Inflation Dynamics in Egypt: Structural Determinants versus Transitory Shocks

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Introduction and motivation

- One premise that is not subject to much controversy in economics is that low and stable inflation is a desirable economic outcome.

- Low and stable inflation promotes long-term growth and economic efficiency (Bernanke & Mishkin (1997)).

- High inflation …
  - discourages savings and productive investments (Pindyck & Solimano (1993), Barro (1995)).
  - reduces the information signal in prices, which distorts efficient allocation of resources (Fischer & Modigliani (1978), and Ball & Romer (2003)).
  - increases the cost of financial intermediation, and has a negative impact on both banking sector development and equity market activity (Boyd, Levine & Smith (2000)).
  - tends to be accompanied by higher inflation volatility and uncertainty.
  - erodes the competiveness of the export sector and places pressure on the current account balance (due to real exchange rate appreciation).
  - has dire socioeconomic consequences for those with fixed income/pension.

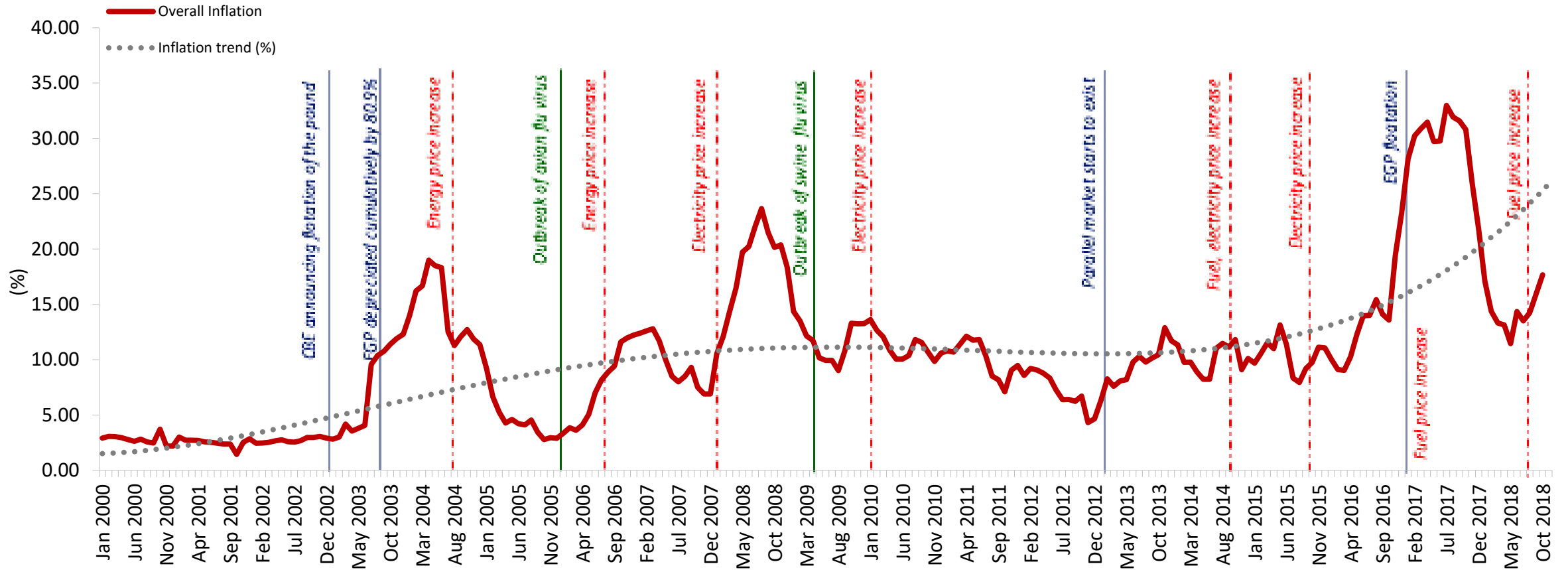- The world witnessed the "Great Moderation" since the mid-1990s.

Inflation in Egypt: A history …
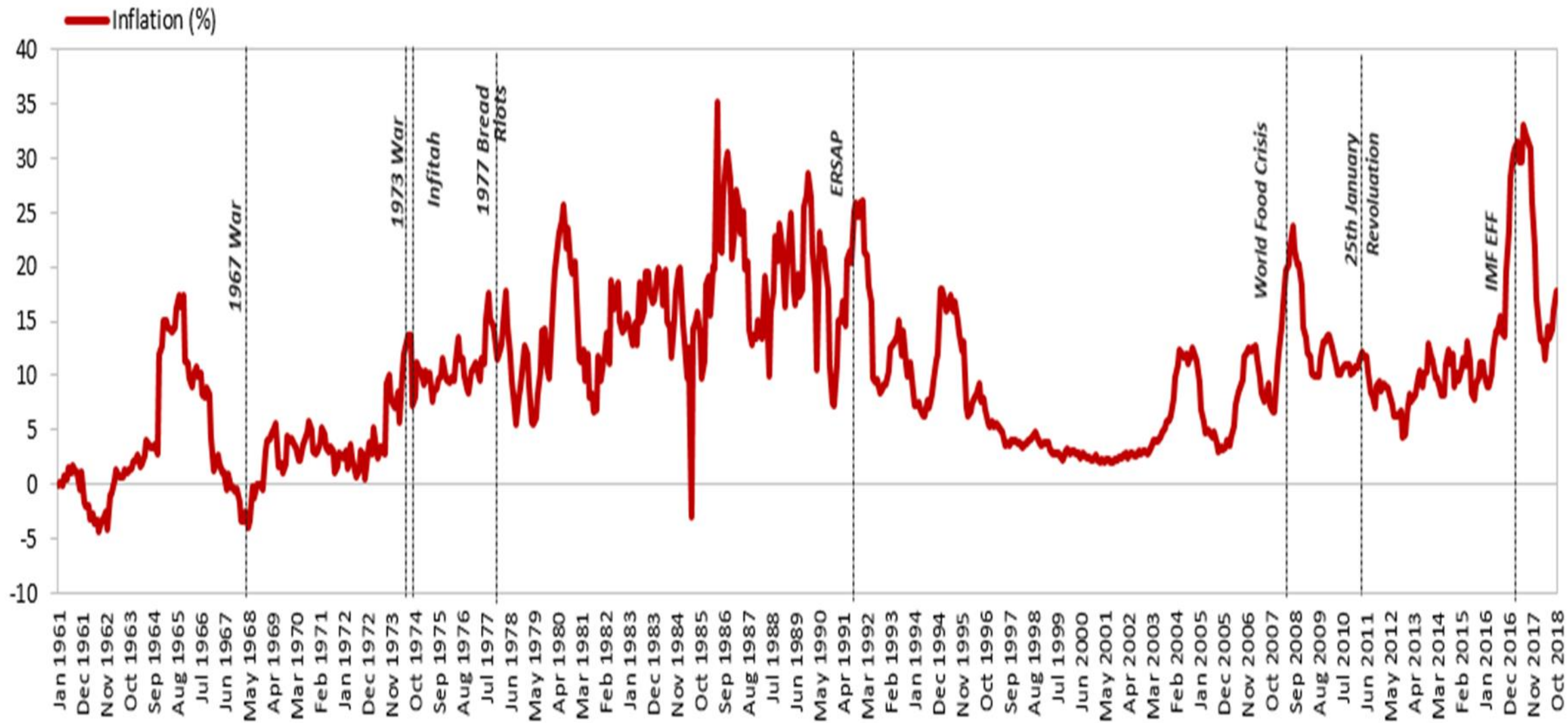
Source: Authors' calculations based on the IMF International Financial Statistics (IFS) database

Recent inflation developments in Egypt (2000-2018)
An unmistakable increasing trend particularly since 2012 …

Legend:
- Overall Inflation
- Inflation trend (%)

Vertical line annotations (left to right):
- CBE announcing floatation of the pound
- EGP depreciated cumulatively by 80.9%
- Energy price increase
- Outbreak of avian flu virus
- Energy price increase
- Electricity price increase
- Outbreak of swine flu virus
- Electricity price increase
- Parallel market starts to exist
- Fuel, electricity price increase
- Electricity price increase
- EGP floatation
- Fuel price increase
- Fuel price increase

Source: Authors' calculations based on the IMF International Financial Statistics (IFS) database

Paper's objective and outline of the talk

- The paper's objective is to study the determinants behind the recent trend increase in inflation.

- The paper specifically considers the role of two important variables: **excessive relative price variability (RPV)** and **excessive monetary growth**.

- These outcomes are themselves a manifestation of structural and institutional rigidities in the economy. This will be discussed later on.

- The rest of the talk will be organized as follows:
  - Theoretical background and cross country evidence.
  - Historical developments in RPV and monetary growth since 2000.
  - Econometric model.
 - Empirical results.
  - Conclusion and policy implications.

Relative price variability (RPV)

- Relative price variability (RPV) refers to the intensity with which relative prices change in the economy.

- This tends to occur when price changes differ significantly across economic sectors and commodity groups.

- Excessive RPV can have a real economic impact on resource allocation, level of output, employment and the informational role of prices in the economy (Hayek (1945), Alchian (1969), Fischer (1981)).

- Keynes (1924) emphasized how high RPV can negatively affect specialization in the economy.

- Ball & Romer (2003) argued that relative prices are the tools which enable the "invisible hand" to guide efficient resource allocation in the economy.

Relative price variability (RPV)

- As RPV increases, the reliability of the information signals transmitted by prices diminish in importance and, in response, search activities increase. More time and resources are consumed in making decisions (Blejer & Leiderman (1980), Ball & Romer (2003), Tommasi (1994)).

- Green (2005) described high RPV as "the root of all evil".

- In the context of the Egyptian economy, Noureldin (2009) examined the impact of RPV on inflation in Egypt during period 2000-2007 concluding the existence of a significant positive association between mean inflation and RPV, and also a close association between RPV and inflation uncertainty.

- Empirically, the intensity of RPV is captured by the dispersion of the cross-section distribution of price changes across different commodity groups.

- We elaborate on this in the following slides.

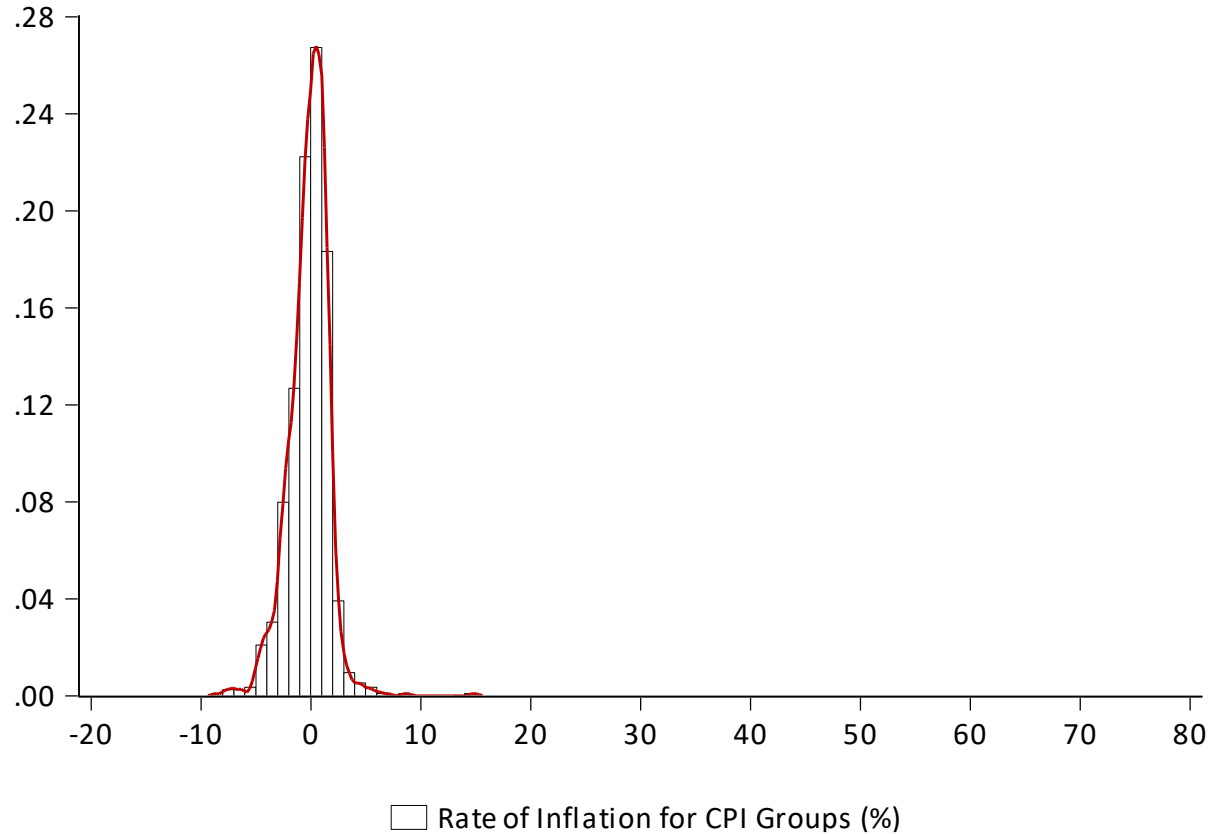# Relative price variability (RPV): Empirical evidence
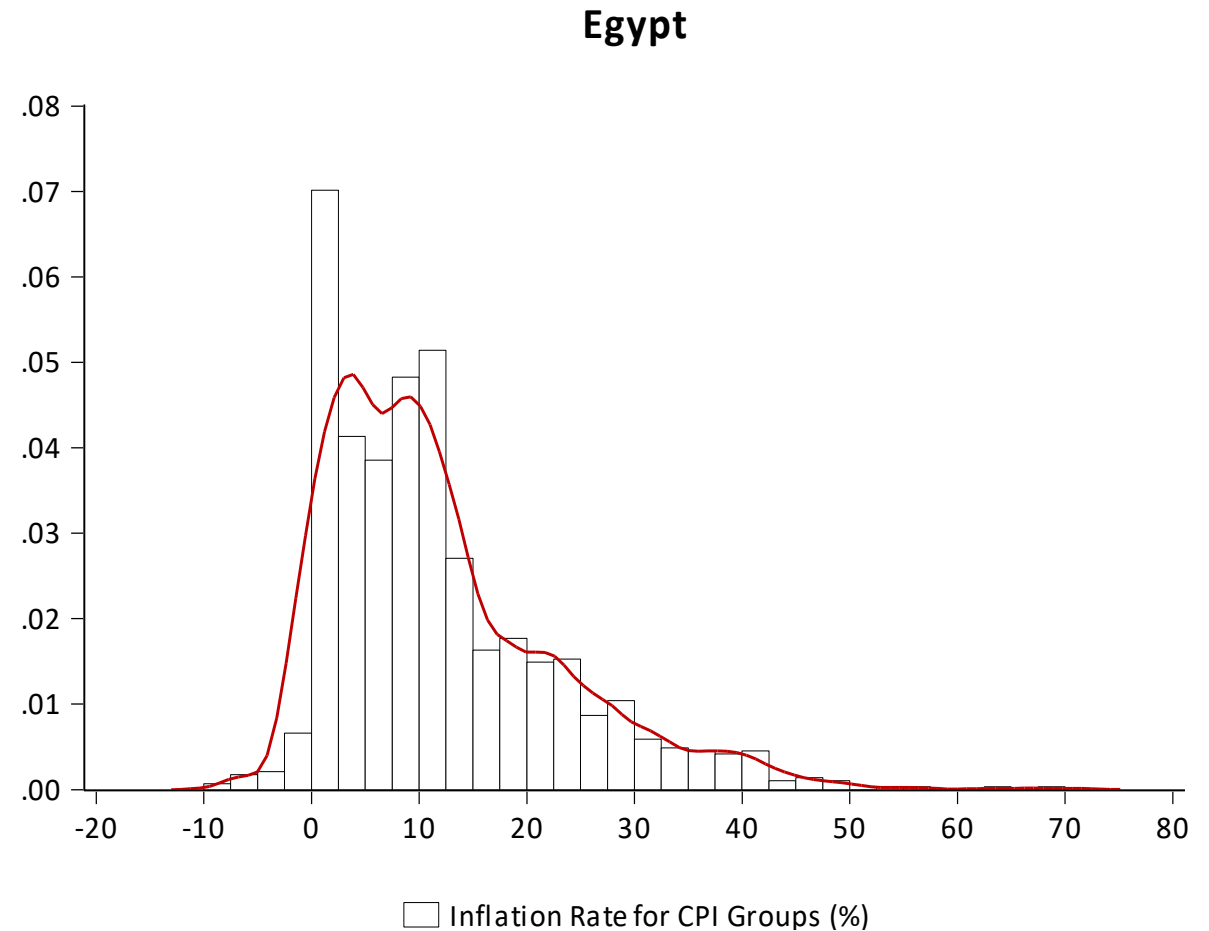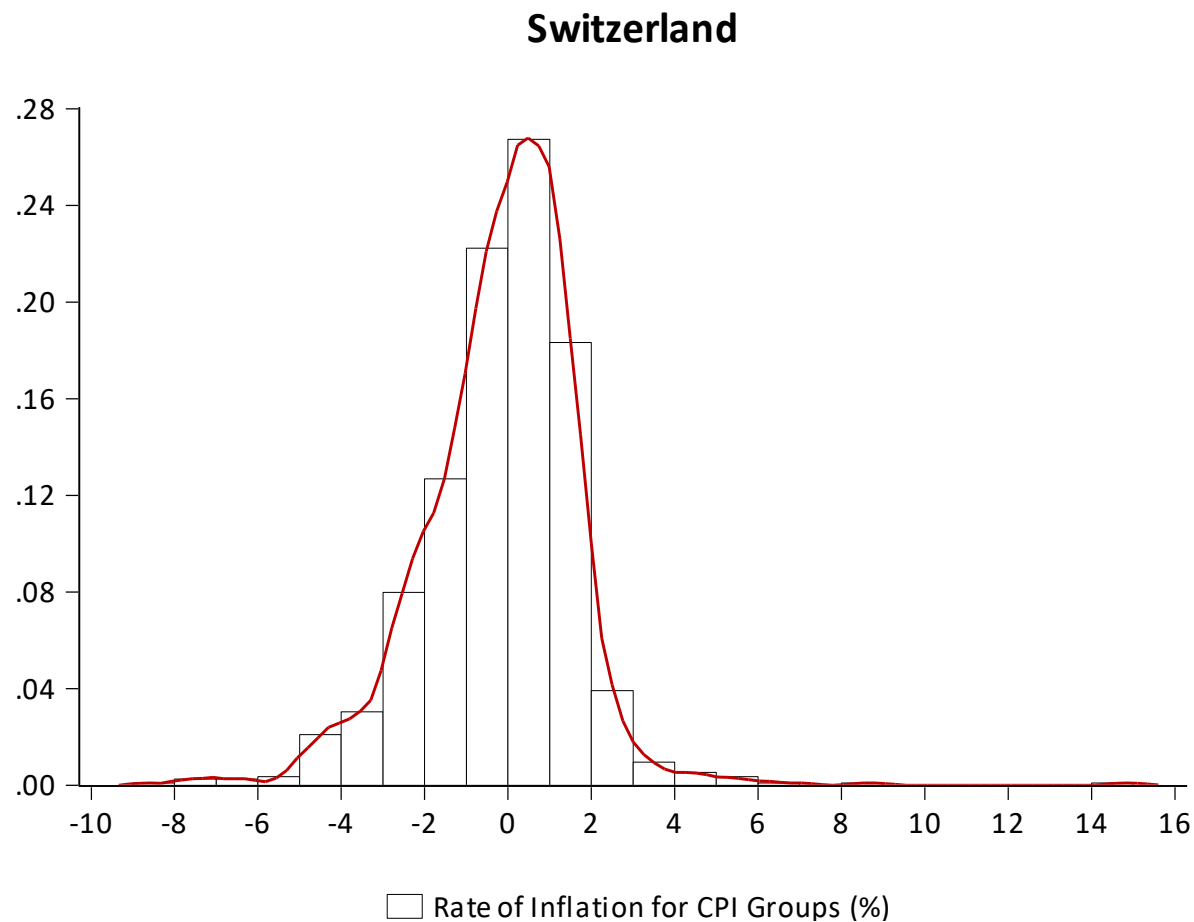
Switzerland

Egypt

Rate of Inflation for CPI Groups (%)

Inflation Rate for CPI Groups (%)

Source: Authors' calculations based on data from the International Monetary Fund (IMF) CPI dataset

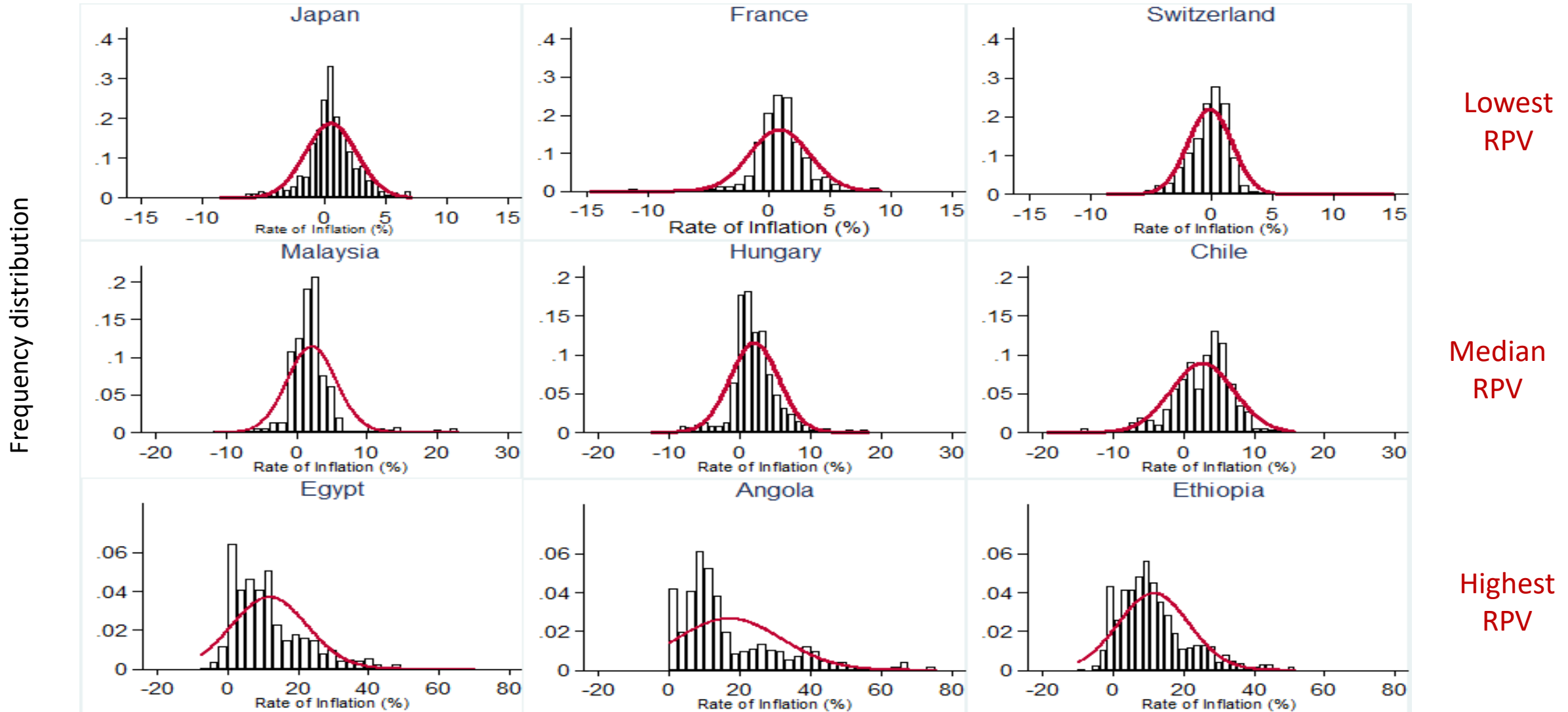# Relative price variability (RPV): Empirical evidence

Switzerland

Egypt

Rate of Inflation for CPI Groups (%)

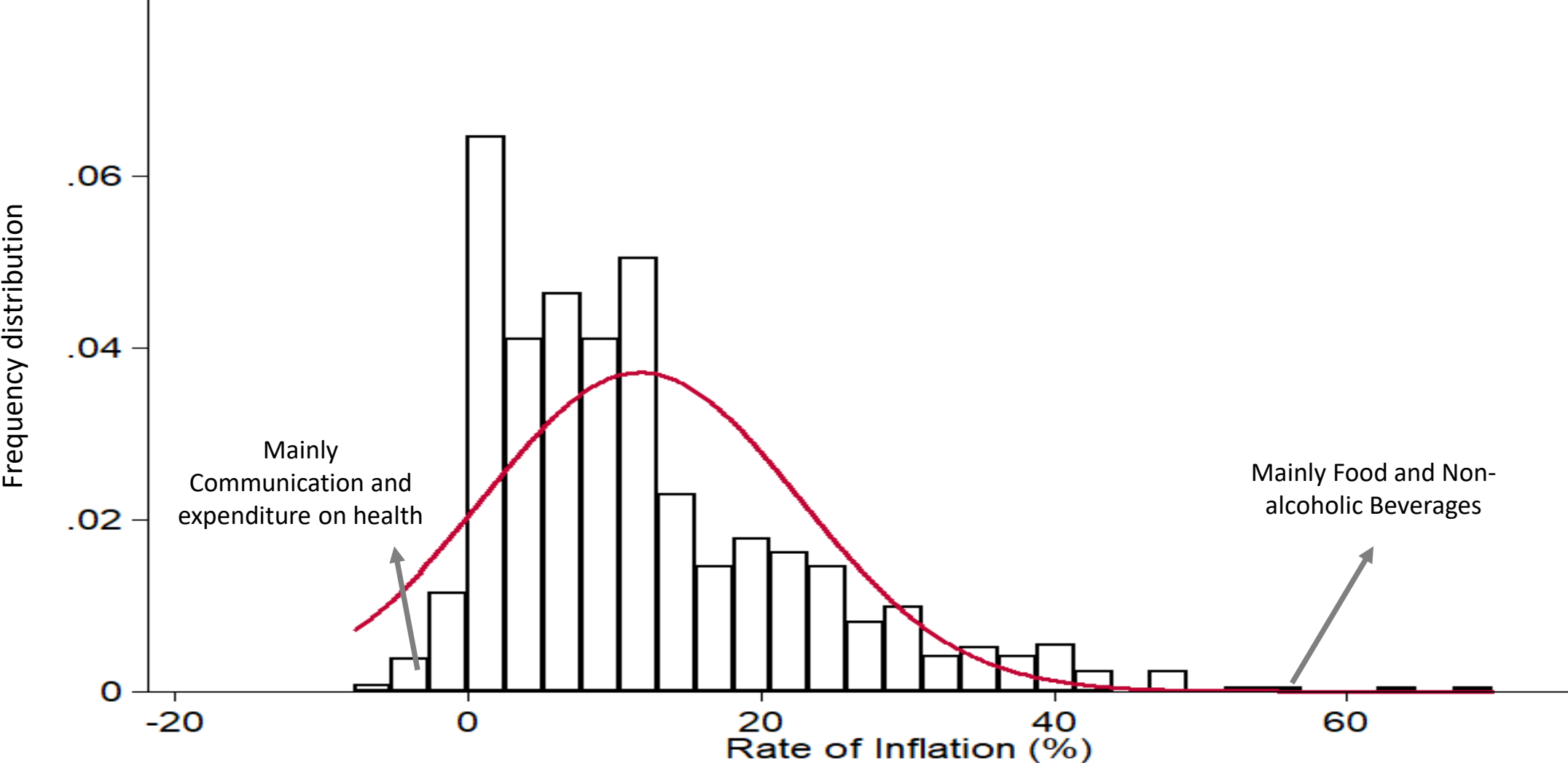Inflation Rate for CPI Groups (%)

Source: Authors' calculations based on data from the International Monetary Fund (IMF) CPI dataset

Relative price variability (RPV): Empirical evidence

Source: Own calculations based on IMF consumer price index dataset.

Relative price variability (RPV): Distribution skewness

Mainly Communication and expenditure on health

Mainly Food and Non-alcoholic Beverages

Frequency distribution

Rate of Inflation (%)
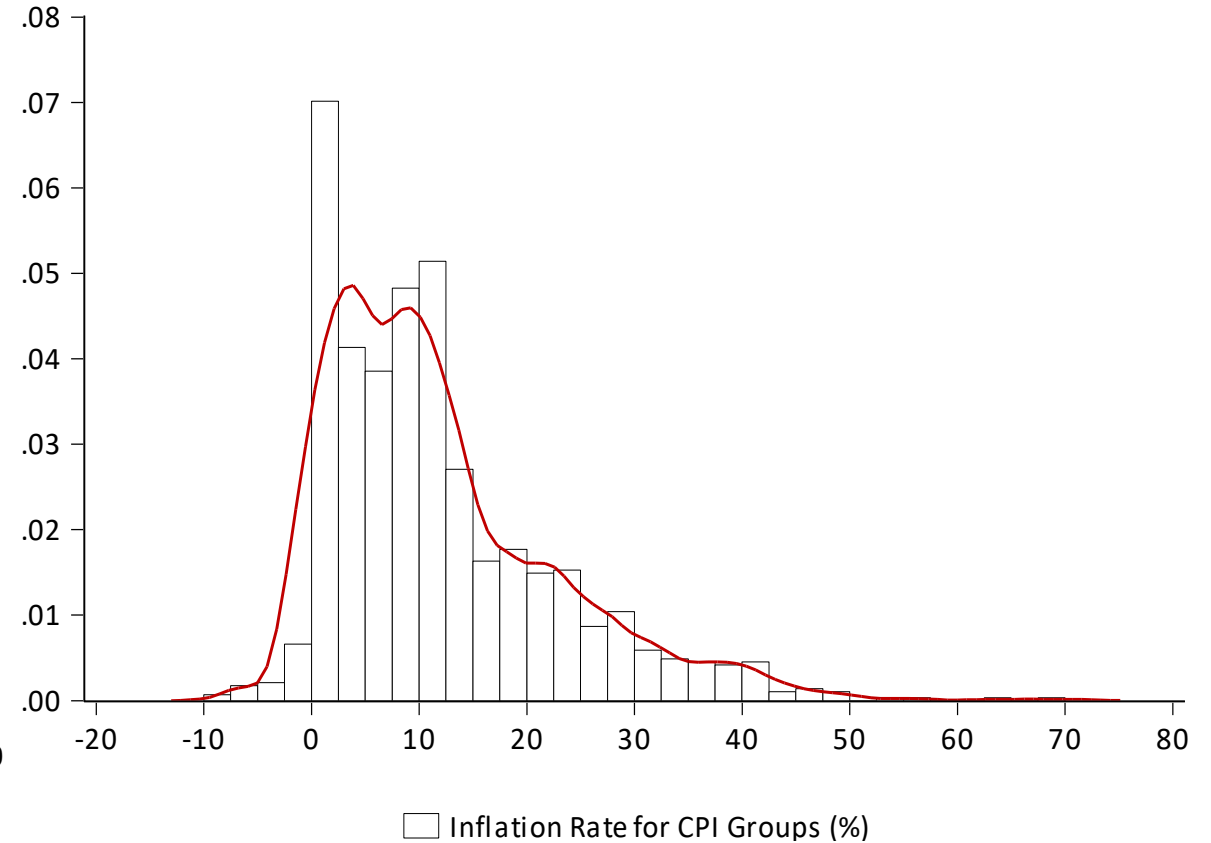
Source: Own calculations based on IMF consumer price index dataset
Note: . The graph shows the frequency distribution of the individual inflation rates of the 12 main components of CPI for Egypt for the period January 2011 till December 2018.

Relative price variability (RPV): Distribution skewness

- A positively skewed cross-section distribution for the sub-components of the CPI for the case of Egypt.

- A few commodity groups with higher-than-average rates of price change pull the mean rate of inflation upwards.

- The majority of the CPI sub-components have positive rates of inflation/ downward rigidity in the price level, *i.e. prices have a higher tendency to rise rather than fall*.

- Ball & Mankiw (1992,1994) employ a menu-cost model with positive trend inflation model assuming that the effects of shocks are asymmetric

- As prices in the right tail of the distribution respond rapidly to shocks, with others in the left tail responding more slowly, the variance of the distribution increases which pulls mean inflation to a higher level.

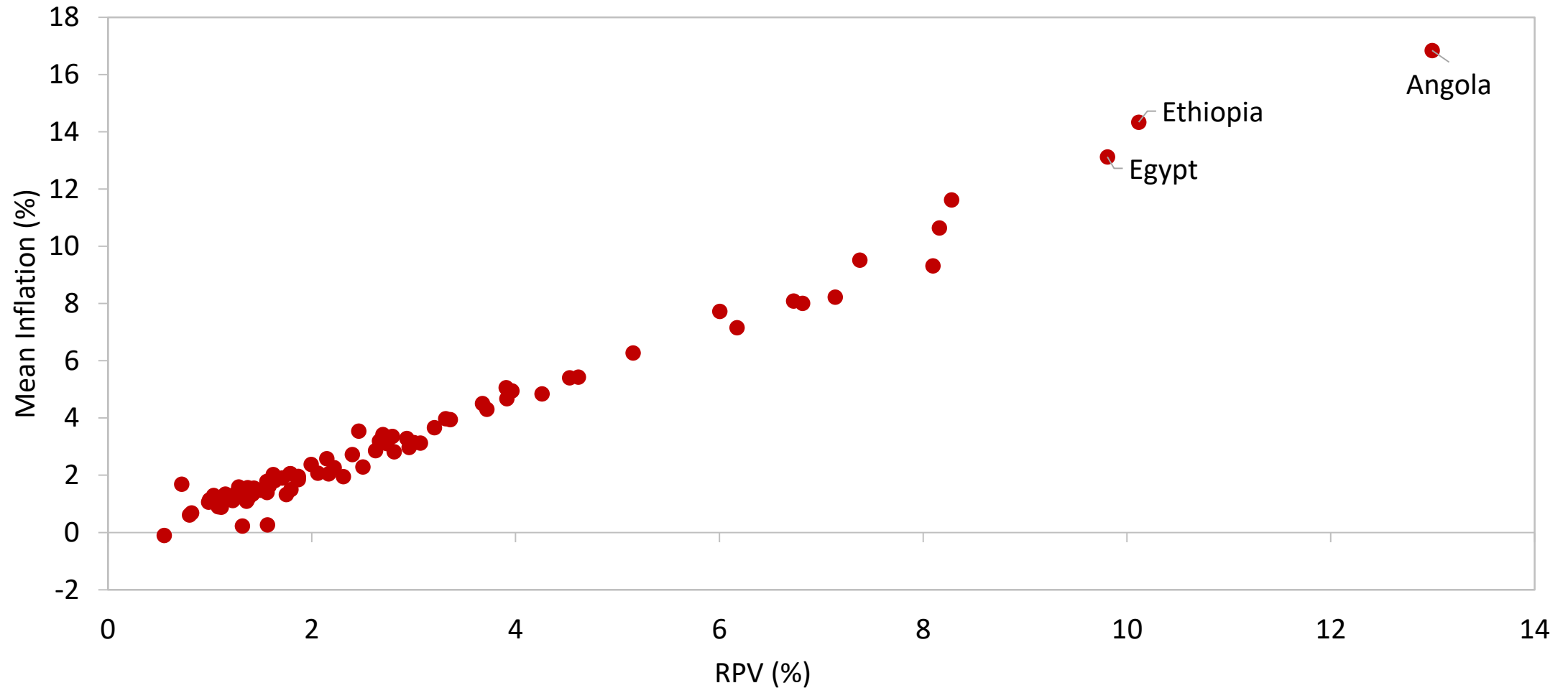# Relative price variability (RPV): Empirical evidence
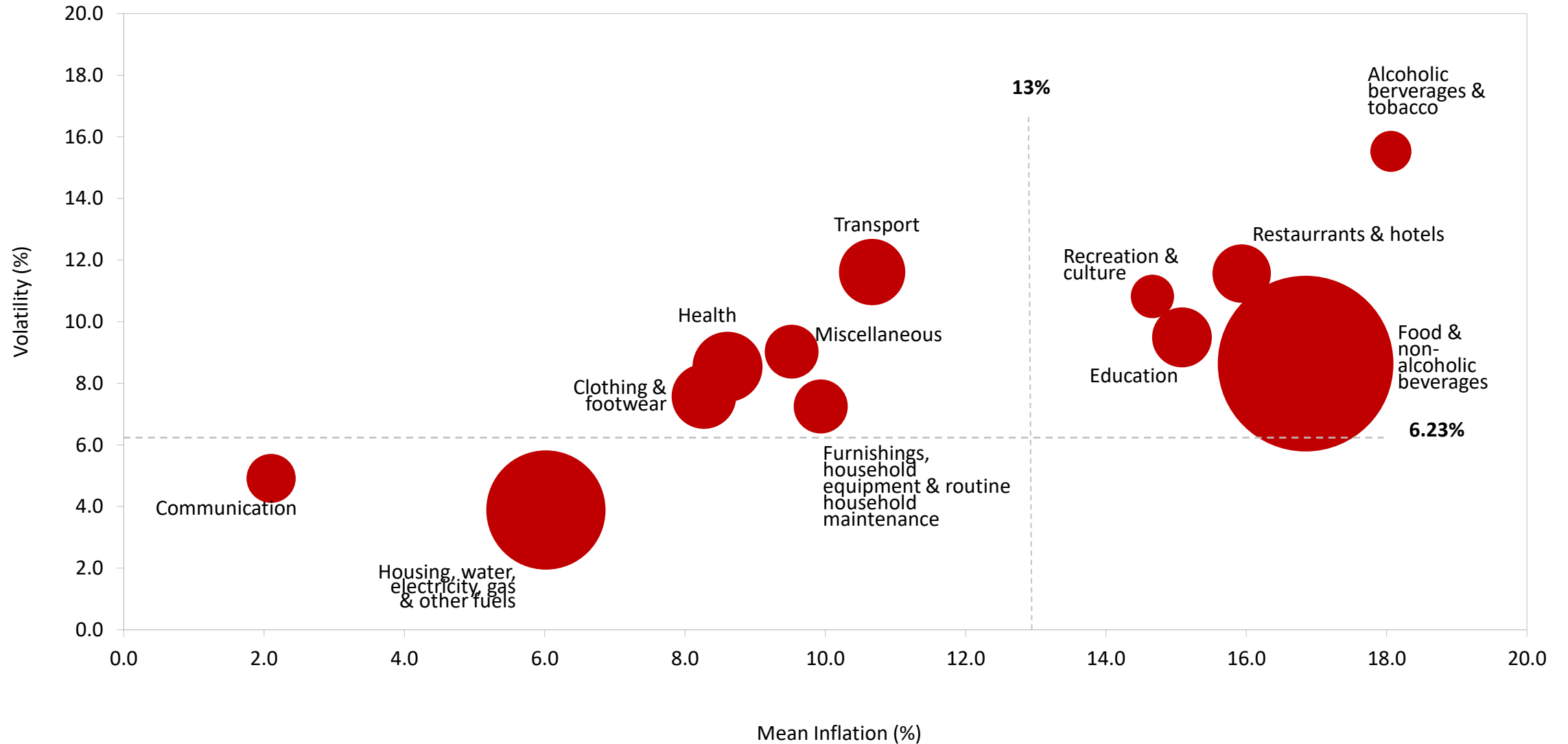
Source: Own calculations based on data from CAPMAS.
Notes: the graph shows mean inflation and volatility for the CPI 12 groups. The size of the bubbles circles represent the weight of each group in the basket.

Relative price variability (RPV): Comparative data
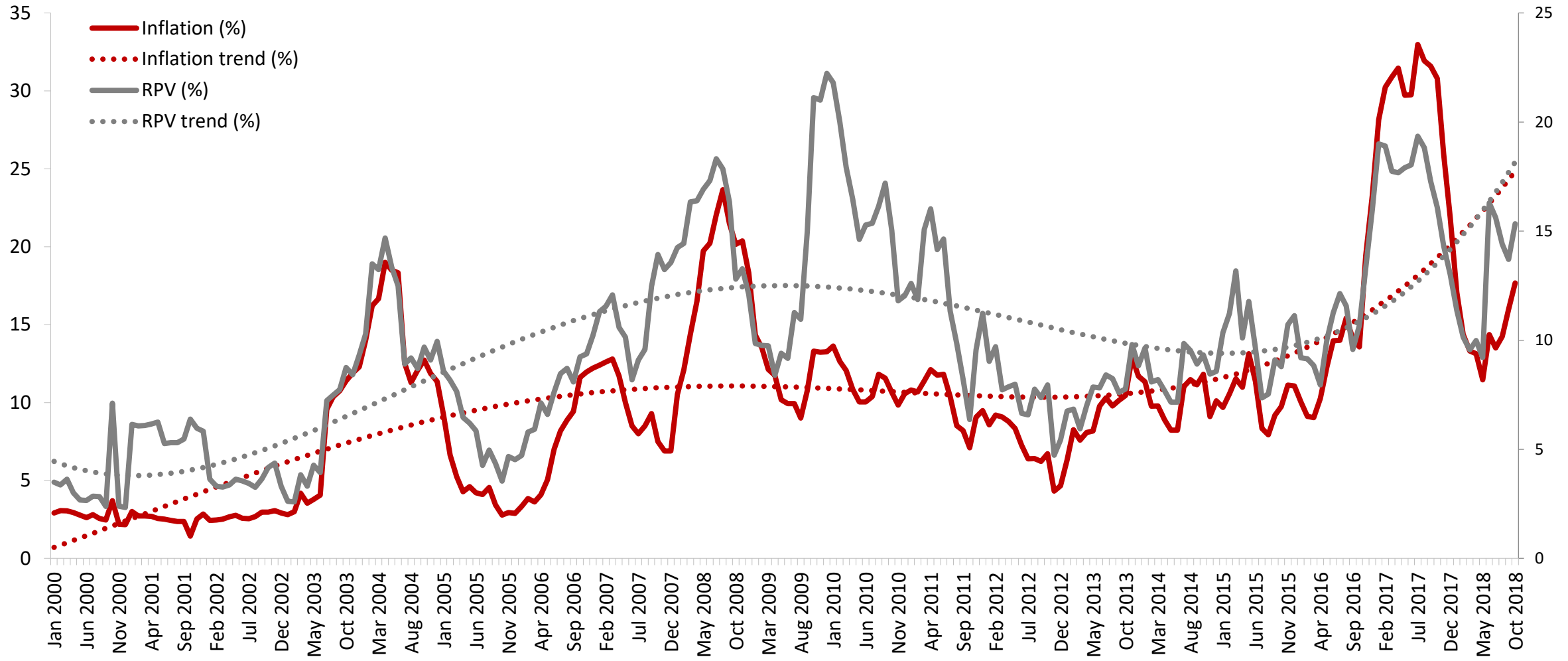## Data for 84 countries over the period 2011-2018

Relative price variability (RPV): Historical trends
Data for Egypt over the period 2000-2018

Legend:
- Inflation (%)
- Inflation trend (%)
- RPV (%)
- RPV trend (%)

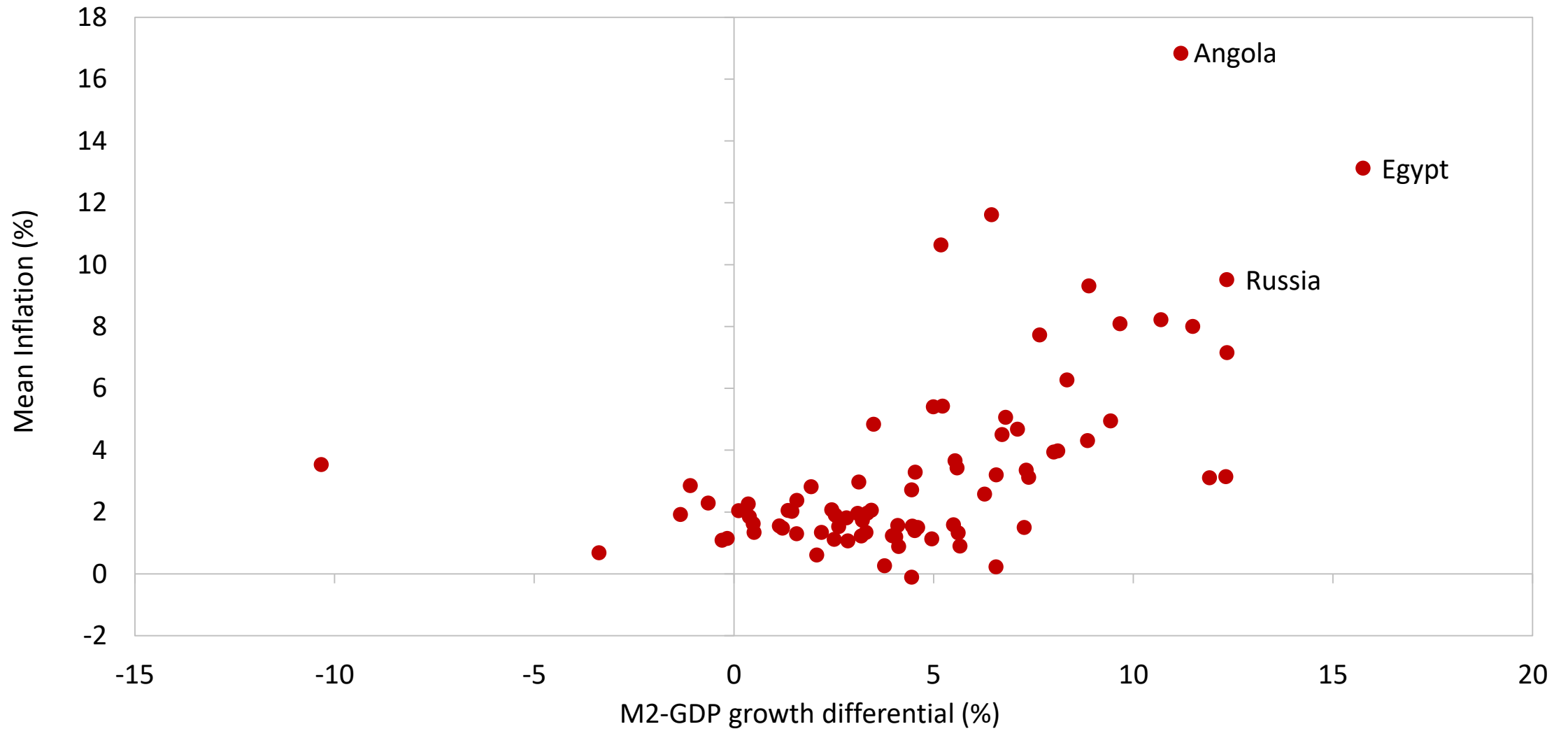# Relative price variability (RPV): Theoretical underpinnings

- Theoretical models and empirical evidence show that an increase in RPV is attributed to the following structural features.

1. Nominal rigidities and the pricing behavior of firms: Sheshinski & Weiss (1977, 1983), Danziger (1983,1984), Mankiw & Reis (2002), Dias *et al.* (2011).

2. The prevalence of administered prices in the economy: Cukierman & Leiderman (1984), Carlton (1986).

3. The role of economic transition: Pujol and Griffiths (1996), Wozniak (1998), Rother (2000).

- The nexus between RPV and inflation dynamics is well documented in various empirical studies: Sheshinski & Weiss (1977), Parks (1978), Cukierman (1979), Fischer (1981,1982), Ball & Mankiw (1992,1994), Coorey *et al.* (1996), Fielding *et al.* (2017).

Excessive monetary growth

- There is consensus in macroeconomics that money is neutral in the long run.

- It can only affect nominal variables (e.g. the price level) but not real variables (e.g. the level of output or unemployment).

- The link between money growth and long run inflation outcomes is well documented starting from the earlier work of Irving Fisher on the quantity theory for money.

- Milton Friedman famously stated that "inflation is always and everywhere a monetary phenomenon."

- It is hardly contested that having a sustained rise in inflation is not possible without excessive growth in the money supply.

- We define excessive monetary growth as the differential between money supply growth and real GDP growth.
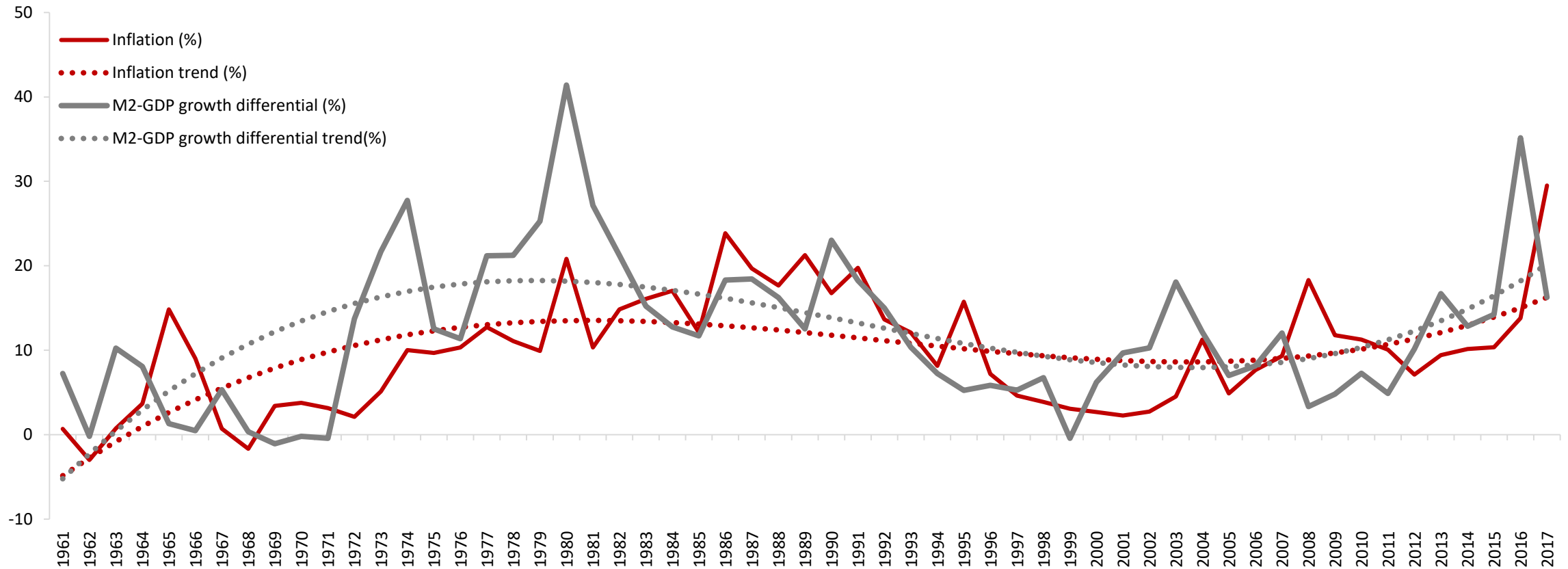
Excessive monetary growth: Comparative data

Mean Inflation (%) — vertical axis

M2-GDP growth differential (%) — horizontal axis

Angola
Egypt
Russia

Excessive monetary growth: Historical trends
Data for Egypt over the period 1961-2018

Legend:
- Inflation (%)
- Inflation trend (%)
- M2-GDP growth differential (%)
- M2-GDP growth differential trend(%)

Source: Authors' calculations using IMF and WDI data.

Excessive monetary growth: Theoretical underpinnings

- Why do some economies experience excessive monetary growth?

- The following theories have been put forward:

  - Fiscal dominance
    - Monetizing the budget deficit/CB balance sheet expansion.
    - Absence of fiscal rules: Dahan & Strawczynski (2013), Badinger & Reuter (2017).
    - *De facto* central bank independence: Berger *et al.* (2001), Klomp & DeHaan (2010).
  - Fiscal theory of the price level (FTPL)
    - Unpleasant monetarist arithmetic: Sargent & Wallace (1981).
    - FTPL contributions: Leeper (1991), Sims (1994), Woodford (1994), Cochrane (1998).
    - $\frac{D}{P} = Expected\ value\ of\ future\ budget\ surpluses$.
  - The gains from (incentives for) unanticipated monetary growth: Cottarelli et al. (1998)
    - Presence of strong nominal rigidities.
    - Underdeveloped domestic financial markets.
    - Lack of trade openness.

Econometric model

- We use the autoregressive distributed lag (ARDL) model of Pesaran & Shin (1999), and Pesaran *et al.* (2001).

- ARDL (p, q_1, q_2, q_3) specification:

➤ $INF_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} INF_{t-i} + \sum_{i=0}^{q_1} \beta_{1i} RPV_{t-i} + \sum_{i=0}^{q_2} \beta_{2i} NER_{t-i} + \sum_{i=0}^{q_3} \beta_{3i} M2GDP_{t-i}$

$+ \gamma_1 ENERGY_t + \gamma_2 SUPPLY_t + \gamma_3 PRIMCOM_t + \varepsilon_t.$

- The Bounds test for cointegration is conducted via the regression:

➤ $\Delta INF_t = \tilde{\alpha}_0 + \sum_{i=1}^{p} \tilde{\alpha}_{1i} \Delta INF_{t-i} + \sum_{i=0}^{q_1} \tilde{\beta}_{1i} \Delta RPV_{t-i} + \sum_{i=0}^{q_2} \tilde{\beta}_{2i} \Delta NER_{t-i} + \sum_{i=0}^{q_3} \tilde{\beta}_{3i} \Delta M2GDP_{t-i}$

$+ \tilde{\gamma}_1 ENERGY_t + \tilde{\gamma}_2 SUPPLY_t + \tilde{\gamma}_3 PRIMCOM_t + \delta_0 INF_{t-1} + \delta_1 RPV_{t-1} + \delta_2 NER_{t-1}$

$+ \delta_3 M2GDP_{t-1} + \eta_t.$

Econometric model

- If evidence of cointegration is found, an error correction model (ECM) can be estimated by including an ECM term for the short-run dynamics, and its coefficients would be the speed of adjustment parameter.

- In this case, the ECM term would be the lagged residual ($\hat{\xi}_{t-1}$) from the following long-run regression:

➢ $INF_t = \varphi_0 + \varphi_1 RPV_t + \varphi_2 NER_t + \varphi_3 M2GDP_t + \varphi_4 ENERGY_t + \varphi_5 SUPPLY_t$

  $+ \varphi_6 PRIMCOM_t + \xi_t.$

Data sources

- We use monthly data for the period January 2000 to October 2018.

- Annual Inflation rates (*INF*) are computed at the monthly frequency using the CPI (urban) from the IMF IFS database.

- Data on the detailed components of the CPI used to compute *RPV* is obtained from CAPMAS.

- For changes in the nominal exchange rate (*NER*), we use monthly data on the EGP/USD exchange rate from the IMF IFS database. For January 2013 - November 2016, we use the average monthly exchange rate in the parallel market using daily data from Bloomberg/Reuters.

- For excess money growth we use the differential between money supply growth and real GDP growth (*M2GDP*) at the quarterly frequency, and use the cubic spline method to interpolate for the monthly frequency.

- We also add a dummy variable for energy price shocks, supply-side shocks (avian and swine flu), and changes in international commodity prices.

Empirical Results: Unit root tests

Augmented Dickey-Fuller (ADF) Unit Root Test Results

	Intercept (no trend)		Intercept and trend	
	(Levels)	*(First differences)*	*(Levels)*	*(First differences)*
INF	-1.261	-8.802***	-3.843**	-8.807***
RPV	-2.563	-14.202***	-2.977	-14.170***
NER	-1.581	-6.597***	-1.950	-6.613***
M2GRDIFF	-1.557	-3.279**	-1.825	-5.994***

Notes: These are t-statistics from the ADF test assuming an intercept but no trend for in the test specification, and using the Schwarz information criterion for lag selection. *** mark statistical significance at the 1 level of significance.

Phillips-Perron Unit Root Test Results

	Intercept (no trend)		Intercept and trend	
	(Levels)	*(First differences)*	*(Levels)*	*(First differences)*
INF	-2.362	-9.644***	-3.198*	-9.622***
RPV	-2.724*	-14.182***	-3.085	-14.148***
NER	-3.120**	-11.622***	-3.152*	-11.595***
M2GRDIFF	-2.320	-3.465***	-2.414	-3.473**

Notes: These are t-statistics from the ADF test assuming an intercept but no trend for in the test specification, and using the Schwarz information criterion for lag selection. *** mark statistical significance at the 1 level of significance.

Empirical Results: ARDL estimates

	Coefficient Estimates	Standard Error	t-Statistic	p-value
$Constant$	-0.6215***	0.2245	-2.7679	0.0062
INF_{t-1}	1.0754***	0.0574	18.7496	0.0000
INF_{t-2}	-0.0636	0.0807	-0.7891	0.4309
INF_{t-3}	-0.1159**	0.0503	-2.3035	0.0222
RPV_t	0.4112***	0.0422	9.7558	0.0000
RPV_{t-1}	-0.3057***	0.0461	-6.6350	0.0000
NER_t	0.0140	0.0184	0.7630	0.4463
NER_{t-1}	0.0850***	0.0277	3.0688	0.0024
NER_{t-2}	-0.0880***	0.0185	-4.7523	0.0000
$M2GDP_t$	2.2424***	0.7260	3.0885	0.0023
$M2GDP_{t-1}$	-4.6396***	1.4653	-3.1663	0.0018
$M2GDP_{t-2}$	2.4391***	0.7549	3.2312	0.0014
$ENERGY_t$	1.3533***	0.3881	3.4868	0.0006
$SUPPLY_t$	0.7367	0.6274	1.1742	0.2416
$PRIMCOM_t$	0.0062*	0.0033	1.8848	0.0609

Notes: Sample period used for estimation is January 2000 to October 2018. The dependent variable is INF_t. *** marks statistical significance at the 1 percent level of significance, ** marks statistical significance at the 5 percent level of significance, and * marks statistical significance at the 10 percent level of significance.

Empirical Results: Long-run parameters

	Coefficient Estimates	Standard Error	t-Statistic	p-value
Constant	-5.9709***	2.0820	-2.8680	0.0046
RPV_t	1.0136***	0.1469	6.8998	0.0000
NER_t	0.1058	0.0704	1.5018	0.1347
$M2GDP_t$	0.4025**	0.1557	2.5853	0.0104
$ENERGY_t$	13.0012***	4.4909	2.8950	0.0042
$SUPPLY_t$	7.0779	6.0966	1.1610	0.2470
$PRIMCOM_t$	0.0596*	0.0353	1.6919	0.0922

Notes: Sample period used for estimation is January 2000 to October 2018. The dependent variable is INF_t. *** marks statistical significance at the 1 percent level of significance, ** marks statistical significance at the 5 percent level of significance, and * marks statistical significance at the 10 percent level of significance.

➢ Evidence of cointegration according to the Bounds test at 1% significance.

➢ Coefficient on ECM term is -0.1004 with a *p*-value of 0.0000.

➢ Half-life measure is 6.5 months.

Empirical Results: GRACH-based inflation uncertainty measure
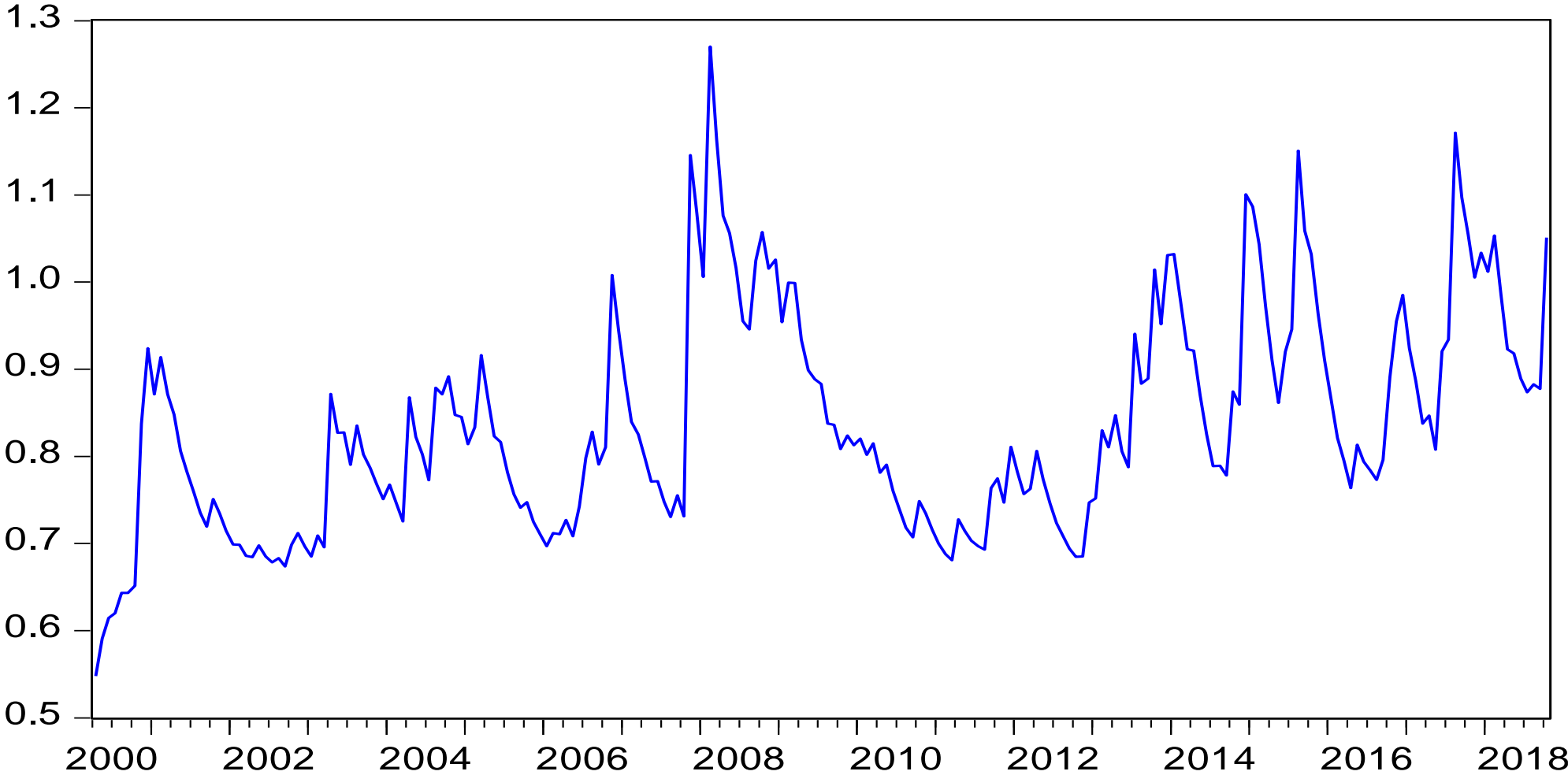
GARCH(1,1) conditional standard deviation

Empirical analysis: Diagnostic checks

1. Residual serial correlation: The Lagrange multiplier test does not reject the null hypothesis of no serial correlation with a p-value of 0.308.

2. The Breusch-Pagan-Godfrey heteroskedasticity test returned a p-value of 0.120 indicating homoscedastic errors.

3. Residual normality not rejected with a p-value of 0.08.
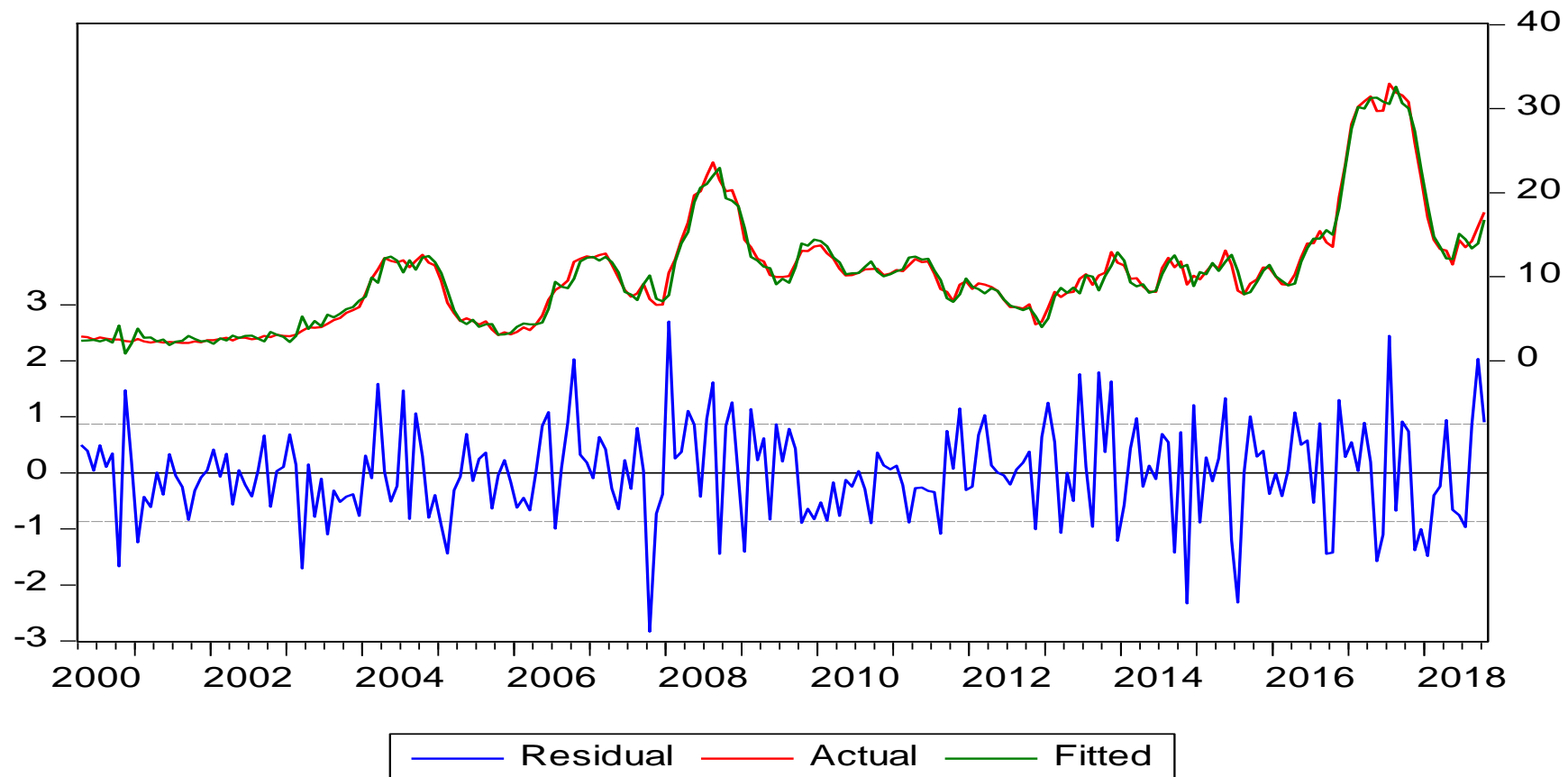
Empirical analysis: Robustness checks

1. Reverse causality from RPV to inflation (Bounds test).
2. Ramsey RESET test indicates absence of nonlinear effects.
3. CUSUM test is indicative of parameter stability.
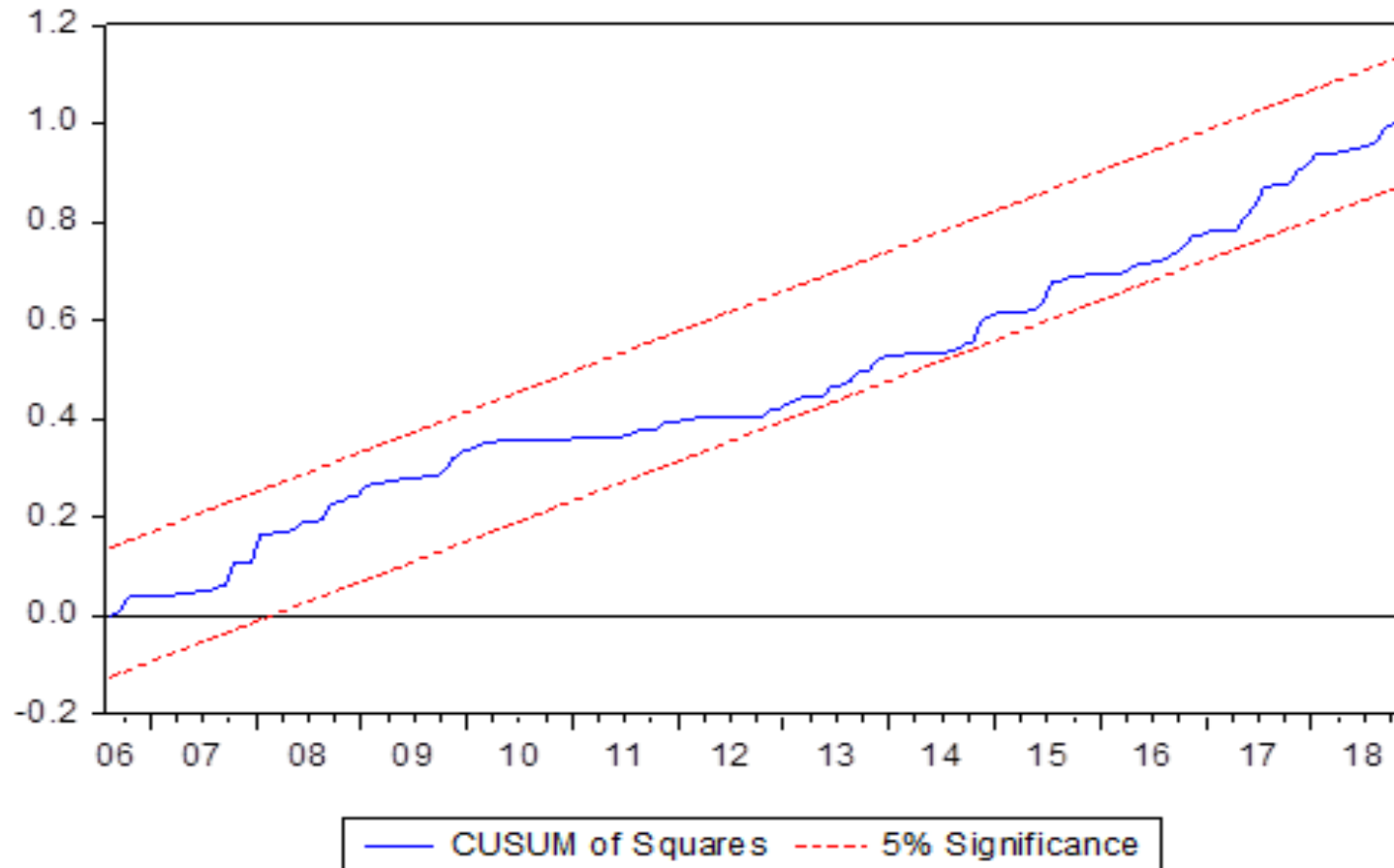
Empirical analysis: Robustness checks (predictive analysis)

The model's predictive ability over the period January 2010 to October 2018 is assessed against the following models: (i) ARDL model excluding RPV, (ii) ARDL model excluding M2GDP, (iii) ARMA(1,1) model, and (iv) AR(1) model. The following table reports the forecast evaluation results.

	ARDL	ARDL (exc. RPV)	ARDL (exc. M2GDP)	ARMA(1,1)	AR(1)
Root Mean Squared Error	0.8854*	1.1683	0.9291	1.5515	1.6460
Mean Absolute Error	0.6904*	0.9052	0.7461	1.1845	1.1743
Theil Inequality Coefficient	0.0305*	0.0403	0.0321	0.0537	0.0570
Bias Proportion	*0.0000**	*0.0004*	*0.0006*	*0.0010*	*0.0004*
Variance Proportion	*0.0000**	*0.0008*	*0.0000*	*0.0057*	*0.0094*
Covariance Proportion	*0.9999**	*0.9987*	*0.9994*	*0.9933*	*0.9901*

Concluding remarks and policy implications

- The findings show that intense RPV and excessive monetary growth are largely driving the trend rise in inflation in recent year.

- These are a manifestation of underlying structural and institutional rigidities that require the immediate attention of policy makers, particularly the CBE. Structural and institutional reforms are needed on the following fronts.

- Structural reforms:
  - A comprehensive approach to price liberalization (legal frameworks and regulation mechanisms).
  - Study and decide on the optimal sequencing for price increases (small gradual increases above the rate of inflation as opposed to rare large price increases).

- Institutional reforms.
  - Fiscal rules.
  - An independent body for the oversight of public finances.
  - A full plan to move towards an inflation targeting monetary policy regime.

Thank you for your attention …