How hard can it be?
Inflation control around the world

Þórarinn G. Pétursson
Seðlabanki Íslands og Háskólinn í Reykjavík

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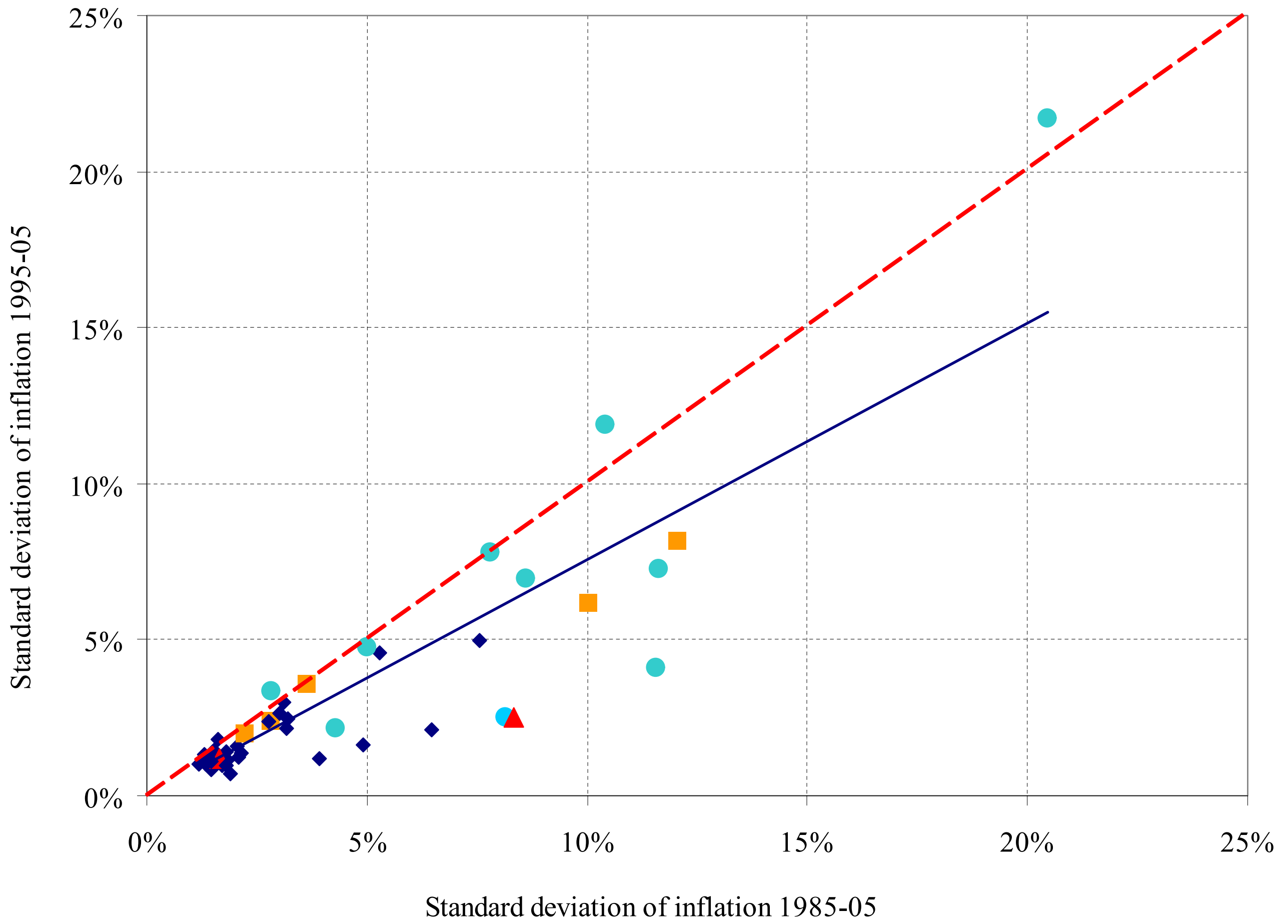
Motivation

During the last two decades, the level and variability of inflation has fallen across the world

Some countries have, however, had more success in controlling inflation than others, and the fact is that these countries are usually the same countries that have been more successful over longer periods

The usual suspects



Inflation volatility

The key question

The focus of this paper is to try to understand what factors explain the different rates of variability of inflation across countries

In particular, why is inflation more volatile in very small open economies and emerging and developing countries than in large and more developed countries?

What determines inflation volatility?

Rate of intrinsic persistence in the inflation process

Rate of persistence and variability of shocks hitting the real economy, terms of trade and other supply shocks

Sensitivity of inflation to these shocks - as reflected in the slope of the Phillips curve and the size of the first-round effects of supply shocks

Many of these factors will in turn be affected by structural features of the economy, such as economic size and development, openness to trade and patterns of trade

All will be affected by the transparency and credibility of monetary policy

Inflation will be less volatile and persistent the more successful monetary policy is in anchoring inflation expectations

Country sample and sample period

The focus is on reasonably developed, market based economies

Countries of similar development as OECD members: PPP adjusted GDP per capita below the poorest OECD member (Turkey) are excluded

Countries of similar size as OECD members: PPP adjusted GDP below the smallest OECD member (Iceland) are excluded (except Malta)

Gives a country sample of 65 countries but exclude centralised economies, countries disrupted by war and where key data are missing

Gives a country sample of 42 countries: 60% of world output and 20% of world population with median per capita income of 28 thousand US$ and median population of 10 million

Sample period: 1985-2005; although there are few exceptions due to data availability and to avoid periods of centralised planning in Eastern Europe and hyperinflation periods in Israel, Mexico and Poland

Two country groups of special interest

Country groups which seem to have more difficulties in controlling inflation

VSOEs

Sample of 7 very small, open economies (population below 2.5 million)

- Cyprus, Estonia, Iceland, Latvia, Luxembourg, Malta and Slovenia

EMEs

Sample of 15 emerging and developing countries, i.e. country sample excluding original OECD countries and Hong Kong, Israel, Korea and Taiwan, but including Turkey

- Chile, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Mexico, Poland, Slovakia, Slovenia, South Africa, Thailand and Turkey

Inflation performance

	Average inflation	Inflation persistence	Inflation volatility	Inflation predictability
Iceland	7.7	0.36	8.3	2.5
United States	3.0	0.34	1.4	1.4
All countries	3.9	0.50	3.1	2.5
EME	9.3	0.57	8.1	4.0
VSOE	6.4	0.28	3.6	2.7
EURO12	2.3	0.58	1.7	1.6
G6	2.6	0.51	1.7	1.3

Inflation is defined as annualised quarterly changes in seasonally adjusted consumer prices and inflation volatility as the standard deviation of inflation (both in percentages). Inflation persistence is estimated from an AR(k) allowing for mean break of unknown date using the ExpF test. Inflation predictability is measured by the one-quarter ahead forecast error (in percentages) for inflation from a rolling-window VAR model including domestic and import price inflation, the output gap and the short-term interest rate.

Size, development and output volatility

Economic development

- More developed countries are better able to undertake investment in indivisible forms of capital
- More developed countries have more balanced sectoral distribution of output
- More developed countries rely less on seignorage income

Economic size

- Larger markets make financial risk diversification easier
- Larger economies rely less on relatively few industries and can more easily absorb shocks

Output volatility

- Countries with more volatile real economies face an inferior trade-off between inflation volatility and output volatility

Size, development and output volatility

	Population	GDP	GDP per capita	Output volatility
Iceland	0.3	11	38.1	2.7
United States	298.4	12,980	43.5	0.9
All countries	10.3	253	27.9	1.4
EME	10.0	173	15.4	2.1
VSOE	0.8	26	22.7	1.9
EURO12	10.6	305	31.2	1.1
G6	72.6	2,244	31.4	1.0

GDP and per capita income are PPP adjusted. Population (in millions), GDP (in billion US$) and per capita income (in thousand US$) are 2006 data. Output volatility is the standard deviation (in percentages) of the cyclical component of the seasaonally adjusted GDP series.

Openness, external shocks and trade patterns

Openness

- Discretionary monetary policy is more costly in more open economies implying that open economies have less incentive to inflate

Exposure to external shocks

- The less co-movement with the world economy, the more challenging monetary policy is: more frequent idiosyncratic shocks and possible pro-cyclical capital flows that can amplify economic volatility
- The more pro-cyclical the exchange rate with private consumption the larger is the exchange rate risk premium - also implies that terms of trade shocks dominate monetary policy shocks

Trade patterns

- Countries with a narrow export product range or countries where primary commodities are an important share of exports may find domestic stabilisation more difficult

Openness, external shocks and trade patterns

	Openness	Output correlation with the rest of the world	Consumption correlation with exchange rate	Trade diversi- fication	Commodity share of exports
Iceland	75.8	0.25	-0.61	0.79	79.8
United States	25.8	0.29	0.00	0.25	14.7
All countries	86.0	0.37	-0.09	0.44	17.5
EME	115.5	0.16	-0.16	0.47	21.8
VSOE	130.0	0.25	-0.01	0.56	22.5
EURO12	75.2	0.54	0.04	0.36	16.2
G6	53.4	0.40	0.07	0.28	13.3

The second column reports a measure of openness to international trade as the sum of exports and imports of goods and services as a percentage of GDP (average for the period 2000-2005). The third column reports the contemporaneous correlation between the cyclical component of GDP for a given country with the cyclical component of world output. The fourth column gives the contemporaneous correlation between the cyclical component of private consumption and the cyclical component of the exchange rate. The fifth column reports a measure of trade diversification. A higher index indicates an export base of relatively few goods. The final column gives primary commodities as a percentage of merchandise exports. The last two trade measures are 2005 data.

Exchange rate volatility and pass-through

One would expect countries with more volatile exchange rates to experience more difficulties in controlling domestic inflation

Similarily, countries where exchange rate shocks have more effect on domestic prices should experience greater difficulties in controlling domestic inflation

It turns out that no pattern with respect to exchange rate volatility and country size is apparent

- The volatility of exchange rates in the EMEs and the G6 is similar but is higher than in the VSOEs
- Thus, exchange rates seem, if anything, to be more volatile in the larger, more developed countries than in the very small, open economies

Consistent with Paul Krugman's conjecture that exchange rates are so volatile in the large, developed countries for the simple fact that the volatility has very little economic effect

Suggests that we need to look deeper for a link between exchange rates and inflation performance

Measuring exchange rate risk

$$\begin{aligned} m_t - p_t &= \varphi y_t - \lambda i_t \\ p_t &= s_t + p_t^* \\ i_t &= i_t^* + \mathsf{E}(s_{t+1} \,|\Theta_t) - s_t + \xi_t \end{aligned}$$

From the law of iterative expectations

$$s_t = \sum_{j=0}^{\infty} \left(\frac{\lambda}{1+\lambda}\right)^j \mathsf{E}(f_{t+j} \,|\Theta_t) + \kappa_t$$

where f_t denotes the economic fundamentals

$$f_t = \left(\frac{1}{1+\lambda}\right)(m_t - \varphi y_t - p_t^* + \lambda i_t^*)$$

and κ_t, defined as *exchange rate risk*, is given as the expected present value of the risk premia ξ_t

$$\kappa_t = \sum_{j=0}^{\infty} \left(\frac{\lambda}{1+\lambda}\right)^{j+1} \mathsf{E}(\xi_{t+j} \,|\Theta_t)$$

Measuring exchange rate risk

Define the perfect foresight, risk neutral exchange rate as

$$s_t^* = \sum_{j=0}^{\infty} \left(\frac{\lambda}{1+\lambda} \right)^j f_{t+j}$$

Such that

$$s_t = \mathsf{E}(s_t^* \,|\Theta_t) + \kappa_t$$

The assumption of rational expectations (RE) implies that

$$\mathsf{E}(s_t^* \,|\Theta_t) = s_t^* - v_t$$

where v_t is the RE forecast error, which satisfies $\mathsf{E}(v_t \,|\Theta_t) = 0$

Thus

$$s_t - s_t^* = \kappa_t - v_t$$

Measuring exchange rate risk

A linear projection of $(s_t - s_t^*)$ on $\Upsilon_t \subseteq \Theta_t$ gives

$$\text{proj}(s_t - s_t^* \,|\Upsilon_t) = \text{proj}(\kappa_t \,|\Upsilon_t)$$

Finally, be defining

$$\zeta_t = \text{proj}(\kappa_t \,|\Theta_t) - \text{proj}(\kappa_t \,|\Upsilon_t) = \kappa_t - \widehat{\kappa}_t$$

we obtain

$$\kappa_t = \widehat{\kappa}_t + \zeta_t$$

and

$$\sigma_\kappa^2 = \sigma_{\widehat{\kappa}}^2 + \sigma_\zeta^2$$

Hence, a lower bound on the variance of κ_t is given as

$$\sigma_{\widehat{\kappa}}^2 \leq \sigma_\kappa^2$$

Measuring exchange rate risk

First step: Estimate money demand equation using DOLS with 1 lead and lag to obtain estimates of φ and λ

Second step: Calculate the fundamentals f_t

$$f_t = \left(\frac{1}{1+\lambda}\right)(m_t - \varphi y_t - p_t^* + \lambda i_t^*)$$

and approximating s_t^* as with the terminal value suggested by Shiller (1981)

$$s_t^* = \sum_{j=0}^{T-t}\left(\frac{\lambda}{1+\lambda}\right)^j f_{t+j} + \left(\frac{\lambda}{1+\lambda}\right)^{T-t} s_T$$

Third step: Generate $\widehat{\kappa}_t$ using as Υ_t a constant and current and four lags of s_t and f_t

Exchange rate volatility and pass-through

	Exchange rate volatility	Volatility of exchange rate risk	Exchange rate pass-through
Iceland	11.0	18.5	0.43
United States	11.0	11.7	0.02
All countries	9.1	11.6	0.20
EME	10.2	18.5	0.26
VSOE	3.6	15.7	0.34
EURO12	5.5	7.2	0.22
G6	10.4	10.7	0.06

Exchange rate volatility is the standard deviation (in percentages) of annualised quarterly changes of the effective exchange rates. Volatility of exchange rate risk is obtained from the lower bound estimate (in percentages). Exchange rate pass-through is estimated as the cumulative effective of an 1% exchange rate shock after 8 quarters in a VAR model including domestic and foreign inflation, exchange rate changes, the short-term interest rate and the output gap. Exchange rate shocks are identified using the generalised impulse response approach.

Exchange rate risk: A comment

Note that σ_κ is not the standard deviation of the risk premium itself, but of the expected present value of the premium

Assuming for simplicity that ξ_t follows an AR(1) process gives

$$\sigma_\kappa = \left(\frac{\lambda}{1 + \lambda(1 - \rho_\xi)}\right)\sigma_\xi$$

As $\lambda > 1$, σ_κ will in general be larger than σ_ξ and can be much larger if ξ_t is very persistent as commonly found

For example, Backus et al. (1993) estimate σ_ξ to be 9.4% on average for the US$ (annualised) and with $\lambda = 1.7$ for the US and assuming $\rho_\xi = 0.8$ (a common finding) gives $\sigma_\kappa = 11.6\%$, the same as in the table

Lithuania has the highest σ_κ (40%); assuming $\rho_\xi = 0.8$ and with $\lambda = 4.2$ implies that σ_κ is more than twice as high as σ_ξ

Monetary policy shocks

According to standard theory, monetary policy is, in the final analysis, the predominant determinant of inflation variation

A credible and transparent monetary policy anchors inflation expectations, thereby directly reducing inflation variation

Can also affect inflation variation indirectly by

- Reducing inflation persistence
- Making inflation more predictable
- Reducing output volatility
- Reducing exchange rate volatility
- Flattening the Phillips curve
- Reducing the response of inflation to relative price shocks
- Reducing exchange rate pass-through
- Reducing the inflation risk premium and therefore the exchange rate risk premium

Monetary policy shocks

Monetary policy shocks are estimated from a forward-looking Taylor-type monetary policy rule

$$i_t = \rho_i i_{t-1} + (1 - \rho_i) \left[(r^* + \pi^*) + \beta_i (\mathsf{E}(\pi_{t+1} \,|\Omega_t) - \pi^*) + \alpha_i x_t \right] + \varepsilon_t$$

Monetary policy shocks can be interpreted in different ways

- Monetary policy is less systematic and predictable
- Stochastic shocks to the inflation target
- Stochastic shocks to the real equilibrium interest rate
- Measurement errors in the output gap

Similar results from a rolling-window VAR model to obtain conditional one-quarter ahead forecast errors for the short-term interest rate

Interest rates and monetary policy

	Interest rate volatility	Interes rate predictability	Monetary policy shocks
Iceland	3.8	1.9	0.6
United States	1.1	0.5	0.4
All countries	1.3	0.9	0.5
EME	2.5	1.7	1.4
VSOE	1.2	1.0	0.6
EURO12	1.0	0.6	0.3
G6	1.0	0.5	0.4

Interest rate volatility is the standard deviation (in percentages) of the cyclical component of short-term interest rates. Interest rate predictability is measured by the one-quarter ahead forecast error (in percentages) for inflation from a rolling-window VAR model including domestic and import price inflation, the output gap and the short-term interest rate. Monetary policy shocks are measured as the standard deviation (in percentages) of the residual from a forward-looking Taylor rule.

Cross-country results: Variables used

Endogenous variable: INFVOL: Standard deviation of inflation

Explanatory variables

CONS	Corr. between cyclical part of consumption and exchange rate
log(SIZE)	log of GDP in PPP adjusted 2006 US$
INTER	Correlation between cyclical part of domestic and world output
OPEN	Exports plus imports divided by GDP; 2000-2005 average
PERS	Inflation persistence
REAL	Standard deviation of cyclical part of real GDP
DIVER	Trade divergence: higher index: export base of few goods (2005)
COMM	Share of commodities in merchandise exports (2005)
log(INC)	log of GDP per capita, PPP adjusted 2006 US$
EXRISK	Standard deviation of exchange rate risk
POLICY	Standard deviation of monetary policy shocks
PASS	Exchange rate pass-through to CPI inflation

Cross-country results: Final results

Start with all potential explanatory variables and gradually exclude the least significant ones, one at a time (t-values in parenthesis)

$$\begin{aligned} \text{INFVOL} &= \underset{(0.8)}{-0.006} + \underset{(4.0)}{0.174}\text{EXRISK} \\ &\quad + \underset{(6.6)}{0.774}\text{POLICY} + \underset{(5.3)}{0.087}\text{PASS} \\ R^2 \text{ (adj.)} &= 0.750, N = 41, SE = 0.021, EXCL = 0.849 \end{aligned}$$

Non-significant variables
CONS, log(SIZE), INTER, OPEN, PERS, REAL, DIVER

Closest to being significant
COMM, log(INC)

Cross-country results: Robustness
Adding different country groups

	Constant	EXRISK	POLICY	PASS	DUMMY	SE
EU15	-0.006	0.132	0.759	0.084	-0.014	0.020
	(0.8)	(2.7)	(6.7)	(5.3)	(1.9)	
EURO12	0.003	0.140	0.765	0.087	-0.013	0.020
	(0.3)	(2.9)	(6.6)	(5.4)	(1.6)	
IT95	-0.007	0.174	0.775	0.088	0.003	0.021
	(0.9)	(3.9)	(6.5)	(5.3)	(0.3)	
EME	0.000	0.105	0.744	0.078	0.017	0.020
	(0.0)	(1.8)	(6.4)	(4.6)	(1.7)	
VSOE	-0.007	0.186	0.756	0.091	-0.008	0.021
	(1.0)	(4.0)	(6.3)	(5.3)	(0.8)	
G6	-0.003	0.169	0.764	0.083	-0.010	0.021
	(0.3)	(3.8)	(6.5)	(4.9)	(1.1)	
PEG	-0.006	0.175	0.773	0.087	0.000	0.021
	(0.8)	(3.8)	(6.5)	(4.8)	(0.0)	
HIGH	-0.003	0.164	0.649	0.077	0.028	0.020
	(0.4)	(3.8)	(4.9)	(4.6)	(1.8)	

Absolute t-values are in parentheses.

Cross-country results: Robustness
Different estimation methods

	Final estimates	Hetero-scedasticty consistent estimates	Excluding Turkey	LAD estimates	LTS estimates	IV estimates
Constant	-0.006	-0.006	-0.006	-0.013	-0.020	-0.012
	(0.8)	(1.0)	(0.8)	(1.7)	(4.3)	(1.2)
EXRISK	0.174	0.174	0.171	0.225	0.317	0.180
	(4.0)	(3.3)	(3.3)	(5.4)	(7.8)	(2.4)
POLICY	0.774	0.774	0.857	0.717	0.804	0.989
	(6.6)	(12.6)	(1.6)	(5.9)	(2.3)	(3.2)
PASS	0.087	0.087	0.087	0.088	0.061	0.097
	(5.3)	(6.1)	(5.1)	(5.2)	(6.0)	(2.9)
SE	0.021	0.021	0.021	0.022	0.011	0.022
Sargan test						0.885
Durbin-Wu-Hausman test						0.396

Absolute t-values are in parentheses. The LTS estimator excludes 7 countries with standardised residuals exceeding 2.5 in magnitude (with resampling using 3,000 different subsamples). The IV estimator uses OPEN, log(SIZE), DIVER, INTER, CONS, EME and PEG as instruments.

Cross-country results: Interpretation

Results give median INFVOL for the VSOEs equal to actual median but underestimate median for the EMEs and overestimate the median for the G6 and the EURO12

Suggest additional factors explaining high INFVOL in the EMEs and low in the G6 and EURO12 countries

What happens if explanatory variables decline by 1 SD?

- EXRISK (13.7% to 5.8%): INFVOL falls by 0.3 SD or by 1.5 per cent
- POLICY (1.2% to 0.5%): INFVOL falls by 0.1 SD or by 0.5 per cent
- PASS (0.23 to 0.03): INFVOL falls by 0.4 SD or by close to 2 per cent

What happens if explanatory variables decline to EURO12 median?

- EXRISK: INFVOL falls by 1.5 per cent (VSOEs) to 2 per cent (EMEs)
- POLICY: INFVOL falls by 0.2 per cent (VSOEs) to 0.8 per cent (EMEs)
- PASS: INFVOL falls by 1 per cent (VSOEs) to 0.3 per cent (EMEs)

Cross-country results: Discussion

The results suggest that countries with more volatile inflation tend to have a more volatile risk premium on their currencies

Furthermore, the degree of pass-through of exchange rate shocks to inflation tends to be larger, especially in the VSOEs

The final factor is the degree of monetary policy predictability - especially important in explaining more volatile inflation in the EMEs

The results suggest that inflation performance in the VSOEs and EMEs can be improved with a more transparent and credible monetary policy

But it is unlikely that they will be able to reduce inflation volatility to the level in the large and more developed countries due to a more volatile exchange rate risk premium that probably stems from a more volatile nature of these economies, more idiosyncratic shocks, and less developed foreign exchange markets