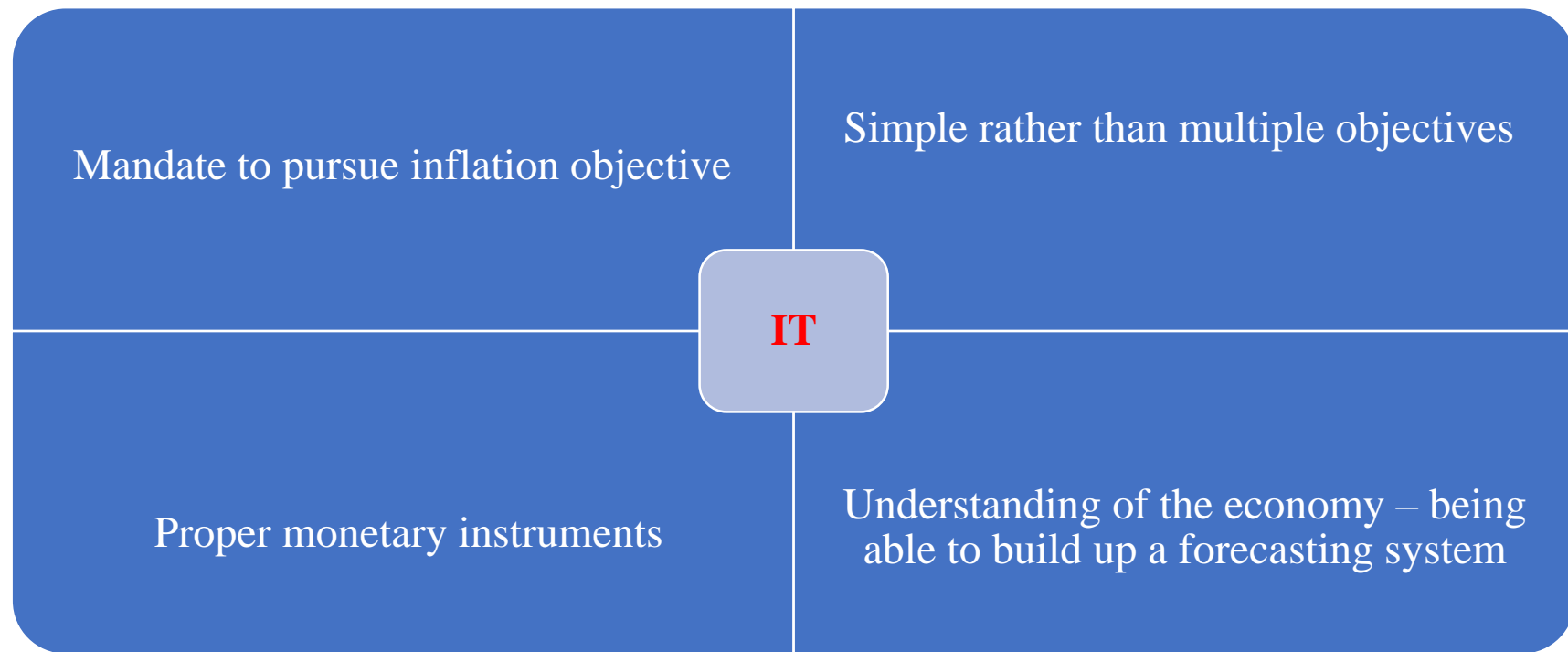
Research

3

- After 1990s many countries moved towards IT policy;
- There is ongoing debate on the effectiveness of Inflation targeting policy;
- Impact on inflation variability in emerging market economies
- Does inflation targeting policy reduce inflation and inflation volatility?

Why Inflation targeting makes difference?

4



Source: (IMF Staff Papers, 2015; Ötker & Freedman, 2010)

Literature

- Inflation targeting has not clear effects on reducing volatility, because same objective (Ball & Sheridan, 2003; Petursson, 2004);
- IT policy effective on reducing dollarization and enhancing monetary policy frameworks (Lin, 2010, 2011; Lin & Ye, 2013)
- Inflation targeters: Advanced economies vs. emerging and developing countries (Lee, 2011; Batini & Laxton, 2006);
- Preconditions matters for successful adoption (Lauren et al., 2015; Fouejieu, 2017; Ismailov et al., 2016)

Data

6

- Data was compiled from World Development Indicators, IFS, and OECD from **1980 – 2018** for 186 countries
- Sample consists of **38 Targeting** countries (13 AEs and 25 EMEs) and all **148 non – Targeting** countries.

Variable name	Variable Label	Obs.	Mean	Std. Dev.
m2/res	M2/Total reserves ratio	5804	8.41	54.83
res/imp	Total reserves in months of imports	5954	4.26	4.36
m2	M2 growth (annual %)	6400	26.67	209.40
def	CPI change % yoy	6636	17.89	126.77
m2/y	Broad money (% of GDP)	6645	47.78	36.13
cpi	CPI (base year 2010 = 100)	6825	62.17	79.31
π100	Inflation rate >100	7040	8.52	11.46
π	Inflation change in consumer prices (annual %)	7158	17.69	125.95
ave_lm2	Log of M2	8050	24.17	3.41
ave_lm2_g	Log of M2 growth rates	8050	2.68	0.50
ave_M2g	Average M2 growth	8050	27.64	52.16
sd_lm2	Standard deviations of log of M2	8050	2.10	1.62
sd_lm2_g	Standard deviations of log of M2 growth rates, %	8050	0.84	0.27
er	Nominal exchange rates, average	8314	808977.80	73700000.00
gdpc_g	GDP per capita growth rates (annual %)	8434	2.08	6.12
gdp_y	GDP growth (annual %)	8437	3.79	6.29
inf_def	Inflation, GDP deflator (annual %)	8449	24.57	279.55
sd_linf	Standard deviations of log inflation rates	9600	1.00	0.39
code	group (CountryCode)	11050	111.00	63.80
TJKdummy	Dummy for TJK	11050	0.00	0.07
treated	Targeting countries	11050	0.19	0.39
time	Time dummy for starting point of IT	11050	0.05	0.22
class	Country classifications (AEs or EMDEs)	11050	0.18	0.38
7 mean	Mean of inflation rate in the pre-adoption period	11050	17.99	50.21
comsup	Dummy for obs. in common support	11050	0.08	0.28

List of Inflation targeting countries

8

Countries	Year of adoption	Target range/point
Advanced Economies		
New Zealand	1990	1-3
Canada	1991	2+/-1
Switzerland	1991	2+/-1
United Kingdom	1992	2
Australia	1993	2-3
Sweden	1993	2
Czech Republic	1997	3+/-1
Israel	1997	2+/-1
Iceland	2001	2.5+/-1.5
Korea	2001	3+/-1
Norway	2001	2.5+/-1
United States	2012	2
Japan	2013	2

Countries	Year of adoption	Target range/point
Emerging market economies		
Colombia	1997	2-4
Poland	1998	2.5+/-1
Chile	1999	3+/-1
Brazil	1999	4.5+/-2
Thailand	2000	0.5-3
South Africa	2000	3-6
Mexico	2001	3+/-1
Hungary	2001	3+/-1
Philippines	2002	4+/-1
Peru	2002	2+/-1
Romania	2005	3+/-1
Indonesia	2005	5+/-1
Guatemala	2005	5+/-1
Turkey	2006	5.5+/-2
Serbia	2006	4-8
Armenia	2006	4.5+/-1.5
Uruguay	2007	3-7
Ghana	2007	8.5+/-2
Georgia	2009	3
Albania	2009	3+/-1
Uganda	2011	5
Paraguay	2011	4.5
Dominican Republic	2012	3-5
Moldova	2013	3.5-6.5
Russia	2015	4
Kazakhstan	2015	4
India	2015	2-6
Ukraine	2017	5+/-1
Jamaica	2017	4-6

Methodology

9

□ DID estimation models with interaction dummy

$$\square \pi_{it} = \beta_1 + \beta_2 \pi_{it-1} + \beta_3 GDP_{it} + \beta_4 REER_{it} + \beta_5 \mathbf{RIR}_{it} + \beta_6 ER_{it} + \beta_7 M2_{it} + \beta_8 M2/GDP_{it} + \beta_9 RES_{it} + \delta treated_{it} * time_{it} + e_{it}$$

□ Treatment effects before-and-after analysis

- Difference-in-Differences estimation $\pi_{it} = \gamma_{s(i)} + \beta_t + \beta I_{it} + \varepsilon_{it}$

- Matching methods (Propensity scores)

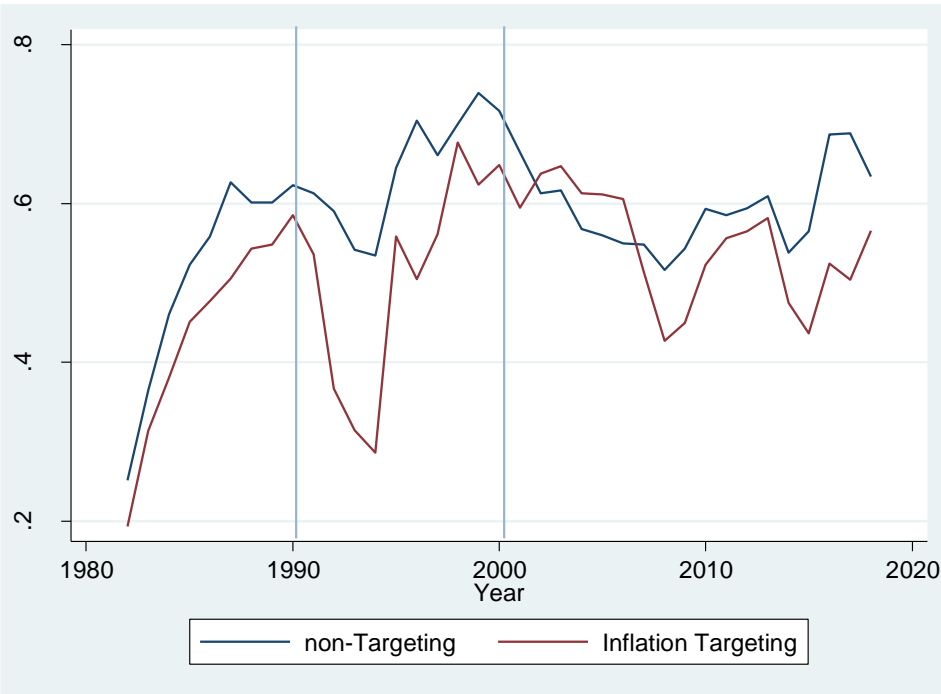
- $ATT = E[Y_{i1} | D_i = 1, X_i] - E[Y_{i0} | D_i = 0, X_i]$

Standard Deviations of inflation rates	(1) OLS sample	(2) FE Pool sample	(3) Inflation targeting	(4) Non-Inflation targeting
Inflation rates, lag (-1)	-0.215*** (-17.10)	-0.171*** (-12.96)	-0.146*** (-5.95)	-0.177*** (-11.95)
Real Effective Exchange rates	-0.286*** (-4.95)	-0.185** (-2.90)	-0.243* (-2.18)	-0.173* (-2.16)
Exchange rates volatility	0.573*** (14.13)	0.469*** (11.14)	0.964*** (5.05)	0.470*** (10.39)
GDP growth	-0.0297* (-2.07)	-0.0424** (-3.08)	0.00668 (0.32)	-0.0550*** (-3.45)
GDP per capita growth	-0.0621*** (-4.89)	-0.169* (-2.21)	0.0156 (0.13)	-0.266** (-2.81)
Broad Money (M2)	-0.0182*** (-5.01)	-0.0267 (-1.77)	-0.0644* (-2.11)	-0.0104 (-0.58)
Reserves-to-months of imports	0.00633* (2.04)	0.00136 (0.34)	-0.00331 (-0.38)	0.000130 (0.03)
M2-to-GDP ratio	-0.00153*** (-3.59)	-0.00328*** (-3.60)	-0.000892 (-0.61)	-0.00414*** (-3.90)
1.did	-0.0619 (-0.48)	-0.201 (-1.20)	-0.216* (-2.06)	
_cons	3.261*** (10.26)	4.093*** (7.02)	3.329** (2.99)	4.624*** (6.71)
<i>N</i>	1183	1183	190	993
adj. <i>R</i> ²	0.248	0.164	0.235	0.168

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Inflation volatility in Inflation Targeting vs. non-Targeting countries

11

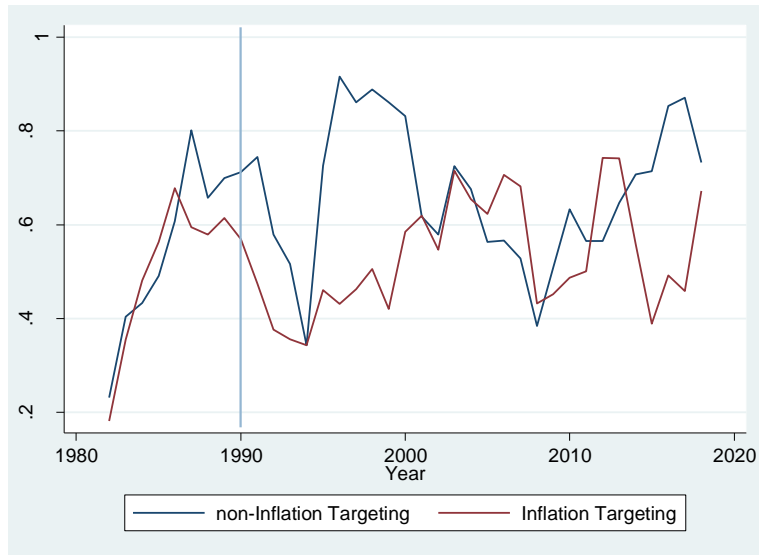


- The overall sample from 1980 includes both Advanced Economies and Emerging market economies
- Used the standard deviations of inflation moving average for 5 years
- We can see the significant reduction of inflation variability in both countries

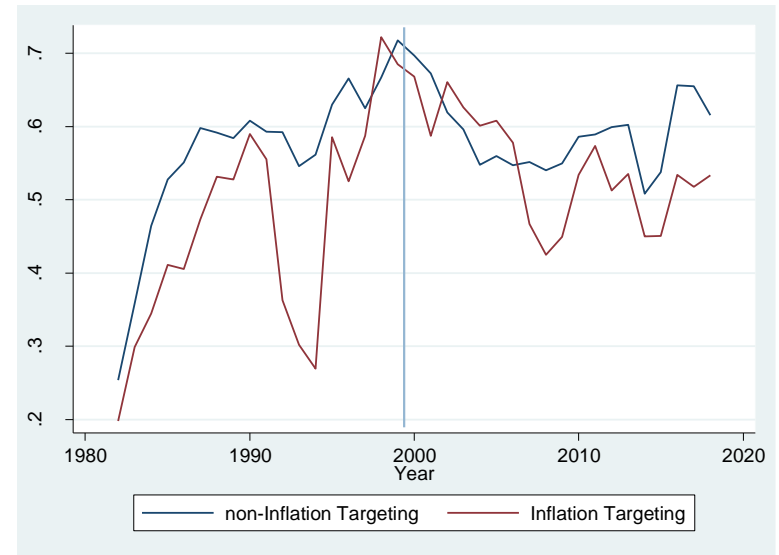
Comparison in different country samples

12

Advanced Economies



Emerging-developing markets



Estimation with Data restrictions

13

- Our model has problems with the high inflation
- Several countries suffer from hyperinflation episodes
- We will drop out the data on inflation if it is higher than $>100\%$ annually

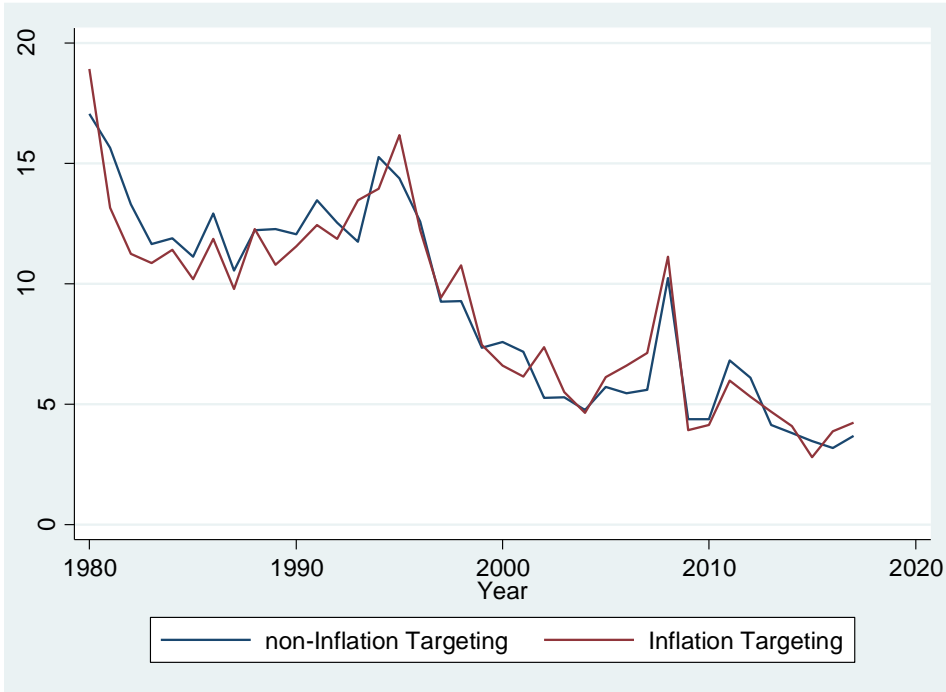
INF_sd excluding hyperinflation episodes	(FE)	(RE)	(FE)	(RE)	(FE)	(RE)
	Overall	Overall	Inflation targeting	Inflation Targeting	Non-Inflation Targeting	Non-Inflation Targeting
Inflation lag (-1)	0.167 (1.09)	0.530*** (3.51)	-0.0587 (-0.13)	0.230 (0.50)	0.114 (0.72)	0.436** (2.80)
Real Effective Exchange rates	-1.480* (-2.09)	-0.294 (-0.43)	-1.535 (-0.79)	1.956 (1.45)	-1.475* (-1.67)	-1.970* (-2.33)
Real Interest Rates	0.0174 (1.09)	0.0282* (1.83)	-0.0242 (-0.79)	-0.0470 (-1.53)	0.0538** (2.81)	0.0714*** (4.02)
Exchange rate volatility	9.018*** (12.20)	10.76*** (14.50)	27.49*** (8.39)	27.11*** (8.89)	7.744*** (10.50)	8.978*** (12.05)
GDP growth annual, in % ln	-0.346* (-2.24)	-0.329* (-2.09)	-0.151 (-0.40)	0.0486 (0.12)	-0.302* (-1.82)	-0.370* (-2.19)
GDP per capita growth	1.442* (1.63)	-0.659* (-2.33)	3.653* (1.68)	-1.512** (-2.65)	1.534 (1.46)	-0.571* (-1.70)
Broad Money M2	-1.865*** (-9.83)	-0.379*** (-4.97)	-1.861*** (-3.48)	-0.286* (-1.76)	-1.876*** (-8.12)	-0.352*** (-4.14)
Reserves/Months of imports ratio	0.0904 (1.41)	0.0995* (1.69)	0.0577 (0.33)	0.0955 (0.70)	0.0959 (1.35)	0.0885 (1.33)
M2/ GDP ratio	0.0151 (1.47)	-0.0103 (-1.35)	-0.0201 (-0.68)	0.0214 (0.99)	0.0215* (1.95)	-0.0118 (-1.38)
1.did	0.740 (0.44)	-0.448 (-0.29)	1.192 (0.67)	2.038 (1.38)		
_cons	43.84*** (6.39)	19.23*** (4.40)	25.24 (1.31)	9.435 (0.91)	42.95*** (5.69)	25.72*** (5.24)
<i>N</i>	932	932	165	165	767	767
adj. <i>R</i> ²	0.335	0.399	0.444	0.596	0.348	0.395

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Inflation variability excluding hyperinflation episodes Inflation Targeting vs. non-Inflation Targeting

15

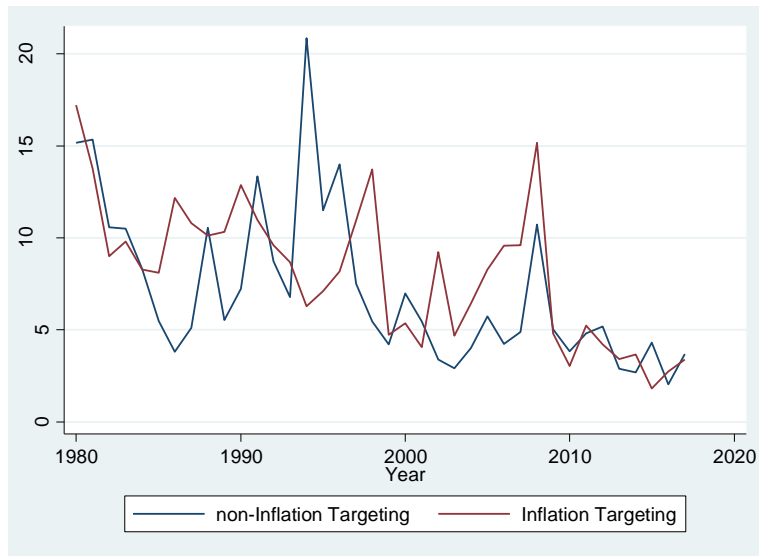


- We will exclude the hyperinflation episodes from our sample
- There is not much reducing on inflation volatility in comparison with the Inflation targeting and non-Inflation targeting countries

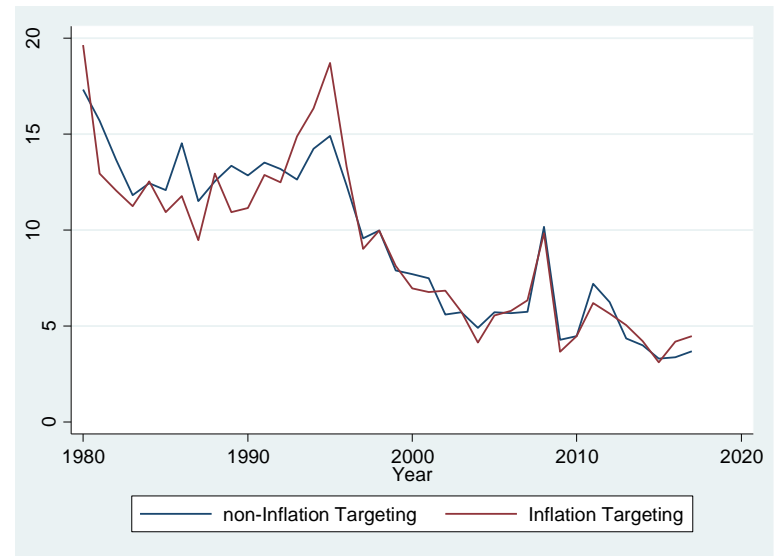
Does inflation targeting makes differences in Advanced economies?

16

Advanced Economies

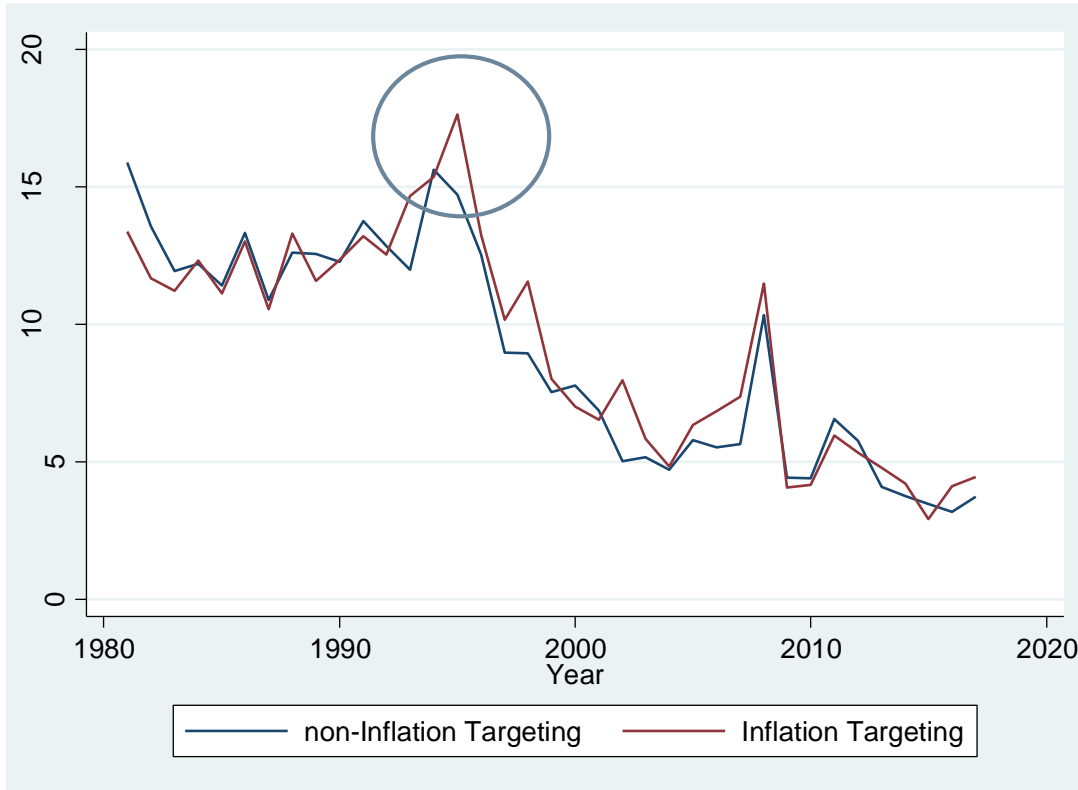


Emerging-developing Economies



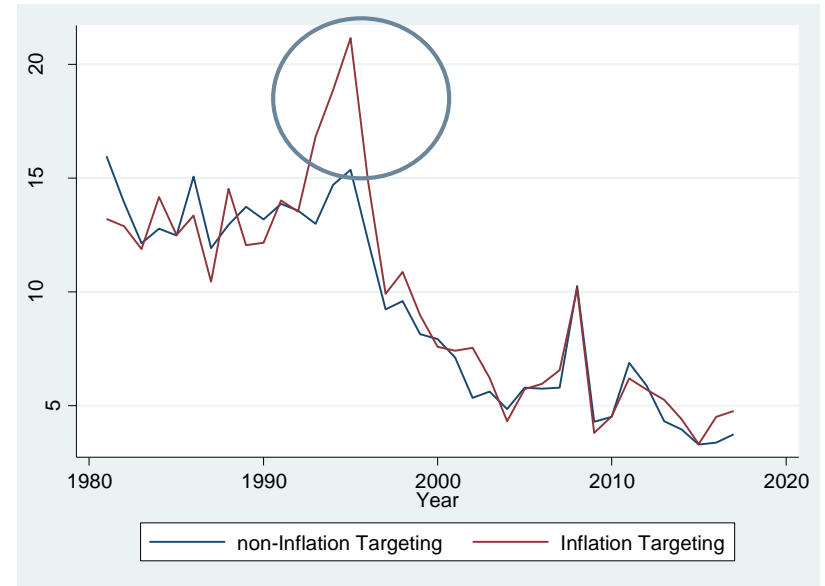
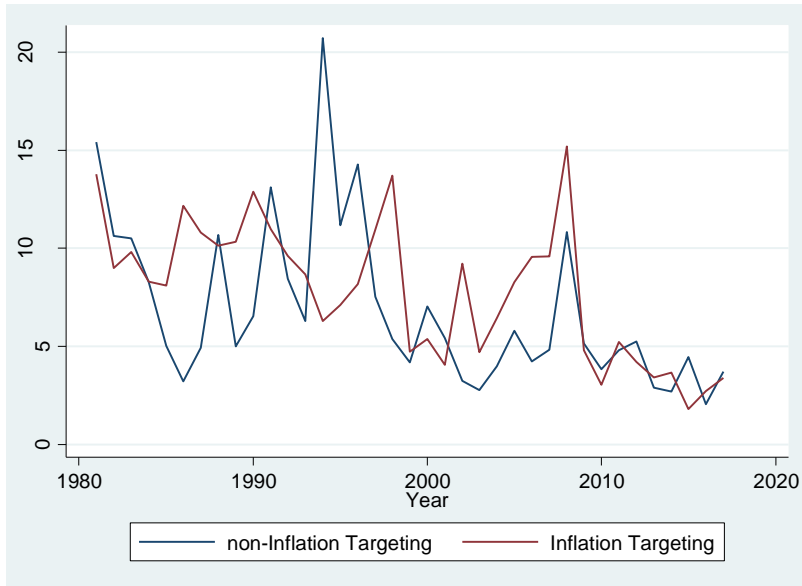
Empirical results: inflation rates

17



Target vs. non-Target

18



DID estimations: Actual vs. Restricted

19

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 861

	Before	After	
Control:	666	49	715
Treated:	138	8	146
	804	57	

Report - Covariates and coefficients:

Outcome var.	inf	S. Err.	t	P> t
Before				
Control	42.113			
Treated	41.241			
Diff (T-C)	-0.872	0.492	-1.77	0.076*
After				
Control	43.579			
Treated	38.879			
Diff (T-C)	-4.700	2.328	2.02	0.043**
Diff-in-Diff	-3.828	2.296	1.67	0.095*

R-square: 0.42

* Means and Standard Errors are estimated by linear regression

Inference: * p<0.01; ** p<0.05; * p<0.1

DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 858

	Before	After	
Control:	663	49	712
Treated:	138	8	146
	801	57	

Outcome var.	INF	S. Err.	t	P> t
Before				
Control	29.283			
Treated	28.826			
Diff (T-C)	-0.457	0.535	-0.85	0.393
After				
Control	29.759			
Treated	27.551			
Diff (T-C)	-2.208	1.655	1.33	0.182
Diff-in-Diff	-1.751	1.634	1.07	0.284

R-square: 0.46

* Means and Standard Errors are estimated by linear regression

Inference: * p<0.01; ** p<0.05; * p<0.1

Matching Estimations

Inflation volatility, standard deviations	Propensity score matching	Nearest neighbor matching	Kernel Matching	Stratification Matching
Baseline Model	-0.215*** (0.023)	-0.048* (0.051)	-0.056 (0.169)	0.129 (0.155)
No hyperinflation episodes	-1.097** (0.247)	-0.046 (0.404)	-0.021 (1.231)	0.117 (1.571)

*Bootstrapped standard errors reported in parentheses based on 500 bootstrap replication of the data. Significance level is *, ** and *** are 10%, 5%, and 1% respectively.*

Conclusion (1)

- Research investigates the inflation variability after the adoption period, that significantly reduces inflation variability and quantitatively large impact
- Applying DID analysis we found out that Inflation targeting has a significant impact on reducing the inflation volatility
- However, after excluding hyperinflation episodes from the dataset, we found not significant reduction on inflation volatility
- The reason is because countries who try to adopt inflation they had relatively higher inflation previously to reduce inflation
- To sum up inflation does reduce inflation, but financial market development, economic base, exchange rate vulnerability to external sector matters in the EMDEs.

Conclusion (2)

- Although IT did not reduce inflation volatility after removing outliers, however it did not make inflation a major problem
- However, country fundamental developments matters in terms of implementing Targeting regime
- Most of the countries have a price stability as a mandate, therefore all the countries has been trying to reduce inflation volatility after 1980-1990s inwards

23

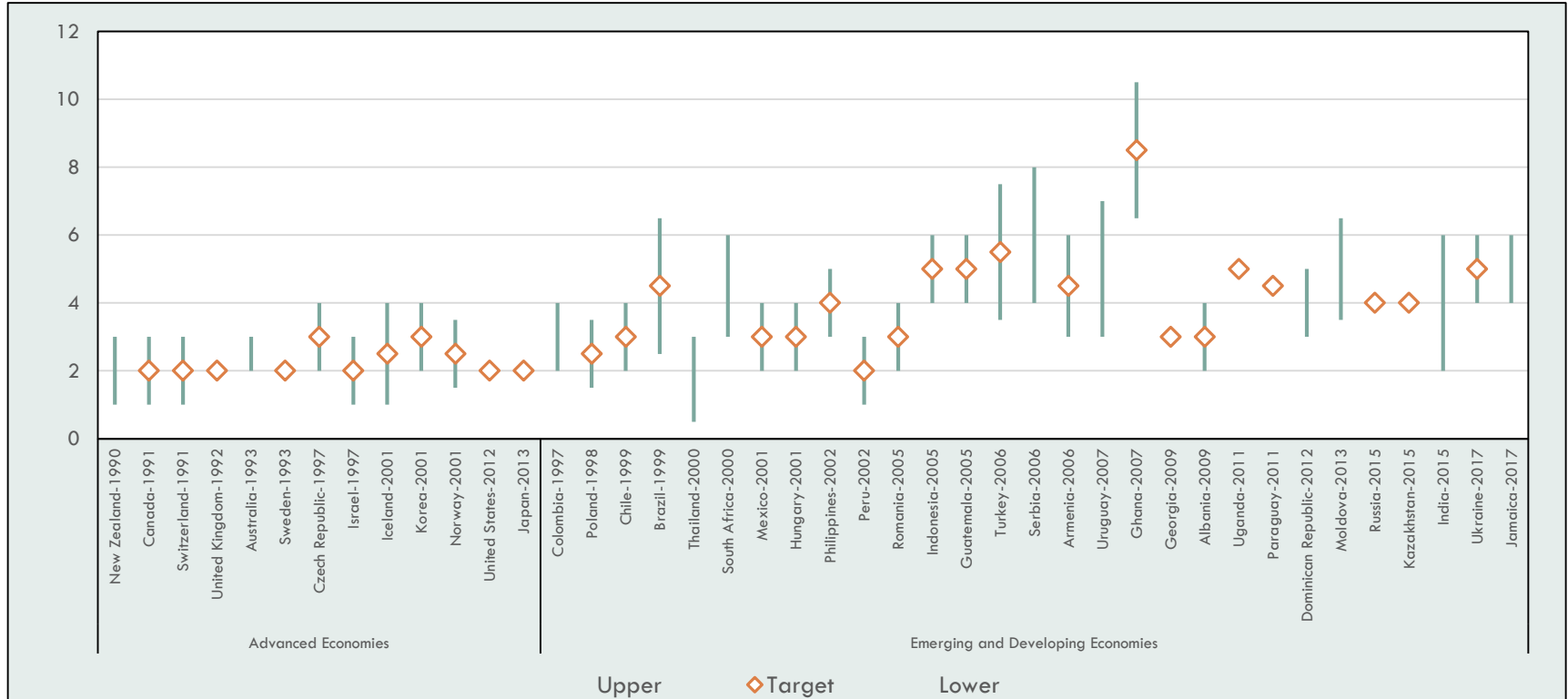
Thanks for your attention!

Q&A

24

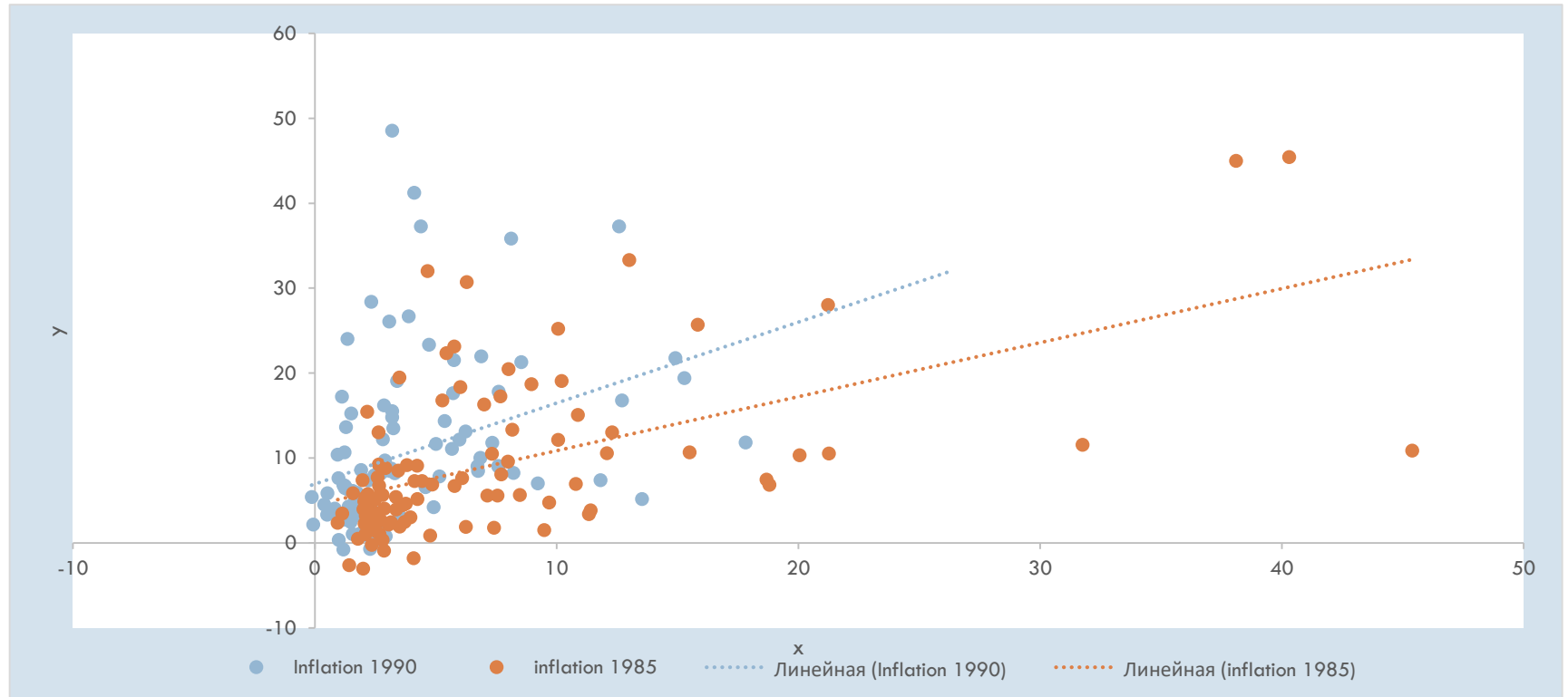
Appendices

Target point and ranges of inflation



Initial inflation rates to last years inflation rates on average

26

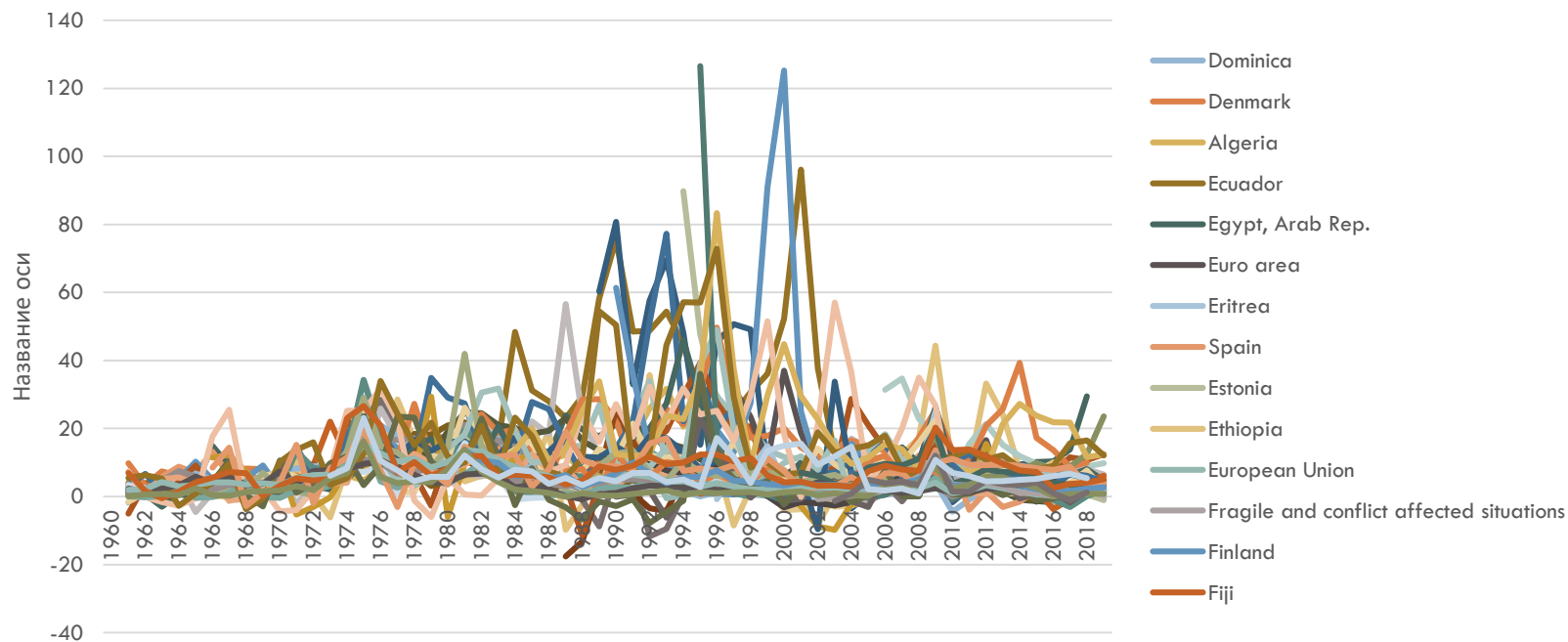


Literature review

27

Study	Period	Number of countries	Method	Main Findings
(Ball & Sheridan, 2003)	1960-1994	20	DID	Negative. No clear evidence; similar interest rate policies based on Taylor rule.
(Lin, 2010)	1985-2005	22 industrials and 52 developing countries	PSM	Positive. significantly increase the exchange rate stability and reserves in developing countries, however in the industrial countries lowers both.
(Xu, 2011)	1985-2007	74 countries from IFS, WDI and AREARS IMF	DID&PSM	Positive. Significant impact on non-industrial countries, financial development matters; reduces the stock market volatility and improves financial stability in industrial countries.
(Pétursson, 2004)	1981:1-2002:4	First sample: 21 Second sample: 13 IT, Third sample 7 IT	SUR with fixed country effects	Negative inflation and output volatility, nor CB's credibility; less adversely affected by the financial crisis.

EMEs – non-Targeters



ADF Unit root test

31

```
. xtunitroot fisher inf, dfuller lags(1)
(2,126 missing values generated)
```

```
Fisher-type unit-root test for inf
Based on augmented Dickey-Fuller tests
```

```
Ho: All panels contain unit roots      Number of panels      =    162
Ha: At least one panel is stationary    Avg. number of periods =   31.65
```

```
AR parameter: Panel-specific           Asymptotics: T -> Infinity
Panel means:   Included
Time trend:    Not included
Drift term:    Not included             ADF regressions: 1 lag
```

		Statistic	p-value
Inverse chi-squared(324)	P	1850.2169	0.0000
Inverse normal	Z	-27.8033	0.0000
Inverse logit t(814)	L*	-38.5336	0.0000
Modified inv. chi-squared	Pm	59.9555	0.0000

P statistic requires number of panels to be finite.

Other statistics are suitable for finite or infinite number of panels.

Challenges along the way on implementing inflation targeting

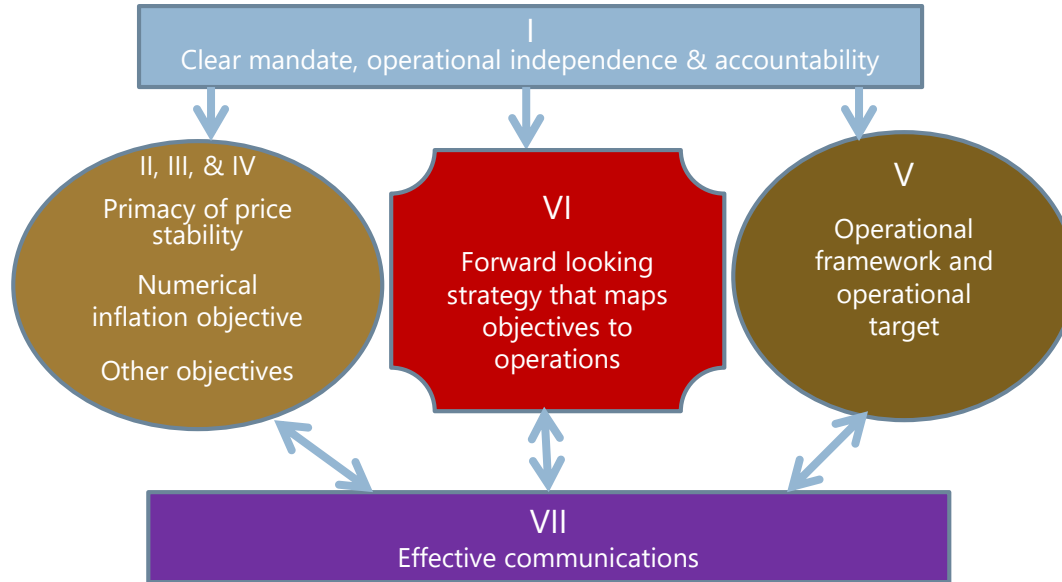
32

- Weak/shallow markets (financial system and interbank) and monetary policy transmission
- Operational issues, instruments, collateral
- Inconsistent operations
- Fiscal dominance (direct or indirect)
- Political control of interest rates/exchange rate
- Serious liquidity forecasting challenges and opaque liquidity management
- Weak analytical and operational capacity—lack of (quality) data
- Ineffective and incoherent communications

Why Inflation targeting frameworks makes difference?

Principles of Effective Monetary Policy Frameworks

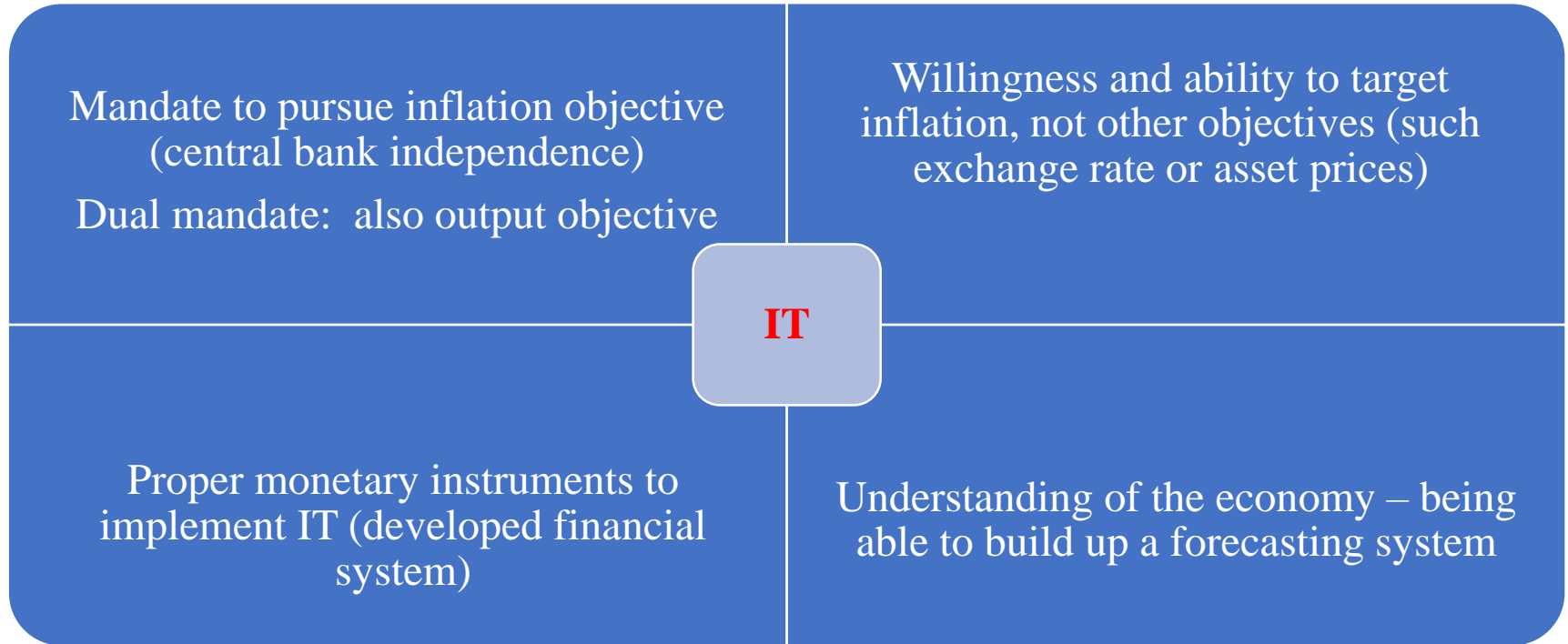
33



Laurens et.al (2015)

Prerequisites for Inflation targeting regime

34



Source: (IMF Staff Papers, 2015; Ötker & Freedman, 2010)

Monetary Versus Inflation Targeting

35

Orthodox textbook view

Monetary Targeting

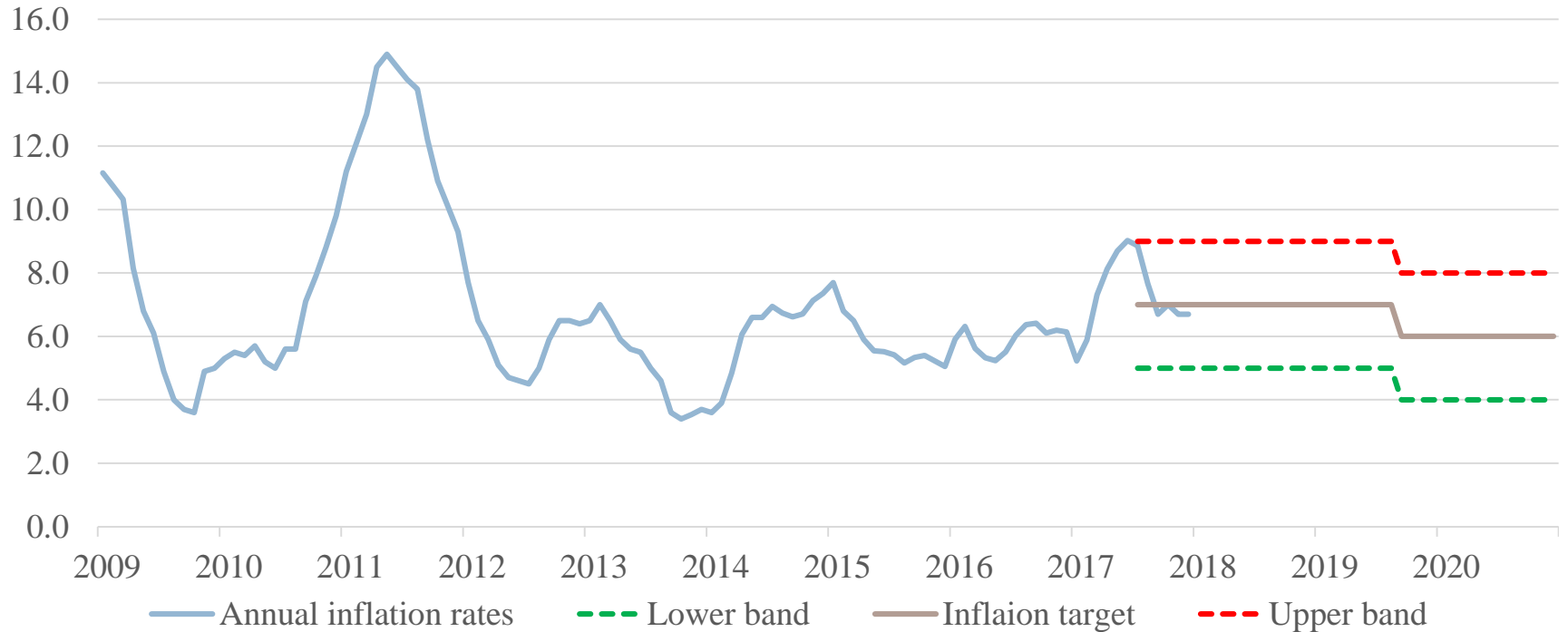
- Controlling the quantity of liquidity and credit in the short run and over the medium term
- Public communication and commitment opaque or non-existing

Inflation Targeting

- Commitment to keeping inflation on target over the medium term
 - ▣ Communication, transparency, and commitment are key
 - ✓ Operations, in practice, focused on interest rates

Inflation target of National Bank of Tajikistan

36



Source: National Bank of Tajikistan

Control group of non – IT countries

Advanced economies

Austria	Ireland	Netherlands
Belgium	Portugal	

Emerging market and developing economies

Algeria	Hong Kong	Paraguay
Argentina	Iran Islamic Rp	Romania
Belarus	Indonesia	Russia
Bulgaria	Jamaica	Singapore
Cape Verde	Jordan	Slovakia
China	Kazakhstan	Slovenia
Costa Rica	Latvia	Syria
Croatia	Lebanon	Trinidad and Tobago
Dominican Republic	Lithuania	Tunisia
Egypt Arab Rp.	Macao	Turkey
Estonia	Macedonia	Ukraine
Tajikistan	Mauritius	Uruguay
Guatemala	Morocco	Venezuela

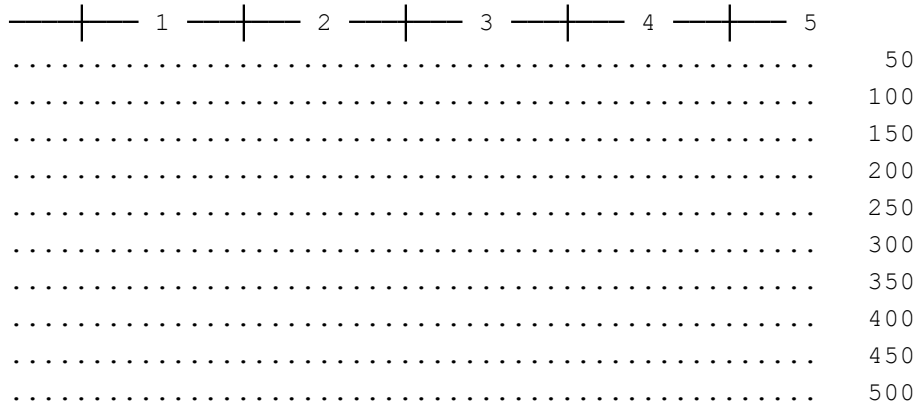
DID Estimation estimations

```
. diff inf, t(treated) p(time) cov(laglinf lreer lrir ler_sd lgdp_y lgdpc lm2 res_imp3 m2_gdp) report bs reps(500)
```

DIFFERENCE-IN-DIFFERENCES WITH COVARIATES

(running regress on estimation sample)

Bootstrap replications (500)



DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 861

	Before	After	
Control:	666	49	715
Treated:	138	8	146
	804	57	

Outcome var.	inf	S. Err.	t	P> t
Before				
Control	42.113			
Treated	41.241			
Diff (T-C)	-0.872	0.492	-1.77	0.076*
After				
Control	43.579			
Treated	38.879			
Diff (T-C)	-4.700	2.328	2.02	0.043**
Diff-in-Diff	-3.828	2.296	1.67	0.095*

R-square: 0.42

* Means and Standard Errors are estimated by linear regression

Inference: * p<0.01; ** p<0.05; * p<0.1

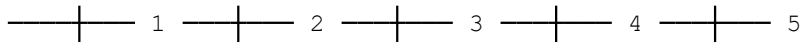
DID Estimation excluding hyperinflation

```
. diff INF, t(treated) p(time) cov(laglinf lreer lrir ler_sd lgdp_y lgdpc lm2 res_imp3 m2_gdp) report bs reps(500)
```

DIFFERENCE-IN-DIFFERENCES WITH COVARIATES

(running regress on estimation sample)

Bootstrap replications (500)



DIFFERENCE-IN-DIFFERENCES ESTIMATION RESULTS

Number of observations in the DIFF-IN-DIFF: 858

	Before	After	
Control:	663	49	712
Treated:	138	8	146
	801	57	

Outcome var.	INF	S. Err.	t	P> t
Before				
Control	29.283			
Treated	28.826			
Diff (T-C)	-0.457	0.535	-0.85	0.393
After				
Control	29.759			
Treated	27.551			
Diff (T-C)	-2.208	1.655	1.33	0.182
Diff-in-Diff	-1.751	1.634	1.07	0.284

R-square: 0.46

* Means and Standard Errors are estimated by linear regression

Inference: * p<0.01; ** p<0.05; * p<0.1

References

- Walsh, Carl E. (2009). Inflation Targeting: What Have We Learned?, *International Finance* 12:2, pp. 195-233.
- Shu Lin. (2010). *On International Effects of Inflation Targeting*, The MIT Press, pp. 195-199.
- Deniz P., Tekce M., and Yilmaz A. (2016). Investigating the Determinants of Inflation: A Panel Data Analysis, Department of Economics, Marmara University, Goztepe, Istanbul, Turkey URL: <http://dx.doi.org/10.5430/ijfr.v7n2p233>
- Martinez, G.O. (2008). Inflation targeting. Bank of Canada, A Festschrift of David Dodge, pp. 85-103.
- Lavigne, R., Mendes, R.R. and Sarker, S. (2012). Inflation Targeting: The Recent International Experience. International Economic Analysis Department.
- Roger S. (2010). Inflation Targeting turns 20. *IMF Finance & Development*, March, pp. 46-49.
- Svensson, L.E.O. (2009). Speech by Mr. Lars E. O. Svensson, Deputy Governor of Sveriges Riksbank and visiting scholar at the IMF, at the workshop 'Towards a new framework for monetary policy? Lessons from the crisis'. organized by the Netherlands Bank, Amsterdam.
- Clinton, K., Hlédik, T., Holub, T., Laxton, D., and Wang, H. (2017). Czech Magic: Implementing Inflation – Forecast Targeting at the CNB. IMF Working Paper WP/17/21.
- Dabla-Norris, E., Kim, D., Zermeño, M., Billmeier, A. and Kramarenko, V. (2007). Modalities of Moving to Inflation Targeting in Armenia and Georgia. IMF Working Paper WP/07/133.
- World Bank Database. www.data.worldbank.org . World Development Indicators