Work in Progress

Monetary Policy and Inflation-Unemployment Variability in a New Keynesian Model

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Abstract

This paper uses a New Keynesian model with unemployment to analyse the effects of explicit inflation targeting on the inflation-unemployment variability trade-off. We argue that adopting an inflation targeting framework provides clarity and transparency to the inflation stabilisation objective of the central bank, thus improving monetary policy efficiency. On the other hand, increasing the policy weight on achieving an inflation target with less clear monetary policy objectives merely moves an economy along the variability frontier. Empirically, several key explicit inflation targeters show reduced variability in both inflation and unemployment. In contrast, non-inflation targeting economies that have seen reduced inflation variability do not display a decline in unemployment variability. These suggest that in terms of the inflation-unemployment variability trade-off, explicit inflation targeting could result in a superior outcome, lending support to the findings of our theoretical model.

Keywords: Inflation, inflation targeting, monetary policy, unemployment, variability trade-off

JEL Classification: E24. E32, E52, E58

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1. Introduction

With the advances in monetary theory and practical monetary policymaking over the past couple of decades, many researchers have focused on measuring efficiency of monetary policy, for which, one tool has been to utilise the so-called *inflation-output variability efficiency frontier*. Also, a plethora of new literature in the New Keynesian custom, paying special attention to unemployment and labour markets has surfaced particularly with the recent re-emergence of economic recessions and unemployment, which, for the most part of this period, have remained latent. [1] In this paper we combine three strands of economic literature: first, on inflation output variability trade-off; second, on inflation targeting and efficiency of monetary policy; and finally, on the New Keynesian literature with unemployment, and show that explicit and credible inflation targeting can reduce both inflation and unemployment variability as opposed to stabilising inflation without the explicit adoption of inflation targeting.

Several studies, starting from Taylor (1979), have attempted to estimate an inflation-output variability efficiency frontier (now known as the *Taylor curve*). Taylor argued that there exists a "second order[2] Philips curve tradeoff between fluctuations in output and fluctuations in inflation" and "over the relevant range of this curve, business cycle fluctuations can be reduced only by increasing the variability of inflation" (p.1284). Taylor (1994) further explains that "the trade-off between the variability of inflation and that of output exists because of the slow adjustment of prices; monetary policy can determine where on the trade-off curve the economy lies"(p. 37). An economy could operate at a point further away from the efficiency frontier (as shown by the performance point in Figure 1), and simultaneous improvements in both inflation and output stability are possible only until the economy reaches the efficiency frontier.

[Fig. 1: Inflation-Output Variability Efficiency Frontier]

[1] Apart from the recent re-emergence of economic recessions and unemployment, our interest in unemployment stems from traditional reasons as well. As Layard, Nickell and Jackman (1994) explain, "unemployment matters. It generally reduces output and aggregate income. It increases inequality, since the unemployed lose more than the employed. It erodes human capital, And finally, it involves psychic costs. People need to be needed. Though unemployment increases leisure, the value of this is largely offset by the pain of rejection" (p.1).

[2] The "first order" here means the tradeoff between the *levels* of output and inflation.

Similar analyses based on optimal policy frontiers are found in Debelle and Stevens (1995), Fuhrer (1997), Erceg, Henderson and Levin (1998), studies in Taylor (1999), Clarida, Galí and Gertler (1999), Cecchetti and Ehrmann (1999), and Cecchetti, Flores-Lagunes and Krause (2006), among others, where they investigate the existence of such a tradeoff under different assumptions about types of shocks and rigidities (see also Bratsiotis and Martin, 1999 and 2005).

With the advent of inflation targeting, a body of literature has emerged to analyse its effect on the efficiency of policymaking. Svensson (2006) argues that "the introduction of inflation targeting has led to major progress in practical monetary policy. Inflation targeting central banks can make substantial additional progress by being more specific, systematic, and transparent about their operational objectives."[3] The methods to capture this improvement vary, with most of these analysing the effect of inflation targeting on the *inflation-output trade-off* or the sacrifice ratio and supporting the argument that inflation targeting has improved this trade-off (Corbo, Moreno and Schmidt-Hebbel, 2000; Clifton, Leon and Wong, 2001; Ball and Sheridan, 2005). Others look at inflation and output performance and persistence (Neumann and von Hagen, 2002; Bratsiotis, Madsen and Martin, 2002; Bratsiotis and Martin, 2002; Levin, Natalucci and Piger, 2004; and Siklos and Weymark, 2008) while some including Debelle (1999), Svensson (2000a), Neumann and von Hagen (2002), and Orphanides and Williams (2005) have indicated in their discussions on inflation targeting the possibility that, through more favourable inflation expectations, inflation targeting could improve both inflation and output variability.

Many have also investigated the effect of inflation targeting on the inflation-output variability efficiency frontier. This literature compares inflation targeting with price level targeting (examples are Svensson, 1999c; Dittmar, Gavin and Kydland, 1999a and 1999b; Chadha and Nolan, 2002; Cecchetti and Kim, 2003; Apergis, 2003; Yetman, 2005; and Vestin, 2006), discretionary outcomes with commitment outcomes (examples are Svensson, 1999a; and Vestin, 2006), and studies the effect of various monetary policy rules (for example, Batini and Haldane, 1999; and Rudebusch and Svensson, 1999).

In theoretical discussions of inflation targeting, Debelle and Stevens (1995) argue that any reduction in inflation volatility is possible only at the expense of increased output volatility and therefore, "controlling inflation within a small margin of error" may increase

[3] Among the other work that argue that inflation targeting has led to higher credibility of monetary policy are Debelle (1999), Svensson (2000b), Faust and Svensson (2001), Chadha and Nolan (2002), Walsh (2003a), Rudd and Whelan (2003), Svensson (2003), Ravenna (2005), Orphanides and Williams (2005), and Demir and Yigit (2008).

output volatility considerably. Walsh (1998) expresses similar concerns: "Attempting to keep inflation within a very narrow band may increase fluctuations in real output and employment." Svensson's Figure 2 (1999b), which is replicated below exemplifies this further. (See also Rudebusch and Svensson, 2002; and Blanchard and Galí, 2008, for similar arguments).

[Fig 2: Standard Relationship between Inflation Targeting
and the Efficiency Frontier]

Empirically, Cecchetti and Ehrmann (1999) compare nine inflation targeters and 14 non-inflation targeting countries to measure monetary policy efficiency and they work backwards to identify monetary policy objectives from variability outcomes and to identify the effects of shocks. They expect reduced inflation variability in inflation targeting countries to increase output variability, but in eight cases, they find that both have declined (Cecchetti, McConnell and Perez-Quiros, 2002; and Cecchetti, Flores-Lagunes and Krause, 2006, are similar). Arestis, Caporale and Cipollini (2002) compare eight inflation targeting and six non-inflation targeting countries utilising a stochastic volatility model to analyse the effects of inflation targeting on the trade-off. They find that inflation targeting has resulted in more favourable monetary policy tradeoffs in six out of the eight inflation targeters they analyse. Levin, Natalucci and Piger (2004) observe that inflation targeting economies do not seem to display heightened volatility of real GDP growth relative to non-inflation targeting economies.

The conclusion of most of the theoretical discussions is that while strict inflation targeting moves the economy along the frontier towards lower inflation variability and higher output variability, strict output targeting moves the economy towards lower output variability with higher inflation variability. However, the empirical literature points toward the fact that both inflation and output variability have declined in many inflation targeting countries, which contradicts the theoretical discussions. Mishkin (2007) summarises this conflict succinctly: "one concern voiced about inflation targeting is that a sole focus on an inflation goal may lead to monetary policy that is too tight when inflation is above target; thus, a singular focus on this target may lead to larger output and employment fluctuations. Yet in practice, exactly the opposite has happened" (p.505).

The third relevant strand of research relates to New Keynesian models with unemployment. During the past few years, several key authors have argued that unemployment is a notable absentee in standard New Keynesian models, and attempt to discuss the labour markets explicitly within a New Keynesian set-up.[4] Arguing that standard New Keynesian models assume Walrasian labour markets with no room for involuntary unemployment – an assumption that contravenes traditional Keynesian thought – many of these models employ search frictions in labour markets and nominal or real wage rigidities following Mortensen and Pissarides (1994), Shimer (2004, 2005), and Hall (2005).[5] Some authors including Blanchard and Galí (2008), Ravenna and Walsh (2008), and Trigari (2009), have even expressed the standard New Keynesian Phillips curve in terms of unemployment.

In summary, several theoretical discussions show that inflation targeting moves an economy along a frontier towards lower inflation variability coupled with higher output variability. Although some authors have suggested that explicit inflation targeting could reduce both, this possibility has not been formally discussed within micro-founded models involving labour markets and unemployment. This paper combines the New Keynesian literature with unemployment as discussed above, with an analytically tractable model that captures the effect of inflation targeting on monetary policy efficiency, which we measure using an inflation-unemployment variability frontier. We argue that adopting an explicit inflation targeting framework provides clarity and transparency to the inflation stabilisation objective of the central bank, thus improving the variability trade-off. On the other hand, merely increasing the policy weight on achieving an inflation target with less clear monetary policy objectives only moves an economy along a frontier. We also look at some empirical evidence comparing inflation and unemployment variability before and after inflation targeting in inflation targeting countries, and before and after end-1992 in non-inflation targeting countries. Our findings aim to shed some light on resolving the conflict between the existing theoretical and empirical observations regarding inflation targeting and the volatility of the real economy.

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[4] Key work includes Blanchard and Galí (2007a, 2008), Christoffel and Linzert (2005), Faia (2006), Krause and Lubik (2007), Gertler, Sala and Trigari (2008), Ravenna and Walsh (2008), Thomas (2008), Sala, Söderström and Trigari (2008), Trigari (2009), and Gertler and Trigari (2009).

[5] "Despite the central role of unemployment in the policy debate, that variable has been – at least until recently – conspicuously absent from the new generation of models that have become the workhorse for the analysis of monetary policy, inflation and the business cycle, and which are generally referred to as New Keynesian." (Galí, 2010, (p.1))

2. The Model

2.1 Households

We assume a representative household h, that maximises expected lifetime utility given by:

$$E_0 \sum_{\tau=0}^{\infty} \beta^{t+\tau} \left(\frac{C_{t+\tau}^{1-\sigma}}{1-\sigma} - \chi \frac{N_{t+\tau}^{1+\eta}}{1+\eta} \right) \tag{1}$$

where C_t is household consumption that consists of a basket of differentiated final consumption goods produced by a continuum of monopolistically competitive retailers ($j \in [0,1]$) as given by:

$$C_t = \left(\int_0^1 c_{jt}^{\frac{\theta-1}{\theta}} dj \right)^{\frac{\theta}{\theta-1}} \tag{2}$$

and N_t is the fraction of employed members of the household. $\beta < 1$ is the intertemporal discount factor, $\sigma > 0$ is the intertemporal elasticity of substitution of consumption, $\eta > 0$ is the inverse of the Frisch labour supply elasticity, $\chi > 0$ is a scaling parameter, and $\theta > 1$ is the elasticity of substitution between consumption goods.

Household's first stage decision problem is to minimise the cost of buying the consumption basket, i.e.,

$$\min_{c_{jt}} \int_0^1 p_{jt} c_{jt}.dj \qquad \text{subject to} \left(\int_0^1 c_{jt}^{\frac{\theta-1}{\theta}} dj \right)^{\frac{\theta}{\theta-1}} \geq C_t \tag{3}$$

where p_{jt} is the price of good j. Solving this minimisation problem results in the conventional product demand of a differentiated good in a model with Dixit-Stiglitz preferences given by:

$$c_{jt} = C_t \left(\frac{p_{jt}}{P_t} \right)^{-\theta} \tag{4}$$

where P_t is the aggregated price index for consumption. In the second stage, the representative household maximises its intertemporal utility function given by (1) subject to the budget constraint:

$$\frac{W_t}{P_t} N_t + \frac{M_{t-1}}{P_t} + (1 + i_{t-1}) \frac{B_{t-1}}{P_t} + \Pi_t \geq C_t + \frac{M_t}{P_t} + \frac{B_t}{P_t} \tag{5}$$

where W_t is the nominal wage rate, M_t is nominal money holdings, B_t is one period bond holdings, i_t is the nominal interest rate on bonds, and Π_t is real profits received from all firms. From the first order conditions of the maximisation problem we obtain:

$$\left(\frac{E_t C_{t+1}}{C_t}\right)^{\sigma} = \beta(1 + i_t)\left(\frac{P_t}{E_t P_{t+1}}\right) \tag{6}$$

and

$$\frac{W_t}{P_t} = \frac{\chi N_t^{\eta}}{C_t^{-\sigma}} \tag{7}$$

where equation (6) is the household Euler equation for the intertemporal optimality condition for the allocation of consumption, and equation (7) gives the marginal rate of substitution between labour supply and consumption equals the real wage.

2.2 Firms

As in most recent New Keynesian literature on labour markets, in order to keep the pricing decisions and employment decisions tractable, we assume two types of firms: intermediate good producing firms, i, and final consumption good producing firms (or retailers), j (see Gertler, Sala and Trigari, 2008; Ravenna and Walsh, 2008; Blanchard and Galí, 2008; and Trigari, 2009). Each final good producing firm uses a single intermediate good x_{jt}, which in turn is supplied by intermediate good producing firms:

$$x_{jt} = \int_0^1 x_{it}^{j} \, .di \tag{8}$$

where x_{it}^{j} is an intermediate good producer (i) supplying the retailer (j).

Intermediate good producing firms operate in a perfectly competitive environment and employ workers in the production process given the homogenous production function:

$$x_{it}^{j} = A_t N_{it} \tag{9}$$

where A_t is the technology parameter and constant returns to scale are assumed for simplicity.

The production function faced by each final good producer is given by:

$$y_{jt} = x_{jt} \tag{10}$$

where the intermediate goods are the sole input involved. As Trigari (2009) states, "retailers do nothing other than buy intermediate goods from firms, differentiate them with a technology that transforms one unit of intermediate goods into one unit of retail goods, and resell them to the households"(p.14).

The aggregate resource constraint for the economy is given by:

$$C_t = A_t N_t \tag{11}$$

The profit maximisation problem of intermediate good firms is given by:

$$\max_{N_{it}} \Pi_{it} = \left(\frac{p_{jt}^{int}}{P_t}\right) A_t N_{it} - \left(\frac{W_t}{P_t}\right) N_{it} \tag{12}$$

where P_t is the aggregate price level and p_{jt}^{int} is the price faced by each intermediate good producer supplying retailer j.

Given constant returns to scale, the resulting marginal cost is identical across firms, and profit maximisation results in:

$$\left(\frac{p_{jt}^{int}}{P_t}\right) = \frac{\varpi_t}{A_t} \equiv mc_t \tag{13}$$

where $\varpi_t = \left(\frac{W_t}{P_t}\right)$ is the real wage and mc_t is the real marginal cost.

2.3 Labour Market and Nash Bargaining of Wages by intermediate good producers

The labour force is normalised to 1, so all agents are either employed or unemployed:

$$u_t = 1 - N_t \tag{14}$$

We assume that, at the start of each period, workers and firms bargain for wages as in Blanchard and Galí (2006, 2008), Ravenna and Walsh (2008), Faia (2008), and Trigari (2009). However, for simplicity, we also assume that there are no hiring and firing costs involved and that there are no unemployment benefits,[6] thus the only friction in the labour market is caused by the relative bargaining power of workers. In each period, bargaining of wages between workers and firms occur according to:

$$\max_{\varpi_t} (S_t^H)^{\Gamma} (S_t^F)^{1-\Gamma} \tag{15}$$

[6] So that the value of an open vacancy for a firm and the unemployment value for a worker expressed in terms of current consumption are both equal to zero.

where S_t^H refers to the surplus accumulating to workers from being employed and S_t^F is the surplus accumulating to firms from employing a worker. The relative bargaining power of workers is given by $0 < \Gamma < 1$. The surplus for workers is the employment value for a worker expressed in terms of current consumption or the real wage income from supplying labour over the disutility from supplying labour ($\varpi_t - MRS_t$), while the surplus for firms stems from the real marginal revenue product over the real wage ($MRP_t - \varpi_t$).

Then the first order condition of the Nash bargaining problem is:

$$\Gamma(MRP_t - \varpi_t) = (1-\Gamma)(\varpi_t - MRS_t) \tag{16}$$

Substituting the expressions for MRS_t and MRP_t into (16), we obtain:

$$\Gamma\left(A_t \frac{p_t^{int}}{P_t} - \varpi_t\right) = (1-\Gamma)\left(\varpi_t - \frac{\chi N_t^{\eta}}{C_t^{-\sigma}}\right) \tag{17}$$

Using $C_t = A_t N_t$ and $\frac{P_t}{p_t^{int}} = \frac{\theta}{\theta-1} = m$, and solving for ϖ_t,

$$\varpi_t = \frac{\Gamma A_t + m(1-\Gamma)\chi N_t^{\eta-\sigma} A_t^{-\sigma}}{m} \tag{18}$$

Equation (18) gives the real wage schedule obtained through Nash bargaining. Substituting (18) into (13) gives the equilibrium condition for the labour market and the expression for real marginal cost[7] in log linear form becomes:

$$\widehat{mc}_t = \frac{mN^{\eta}(1-\Gamma)(\eta-\sigma)\chi}{A^{1+\sigma}N^{\sigma}\Gamma + mN^{\eta}(1-\Gamma)\chi}\widehat{N}_t - \frac{m(1-\Gamma)N^{\eta}(1+\sigma)\chi}{A^{1+\sigma}N^{\sigma}\Gamma + m(1-\Gamma)N^{\eta}\chi}\hat{A}_t \tag{19}$$

Then using the log-linearised labour market relationship, we obtain real marginal cost in terms of unemployment:

$$\widehat{mc}_t = -\frac{m(1-N)(1-\Gamma)(\eta-\sigma)\chi}{A^{1+\sigma}N^{1-\eta+\sigma}\Gamma + mN(1-\Gamma)\chi}\hat{u}_t - \frac{mN^{\eta}(1-\Gamma)(1+\sigma)\chi}{A^{1+\sigma}N^{\sigma}\Gamma + mN^{\eta}\Gamma(1-\Gamma)\chi}\hat{A}_t \tag{20}$$

For standard parameter values, real marginal cost is negatively related to technology shocks and also negatively related to unemployment.

2.4 Price setting by final good producing firms

As in standard New Keynesian literature, the final good producing firms (or retailers) are monopolistically competitive and adjust prices according to a Calvo

[7] As shown in Trigari (2009), "the relative price of intermediate goods, coincide with the real marginal cost faced by the retailers." (p.14)

specification where a fraction $(1-\omega)$ of retailers adjusts their prices in the current period but the remaining ω fraction does not. They choose the optimal price for its good given the demand curve:

$$E_0 \sum_{\tau=0}^{\infty} \omega^{\tau} \Delta_{\tau,t+\tau}\left(\Pi_{jt+\tau}\right) \tag{21}$$

where

$$\Pi_{jt} = \frac{p_{jt}}{P_t} C_{jt} - mc_t c_{jt}$$

and $\Delta_{\tau,t+\tau} = \beta^{\tau}\left(\frac{C_{t+\tau}}{C_t}\right)^{-\sigma}$ is the discount factor.

Substitute the product demand function (4) into (21), differentiate with respect to p_{jt} and rearrange to obtain:

$$E_0 \sum_{\tau=0}^{\infty} (\omega\beta)^{\tau} \frac{C_{t+\tau}^{1-\sigma}}{C_t^{-\sigma}} \left((1-\theta)\frac{p_{jt}}{P_{t+\tau}} - \theta mc_{t+\tau}\right)\left(\frac{1}{p_{jt}}\right)\left(\frac{p_{jt}}{P_{t+\tau}}\right)^{-\theta} = 0 \tag{22}$$

Since all firms adjusting in period t set the same price:

$$p_{jt} = p_t^* \tag{23}$$

equation (27) Can be rearranged, and log linearised to obtain:

$$\hat{p}_t^* = (1-\omega\beta)\left(\widehat{mc}_t + \hat{P}_t\right) + \omega\beta E_t\left(\widehat{mc}_{t+j} + \hat{P}_{t+j}\right) \tag{24}$$

whereas the log linearised flexible price equilibrium is given by:

$$\hat{p}_t^* = \widehat{mc}_t + \hat{P}_t \tag{25}$$

Iterating forward:

$$E_t \hat{p}_{t+j}^* = E_t \widehat{mc}_{t+j} + E_t \hat{P}_{t+j} \tag{26}$$

Using (26) in (24) and for period $j = 1$,

$$\hat{p}_t^* = (1-\omega\beta)\left(\widehat{mc}_t + \hat{P}_t\right) + \omega\beta E_t(\hat{p}_{t+1}^*) \tag{27}$$

The prices set by firms adjusting their prices in the current period and non-adjusting firms in past periods can be aggregated using the Dixit-Stiglitz price index derived in the household's minimisation problem:

$$P_t^{1-\theta} = \int_0^1 p_{it}^{1-\theta}.di \tag{28}$$

Since a $(1-\omega)$ fraction of firms adjust prices, rewrite (28) as:

$$P_t^{1-\theta} = (1-\omega){p_{it}^*}^{1-\theta} + \omega \int_0^1 p_{it-1}^{1-\theta}.di \tag{29}$$

Simplify and log linearising results in:

$$\hat{p}_t^* = \frac{1}{1-\omega}\hat{P}_t - \frac{\omega}{1-\omega}\hat{P}_{t-1} \tag{30}$$

Iterating forward gives:

$$E_t\hat{p}_{t+1}^* = \frac{1}{1-\omega}\hat{P}_{t+1} - \frac{\omega}{1-\omega}\hat{P}_t \tag{31}$$

Substituting (30) and (31) into (27) and using $\pi_t = \hat{P}_t - \hat{P}_{t-1}$, we obtain the standard New Keynesian Phillips curve:

$$\pi_t = \kappa\widehat{mc}_t + \beta E_t\pi_{t+1} \tag{32}$$

where

$$\kappa = \frac{(1-\omega)(1-\omega\beta)}{\omega}$$

2.5 NKPC in terms of Unemployment

Using the expression for the log-linearised real marginal cost given by (20) in the New Keynesian Phillips curve (32), we obtain the New Keynesian Phillips curve in terms of unemployment:

$$\pi_t = \beta E_t\pi_{t+1} - \kappa\Phi\hat{u}_t - \kappa\Psi\hat{A}_t \qquad (33)^{8}$$

where

$$\Phi = \frac{m(1-N)(1-\Gamma)(\eta-\sigma)\chi}{A^{1+\sigma}N^{1-\eta+\sigma}\Gamma + mN(1-\Gamma)\chi} \qquad \text{and}$$

$$\Psi = \frac{mN^{\eta}(1-\Gamma)(1+\sigma)\chi}{A^{1+\sigma}N^{\sigma}\Gamma + mN^{\eta}(1-\Gamma)\chi}$$

Also, as in Svensson and Woodford (2003), we assume that $\hat{A}_t$ follows an autoregressive process given by:

$$\hat{A}_t = \gamma\hat{A}_{t-1} + \varepsilon_t \tag{34}$$

where ε_t is white noise.

[8] Blanchard and Galí (2008) and Ravenna and Walsh (2008), also derive similar unemployment-based Phillips curves. Due to the labour market flows they assume, their Phillips curves include past and expected future unemployment as well.

2.6 Goods market Equilibrium

We can rewrite the household Euler equation (6) as:

$$\left(\frac{E_t C_{t+1}}{C_t}\right)^{\sigma} = \beta E_t R_{t+1} \tag{35}$$

where $E_t R_{t+1} = (1 + i_t)\left(\frac{P_t}{E_t P_{t+1}}\right)$

Log-linearising (35) around a zero inflation steady state, and using $E_t \hat{R}_{t+1} = \hat{r}_t - E_t \pi_{t+1}$ we obtain:

$$\hat{C}_t = E_t \hat{C}_{t+1} - \frac{1}{\sigma}(\hat{r}_t - E_t \pi_{t+1}) \tag{36}$$

Using the log-linearised aggregate resource constraint, we get

$$\hat{N}_t = (\gamma - 1)\hat{A}_t + E_t \hat{N}_{t+1} - \frac{1}{\sigma}(\hat{r}_t - E_t \pi_{t+1}) \tag{37}$$

and in terms of unemployment, this can be expressed as:

$$\hat{u}_t = \frac{N(1-\gamma)}{(1-N)}\hat{A}_t + E_t \hat{u}_{t+1} + \frac{N}{\sigma(1-N)}(\hat{r}_t - E_t \pi_{t+1}) \tag{38}$$

Equation (38) displays that higher expected real interest rates increase unemployment.

2.7 Monetary Policy

The central bank conducts monetary policy through a simplified Taylor-type interest rate rule given by:

$$\boldsymbol{\hat{r}_t = \phi \pi_t - \psi \hat{u}_t} \tag{39}$$

where the central bank changes the policy instrument, the nominal interest rate $\hat{r}_t$, in response to changes in inflation in relation to an explicit or implicit inflation target (here assumed to be zero) and in response to changes in unemployment (or broadly, the real economy).[9] ϕ and ψ are designed policy weights on inflation stabilisation and real sector stabilisation.

[9] It is more common to include the output gap in a central bank loss function and a policy rule. We include reducing unemployment fluctuations to represent central bank's concerns on the real sector for simplicity. This is also motivated by the fact that maximum employment is a core objective of monetary policy as defined by the Federal Reserve Act of 1977 (and a secondary objective for the Bank of England and the European System of Central Banks), and Svensson's (2006) argument, that "flexible inflation targeting implies that the central bank is not concerned exclusively about stabilizing inflation around the inflation target but is also

To assess the impact of inflation targeting, we employ an argument by Blanchard and Galí (2007b), and Galí (2008a), where in addition to the actual policy rule, they utilise a perceived policy rule with a shift parameter to model credibility of monetary policy. In the same vein, we model the public perception of the policy rule as follows:

$$\hat{r}_t = \phi^{per}\pi_t - \psi\hat{u}_t + d_t \tag{40}$$

where ϕ^{per} is the relative policy weight on inflation stabilisation as perceived by the public.[10]

Equations (39) and (40) are different in two aspects. First, the policy weight on inflation stability may be perceived as lower than the designed policy weight, so $\phi^{per} \leq \phi$. Following the literature which argues that inflation targeting improves policy credibility (Debelle, 1999; Svensson, 2000a; Neumann and Von Hagen, 2002; Mishkin, 2007; and Libich, 2008), we assume that $\phi^{per} \rightarrow \phi$ as the credibility and transparency of the policy regime improve, and $\phi^{per} = \phi$ in a "perfect information" inflation targeting regime. The second difference between equations (39) and (40), is the disturbance that appears in equation (40). Similar to Blanchard and Galí (2007b) and Galí (2008a), when the central bank truly follows the designed policy rule (39), *ex post*, an expression for this disturbance can be obtained by solving for the difference between (39) and (40):

$$d_t = (\phi - \phi^{per})\pi_t \tag{41}$$

As $\phi^{per} \rightarrow \phi$, then $d_t \rightarrow 0$, and equations (39) and (40) become identical.

3. Model Solution

3.1 Analytical Solution

Substituting the perceived policy rule (40) into (38) and solving for $\hat{u}_t$:

concerned with stability of the real economy, as represented by the output gap, the employment gap, or the unemployment gap" (p.6).

[10] Orphanides and Williams (2005) discuss the difference between a known inflation target and an unknown inflation target and their impact on the variability trade-off. This can be incorporated in our set-up as a perceived inflation target different to a designed target. However, we assume that an inflation target of a central bank (explicit or implicit) is easily identified, and it is the relative policy weight on inflation stabilisation that is made clearer by adopting an inflation targeting framework, thus making the perceived policy weight more important than the perceived inflation target. See also Svensson (2003), who argues that "central banks can improve transparency and accountability by specifying not only an inflation target but also the dislike of output-gap variability relative to inflation variability".

$$\hat{u}_t = -\frac{N}{\sigma(1-N)+N\psi} E_t\pi_{t+1} + \frac{N\phi^{per}}{\sigma(1-N)+N\psi}\pi_t$$

$$+\frac{\sigma(1-N)}{\sigma(1-N)+N\psi} E_t\hat{u}_{t+1} + \frac{N\sigma(1-\gamma)}{\sigma(1-N)+N\psi}\hat{A}_t + \frac{N}{\sigma(1-N)+N\psi} d_t \quad (42)$$

Substituting (42) into (33) and solving for π_t we obtain:

$$\pi_t = \frac{\beta\sigma(1-N)+N(\kappa\Phi+\beta\psi)}{\sigma(1-N)+N(\kappa\phi^{per}\Phi+\psi)} E_t\pi_{t+1} - \frac{(1-N)\kappa\sigma\Phi}{\sigma(1-N)+N(\kappa\phi^{per}\Phi+\psi)} E_t\hat{u}_{t+1}$$

$$-\frac{N\kappa\sigma\Phi(1-\gamma)+\kappa\Psi(\sigma(1-N)+N\psi)}{\sigma(1-N)+N(\kappa\phi^{per}\Phi+\psi)}\hat{A}_t - \frac{N\kappa\Phi}{\sigma(1-N)+N(\kappa\phi^{per}\Phi+\psi)} d_t \quad (43)$$

As in Blanchard and Galí (2007b), we propose the following guessed solutions and form expectations based on these solutions:

$$\pi_t = \mathbb{X}_1 + \mathbb{X}_2\hat{A}_t + \mathbb{X}_3 d_t \quad (44)$$

$$\hat{u}_t = \mathbb{Y}_1 + \mathbb{Y}_2\hat{A}_t + \mathbb{Y}_3 d_t \quad (45)$$

$$\pi_{t+1} = \mathbb{X}_1 + \mathbb{X}_2\hat{A}_{t+1} + \mathbb{X}_3 d_{t+1} \quad (46)$$

$$\hat{u}_{t+1} = \mathbb{Y}_1 + \mathbb{Y}_2\hat{A}_{t+1} + \mathbb{Y}_3 d_{t+1} \quad (47)$$

$$E_t\pi_{t+1} = \mathbb{X}_1 + \mathbb{X}_2\gamma\hat{A}_t \quad (48)$$

$$E_t\hat{u}_{t+1} = \mathbb{Y}_1 + \mathbb{Y}_2\gamma\hat{A}_t \quad (49)$$

Substituting (44), (45), (48), and (49) into (42) and (43) and solving for undetermined coefficients, we obtain:

$$\mathbb{X}_1 = 0 \quad (50)$$

$$\mathbb{X}_2 = -\frac{N(1-\gamma)\kappa\sigma\Phi+\kappa\Psi\big((1-N)(1-\gamma)\sigma+N\psi\big)}{(1-N)(1-\gamma)(1-\beta\gamma)\sigma+N\kappa\Phi(\phi^{per}-\gamma)+N(1-\beta\gamma)\psi} \quad (51)$$

$$\mathbb{X}_3 = -\frac{N\kappa\Phi}{\sigma(1-N)+N(\kappa\phi^{per}\Phi+\psi)} \quad (52)$$

so that the reduced form inflation equation is given by:

$$\pi_t = -\frac{N(1-\gamma)\kappa\sigma\Phi+\kappa\Psi\big((1-N)(1-\gamma)\sigma+N\psi\big)}{(1-N)(1-\gamma)(1-\beta\gamma)\sigma+N\kappa\Phi(\phi^{per}-\gamma)+N(1-\beta\gamma)\psi}\hat{A}_t$$

$$-\frac{N\kappa\Phi}{\sigma(1-N)+N(\kappa\phi^{per}\Phi+\psi)} d_t \quad (53)$$

and

$$\mathbb{Y}_1 = 0 \tag{54}$$

$$\mathbb{Y}_2 = -\frac{N(\kappa\Psi(\phi^{per}-\gamma)-(1-\gamma)(1-\beta\gamma)\sigma)}{(1-N)(1-\gamma)(1-\beta\gamma)\sigma+N\kappa\Phi(\phi^{per}-\gamma)+N(1-\beta\gamma)\psi} \tag{55}$$

$$\mathbb{Y}_3 = \frac{N}{\sigma(1-N)+N(\kappa\phi^{per}\Phi+\psi)} \tag{56}$$

Thus giving the reduced form unemployment equation as:

$$\hat{u}_t = -\frac{N(\kappa\Psi(\phi^{per}-\gamma)-(1-\gamma)(1-\beta\gamma)\sigma)}{(1-N)(1-\gamma)(1-\beta\gamma)\sigma+N\kappa\Phi(\phi^{per}-\gamma)+N(1-\beta\gamma)\psi}\hat{A}_t$$

$$+\frac{N}{\sigma(1-N)+N(\kappa\phi^{per}\Phi+\psi)}d_t \tag{57}$$

Equations (53) and (57) are obtained by utilising the policy rule as perceived by the public. However, using the solution to d_t given by (41), inflation and unemployment can be expressed purely as functions of $\hat{A}_t$. Substituting (41) into (53) and (57) we obtain:

$$\pi_t = \mathbb{X}_2\hat{A}_t + \mathbb{X}_3\big((\phi-\phi^{per})\pi_t\big) \tag{58}$$

$$\hat{u}_t = \mathbb{Y}_2\hat{A}_t + \mathbb{Y}_3\big((\phi-\phi^{per})\pi_t\big) \tag{59}$$

where, for clarity, $\mathbb{X}_2$, $\mathbb{X}_3$, $\mathbb{Y}_2$, and $\mathbb{Y}_3$ are as defined in (51),(52), (55), and (56). Simplifying further gives:

$$\pi_t = \frac{\mathbb{X}_2}{1-\mathbb{X}_3(\phi-\phi^{per})}\hat{A}_t \tag{60}$$

and

$$\hat{u}_t = \frac{\mathbb{X}_2\mathbb{Y}_3(\phi-\phi^{per})+\mathbb{Y}_2\big(1-\mathbb{X}_3(\phi-\phi^{per})\big)}{1-\mathbb{X}_3(\phi-\phi^{per})}\hat{A}_t \tag{61}$$

The unconditional variances of (60) and (61) are given by:

$$Var_\pi = \left(\frac{\mathbb{X}_2}{1-\mathbb{X}_3(\phi-\phi^{per})}\right)^2 Var_A \tag{62}$$

and

$$Var_u = \left(\frac{\mathbb{X}_2\mathbb{Y}_3(\phi-\phi^{per})+\mathbb{Y}_2\big(1-\mathbb{X}_3(\phi-\phi^{per})\big)}{1-\mathbb{X}_3(\phi-\phi^{per})}\right)^2 Var_A \tag{63}$$

Equations (62) and (63) show that, as $\phi^{per} \to \phi$, variability of both inflation and unemployment decreases. We then use these variances to plot the inflation-unemployment variability efficiency frontier and explain the results.

3.2 Parameterisation

The parameter values used in the analysis are as follows: We assume the intertemporal discount factor $\beta = 0.99$ (Erceg, Henderson and Levin, 2000; Zanetti, 2006; Krause and Lubik, 2007; Blanchard and Galí, 2008; Faia, 2008 and 2009; Galí, 2008b; Ravenna and Walsh, 2008; Trigari, 2009), and Calvo price adjustment probability $(1 - \omega) = 0.25$ (King and Wolman, 1996; Blanchard and Galí, 2007a; Ravenna and Walsh, 2008; Christoffel, *et al.*, 2009), so that $\kappa = 0.08583$. The price markup $m = 1.2$ implying $\theta = 6$ is used, following Basu and Fernald (1997), Sbordone (2002), Blanchard and Galí (2008), Faia (2006, 2008, 2009), and Ravenna and Walsh (2008), while other values used in literature include $m = 1.1$ (Krause and Lubik, 2003; Abbritti, Boitani and Damiani, 2006; Christoffel, *et al.*, 2009), $m = 1.3$ (King and Wolman, 1996), and $m = 1.7$ (Sveen and Weinke, 2008).

The productivity disturbance is highly persistent as in Erceg, Henderson, and Levin (2000), Abbritti, Boitani and Damiani (2006), Krause and Lubik (2007), Faia (2008, 2009), and Galí (2008a) and we assume $\gamma = 0.9$. Steady state value for the technology parameter is normalised, so $A = 1$, as in Shimer (2004, 2005), Abbritti, Boitani and Damiani (2006), and Blanchard and Galí (2006).

We also fix the policy weight on real sector stabilisation ψ at the standard value 0.5, so ϕ represents the *relative* policy weight on inflation stabilisation.

The bargaining power of workers, Γ is assumed to be 0.5 following Krause and Lubik (2003), Shimer (2004), Chrisoffel and Linzert (2005), Abbritti, Boitani and Damiani (2006), Faia (2008, 2009), Gertler and Trigari (2009), Christoffel, *et al.* (2009), although Ravenna and Walsh (2008) use 0.6, while Rotemberg (2006) uses an even higher value of 0.72 for this parameter. The steady state level of employment $N = 0.9$, so $u = 0.1$ as in Blanchard and Galí's (2008) assumed value for Europe, Thomas (2008), Christoffel, *et al.* (2009). The value for this parameter varies widely from Blanchard and Galí (2008), $u = 0.05$ for the US, Mandelman and Zanetti (2008), $u = 0.05$, Ravenna and Walsh (2008), $N = 0.95$, Krause and Lubik (2003), $N = 0.94$, Cole and Rogerson (1999), $u = 0.12$, Krause and

Lubik (2007), $u = 0.12$, Chrisoffel and Linzert (2005), $u = 0.2$, to high values of Faia (2009), $u = 0.4$, Cooley and Quadrini (2004), $u = 0.43$, and Andolfatto (1996), $u = 0.58$.

The scaling parameter χ is held at 1 for simplicity and is not very different to Blanchard and Galí's (2008) values of 1.03 for the US and 1.22 for Europe. The intertemporal elasticity of substitution of consumption $\sigma = 1.5$, as in Chrisoffel and Linzert (2005), Christoffel, *et al.* (2009), while values including $\sigma = 1$ (Galí, 2008a; Thomas, 2008), $\sigma = 2$ (Abbritti, Boitani and Damiani, 2006; Krause and Lubik, 2007; Ravenna and Walsh, 2008), and as low as $\sigma = 0.16$ (Rotemberg and Woodford, 1997) have been used in literature. For η, we use a value of 5 following Chrisoffel and Linzert (2005), Sveen and Weinke (2008), and Galí (2010), so that the Frisch labour supply elasticity is $\frac{1}{\eta} = 0.2$. Other values for η range from $\eta = 1$ (Blanchard and Galí, 2007a and 2008; Abbritti, Boitani and Damiani, 2006), to $\eta = 10$ (Trigari, 2009; Christoffel, *et al.*, 2009). With regard to sensitivity, our results hold for a reasonable range of parameter values around the values used in this analysis, the only essential requirement being the elasticity η must be considerably greater than σ (at least around 3 fold).

[Table 1: Parameter Values]

3.3 Graphical Exposition and Discussion

Equations (62) and (63) are used to generate the inflation-unemployment variability efficiency frontiers as shown in Figure 3.

[Fig 3 Monetary Policy and Inflation-Unemployment Variability]

The red lines (—×—) represent the case when the perceived policy weight on inflation stability coincides with the designed policy weight as in an explicit and credible inflation targeting regime. Each line in Figure 3.b shows that when policy weight on inflation stabilisation increases inflation variability falls, while each line in Figure 3.c shows that as the policy weight on inflation stability increases variability of unemployment also increases (ϕ on $y - axis$). Combining the variability points in Figures 3.b and 3.c, we obtain the inflation unemployment variability efficiency frontier as shown in Figure 3.a.

Figure 3 also displays that when the perceived policy weight on inflation stabilisation does not coincide with the designed policy weight (for instance when $\phi^{per} = 0.5\phi$ as represented by the blue lines (—O—)), while increasing ϕ reduces inflation variability and increases unemployment variability (e.g., from A to A' in Figure 3), both inflation and unemployment variability are higher than when $\phi^{per} = \phi$ (e.g., A>B and A'>B' in terms of variability in Figure 3). When ϕ^{per} is further away from ϕ, a greater increase in the policy weight is required to achieve inflation stability resulting in a greater increase in unemployment stability.

Intuitively, to reduce inflation variability, ϕ needs to be high. However, if the central bank can effectively communicate to the public that inflation stability is its prime and overriding objective (as in the case of an explicit inflation targeting framework), the favourable public perception makes ϕ more efficient at reducing inflation variability, lowering the need for a greater increase in the interest rate when inflation is rising, thereby having a less adverse effect on unemployment, as well as on unemployment variability. When monetary policy objectives are less clear and the policy maker is trying to achieve multiple objectives, ϕ needs to be even higher to effectively reduce inflationary pressures, and a higher increase in the interest rate is needed, worsening the tradeoff between inflation and unemployment variability. This explanation is in line with Debelle (1999), who argues that the variability tradeoff improves with the credibility of the policy framework; Svensson (2000a), who observes that inflation targeting improves credibility, and as a result "there is less need for monetary policy to affect real activity in order to keep inflation close to the target" (p.24); Woodford (2003), who asserts that "there is good reason for a central bank to commit itself to a systematic approach to policy that not only provides an explicit framework for decisionmaking within the bank, but that is also used to explain the bank's decisions to the public" (p.14); Orphanides and Williams (2005), who explain that "the adoption and effective communication of an explicit inflation target also mitigate the influence of imperfect knowledge on the economy. Communication of an inflation target may greatly improve attainable macroeconomic outcomes and afford greater economic stability relative to the outcomes that are attainable when the public perceives the policymaker's ultimate inflation objective less clearly" (p.231); and Mishkin's (2007) argument that "if inflation targeting produces a stronger nominal anchor, which is a key to successful economic performance, then inflation targeting can lead not only to a decline in inflation but also output volatility".

3.4 Optimal Monetary Policy

Within the theoretical framework discussed above, it is also possible to identify the optimal policy weight on inflation stabilisation, given the loss function of a central bank. As in Debelle (1999), Cecchetti and Ehrmann (1999), and Orphanides and Williams (2005), we assume that the central bank seeks to minimise an intertemporal loss function given by:

$$E_0 \sum_{\tau=0}^{\infty} \beta^{t+\tau} \left[(1-\lambda)(\pi_{t+\tau})^2 + \lambda u_{t+\tau}^2\right] \tag{64}$$

where the objectives of the central bank are stabilising inflation around an implicit or explicit inflation target (which is assumed to be zero) and reducing real sector fluctuations (here considered to be unemployment gap fluctuations[11]). λ is the relative aversion of the policy maker to real sector fluctuations. For a modern central bank, whether inflation targeting or not, λ is assumed to be very close to zero.

Rudebusch and Svensson (1999), Svensson (2002), and Vestin (2006) show that when the intertemporal discount factor β is close to one, the limit of equation (64) approaches the weighted sum of the unconditional variances of inflation and unemployment, thus reducing equation (64) to:

$$L_t = (1-\lambda)\, Var_\pi + \lambda Var_u \tag{65}$$

where Var_x stands for the variance of variable x.

Substituting the unconditional variances of inflation and unemployment as given by equations (62) and (63) into equation (65) we obtain:

$$L_t = (1-\lambda)\left(\frac{\mathbb{X}_2}{1-\mathbb{X}_3(\phi-\phi^{per})}\right)^2 Var_A + \lambda\left(\frac{\mathbb{X}_2\mathbb{Y}_3(\phi-\phi^{per})+\mathbb{Y}_2\left(1-\mathbb{X}_3(\phi-\phi^{per})\right)}{1-\mathbb{X}_3(\phi-\phi^{per})}\right)^2 Var_A \tag{66}$$

Substituting the determined coefficients and differentiating with respect to ϕ, we obtain the optimal policy weight on inflation stabilisation which are presented graphically in Figure 4.

[Fig. 4: Public Perception and Optimal Policy Weights]

[11] See also Footnote 12.

Using the parameter values given in section 3.2, Figure 24 plots the optimal policy weight on inflation stabilisation against monetary authority's relative aversion to real sector fluctuations λ. The graphs display that the optimal ϕ is a decreasing function of λ. Also, for a given value of λ, higher the distance between ϕ and ϕ^{per}, higher is the optimal policy weight on inflation stabilisation. For example, assuming $\lambda = 0.005$,[12] the optimal $\phi = 2.70$ when $\phi^{per} = \phi$ (along the thin red line), while the optimal $\phi = 3.01$ when $\phi^{per} = 0.5\phi$ (along the thick blue line). Calculating the variances of inflation and unemployment corresponding to these optimal policy weights, for the case of $\phi^{per} = \phi$ (i.e., optimal $\phi = 2.69$), we obtain $Var_{\pi} = 0.40$ and $Var_{u} = 3.60$, while for the case of $\phi^{per} = 0.5\phi$ (i.e., optimal $\phi = 3.01$), we obtain $Var_{\pi} = 0.60$ and $Var_{u} = 5.48$, thus confirming that explicitness and clarity of objectives and greater credibility of an inflation targeting regime enable the economy to achieve a lower inflation-unemployment variability frontier.

4. Empirical Evidence

4.1 Methodology

We use quarterly OECD Main Economic Indicators dataset and generally cover the period from 1980-2007. For countries where a long series of quarterly data is not available, annual data (OECD or IMF) has been used. Country selection is based on data availability.

To obtain inflation variability and unemployment variability, we follow a method similar to Cecchetti, Flores-Lagunes and Krause (2006). The methodology used by them to construct the inflation-output variability efficiency frontier is as follows: Using data for 24 countries for two sub-samples (from 1983-1990 and 1991-1998), they assume that policymakers are interested in achieving an inflation target of two per cent and in minimising the variability of output around its potential level. Potential output is measured as Hodrick-Prescott filtered industrial production, while inflation variability is measured as the squared deviation from a two per cent target level and output variability is measured as the squared deviation from the HP trend. They then use the results to construct the inflation-output variability efficiency frontier. Inefficiency points are shown up and to the

[12] If $\lambda = 0$, then the central bank will assume a value of $\phi \rightarrow \infty$ in both cases in order to eliminate inflation variability at any cost to the real economy, the case which was famously referred to by Mervyn King (1997) as an "inflation nutter".

right of the frontier and any movement towards the frontier are considered favourable (similar to Figure 2). According to them "if monetary policy is optimal, the economy will be on this curve. The exact point depends on the policymaker's preferences for inflation and output stability" (p. 411).

The method followed by us is as follows: For inflation and unemployment, we measure the deviation from a Hodrick-Prescott filter and plot their absolute values against each other.[13] For inflation targeters, we compare these data points for the two subsamples – before inflation targeting, and after inflation targeting. For non-inflation targeters, we split the two subsamples as upto 1993Q1 and from 1993Q1. 1993Q1 is the median quarter when the pioneering inflation targeting countries adopted inflation targeting as their monetary policy framework. For ease of comparison, we also plot the average inflation and unemployment variability in the two periods. The inflation-unemployment variability efficiency frontier for each sample should roughly go through these average data points.

The key differences between the Cecchetti, *et al.* (2006) methodology and ours are that unemployment variability replaces output variability, and that we measure variability points for each observation instead of one variability observation for each country enabling us to plot a variability frontier for each country. The use of Hodrick-Prescott trend to filter inflation data rather than using standard deviation or a deviation from a target, also allows us to account for the disinflationary episodes that have occurred.[14]

It must be noted that the theoretical model was log-linearised around a zero inflation steady state, while the use of the Hodrick-Prescott filter to obtain inflation variability assumes that steady state inflation is non-zero. Thus, the Hodrick-Prescott filter essentially undermines inflation variability in both periods as opposed to the use of a zero inflation steady state to obtain inflation variability. However, since we deal with both inflation targeters and non-inflation targeters, and since the first period for inflation targeters also lacks identifiable inflation targets, we opt for this method as opposed to other empirical methods discussed above. In theory, a better reconciliation with the empirical evidence presented below could be found by log-linearising the model around a trend

[13] In the analysis, Inflation and unemployment are defined as e.g., 0.05 (for 5 per cent). Inflation is not annualised.

[14] Ball and Sheridan (2005), who use standard deviation to capture inflation variability, conclude that standard deviations have been lower for non-targeters than for targeters. This is probably because standard deviation is measured around a constant mean, therefore does not identify disinflations accurately even when sample periods are split, thus showing increased standard deviations for countries that have undergone rapid disinflations under inflation targeting.

inflation rate as in Ascari (2004), and Ascari and Ropele (2007), which we set aside for further research.

4.2 Graphical Evidence

The variability points obtained for each of the 19 inflation targeting countries in the sample are plotted in Figure 5. Note that for Chile, Israel and Thailand, annual data are used, while for Finland and Spain data are only upto end-1998.[15]

[Figure 5: Inflation and Unemployment Variability – Inflation Targeters]

For several countries that adopted explicit inflation targeting frameworks, both inflation variability and unemployment variability have reduced in the post-inflation targeting period as summarised by the average inflation variability and unemployment variability after inflation targeting (the red + mark) lying closer to the origin than the average inflation variability and unemployment variability before inflation targeting (the blue × mark). In other words, the post-IT average lies lower and to the left of the pre-IT average indicating an inward shift in the inflation-unemployment variability efficiency frontier. The exceptions for this general finding are Finland, Iceland, Norway, Sweden and Switzerland.

The findings are similar for the Unites States, which is considered a credible implicit inflation targeter. Also, for EU-15, inflation and unemployment using consolidated CPI and standardised unemployment data since 1988 show that both inflation and unemployment variability have declined since 1999.

[Figure 6: Inflation and Unemployment Variability – USA and EU15]

For the 17 non-inflation targeters for which data are available, the variability points are plotted in Figure 7. Annual data are used for Argentina, Pakistan, Singapore, Sri Lanka Uruguay, and Venezuela.

[15] Finland and Spain abandoned inflation targeting to join the Eurozone in January 1999.

[Figure 7: Inflation and Unemployment Variability – Non-Inflation Targeters]

For Argentina, Austria, Belgium, France, Germany, Greece, Ireland, Japan, Luxembourg, Pakistan, the Netherlands, Portugal, Uruguay, and Venezuela, there is a possible tradeoff between inflation variability and unemployment variability. Out of these countries, for all countries except for Ireland and Pakistan, the post-1993 average variability point (red + mark) lies lower and to the right of the pre-1993 average variability point (blue × mark) indicating lower inflation variability coupled with higher unemployment variability in the post-1993 period. However, four countries in this sample, i.e., Denmark, Italy, Singapore and Sri Lanka, show improved inflation and unemployment stability similar to the findings for our sample of inflation targeters.

4.3 Econometric Evidence

Using the deviations of inflation and unemployment from a Hodrick- Prescott filter as described in section 4.1, for the 29 countries where quarterly data are available, Tables 2.a and 2.b provide results from pooled dummy variable regressions in the form of

$$\mathbb{V} = \hat{\beta}_0 + \hat{\beta}_1 d_1 + \hat{\beta}_2 d_2 + \hat{\beta}_3 d_3 + \hat{\beta}_4 d_4 + \hat{\beta}_5 d_5 \quad (67)$$

where

$$\mathbb{V} = Inflation\ (or\ unemployment) variability$$

$$d_1 = Post$$

$$d_2 = IT$$

$$d_3 = Industrial$$

$$d_4 = Euro$$

$$d_5 = Post * IT$$

The intercept $\hat{\beta}_0$, is the average inflation (or unemployment) variability of a "non-IT, non-Industrial, non Eurozone country for the pre-treatment[16] period". Compared to this "base"

[16] Treatment here means, for inflation targeting countries, the introduction of inflation targeting, and for non-inflation targeting countries, the period from 1993Q1.

category, $\hat{\beta}_1$ is the difference of average variability in post-treatment period, $\hat{\beta}_2$ is the difference of average variability in inflation targeting countries, $\hat{\beta}_3$ is the difference of average variability in industrial countries, $\hat{\beta}_4$ is the difference of average variability in Eurozone countries in the period after entering Eurozone, $\hat{\beta}_5$ is the key parameter of interest and is a difference-in-difference estimator which estimates:

$$\hat{\beta}_5 = \left(\overline{\mathbb{V}}_{post,IT} - \overline{\mathbb{V}}_{post,nonIT}\right) - \left(\overline{\mathbb{V}}_{pre,IT} - \overline{\mathbb{V}}_{pre,nonIT}\right) \quad (68)$$

where $\overline{\mathbb{V}}$ refers to the average of the deviations of inflation (or unemployment) from the Hodrick-Prescott trend, "post" stands for the period after introducing IT for IT countries, and for the period from 1993Q1 for non-IT countries, and "pre" stands for the period before IT in IT countries and for the period upto 1993Q1 for non-IT countries. Following Wooldridge (2003), $\hat{\beta}_5$ is "the difference over time in the average difference" of inflation (or unemployment) variability in IT and non-IT countries. The inclusion of several control variables is to account for issues relating to possible endogeneity as argued by Ball and Sheridan (2005).

[Table 2.a: Pooled Difference-in-Difference Estimates for Average Inflation Variability]

[Table 2.b: Pooled Difference-in-Difference Estimates for Average Unemployment Variability]

Table 2.b shows that for inflation targeting countries in the dataset average unemployment variability has been historically higher, and for industrial countries it has been historically lower. Since the coefficient $\hat{\beta}_1$ is statistically insignificant, the estimate fails to show that unemployment variability has reduced for the entire sample in the post-treatment period. However, the difference-in-difference estimator, $\hat{\beta}_5$, shows that there is a statistically significant reduction in average unemployment variability in the inflation targeting countries in the post-IT period.

With regard to average inflation variability, Table 2.a displays that average inflation variability has been historically higher for inflation targeting countries included, while it has been historically lower for industrial countries. Again $\hat{\beta}_1$ is statistically insignificant, so inflation variability has not reduced in the post-treatment period for the entire sample. However, once again, the difference-in-difference estimator shows that inflation variability has indeed reduced in inflation targeting countries following the adoption of inflation targeting, and this reduction is statistically significant.

Tables 3 - 4 provide results from pooled dummy variable regressions separately for inflation targeting and non-inflation targeting countries.

[Table 3.a: Pooled Estimates for Average Inflation Variability in Inflation Targeting Countries]

[Table 3.b: Pooled Estimates for Average Unemployment Variability in Inflation Targeting Countries]

[Table 4.a: Pooled Estimates for Average Inflation Variability in Non-Inflation Targeting Countries]

[Table 4.b: Pooled Estimates for Average Unemployment Variability in Non-Inflation Targeting Countries]

The estimated coefficients for "Post" in Tables 3.a and 3.b show that on average both unemployment variability and inflation variability have fallen across the sample of inflation targeting countries in the post-IT period. However, as shown in Tables 4.a and 4.b, for non-inflation targeting countries, while average inflation variability shows a decline in the post-1993Q1 period, the reduction in average unemployment variability in the post-1993Q1 period is statistically insignificant.

4.4 Discussion

The graphical and econometric evidence support our argument that while inflation targeters have experienced a reduction in both inflation and unemployment variability following the adoption of inflation targeting, for the non-inflation targeters the reduction in inflation variability has come at the cost of increased unemployment variability. The empirical observations point towards the finding that without clearly communicated monetary policy objectives and without an explicit and credible framework such as inflation targeting, reducing inflation variability moves a country along a frontier towards higher unemployment variability (and *vice versa*).

It is also significant that the fall in inflation and unemployment variability is more prominent among emerging market inflation targeters. This is probably due to the fact that these countries started off at an inefficiency point further away from a variability frontier, so the total gains following a credible inflation targeting regime could have been higher.

Our findings contradict Cecchetti and Ehrmann's (1999) theoretical observation that "the shift to inflation targeting can move countries along an output-inflation variability frontier, lowering the latter at the expense of the former," but are in line with their empirical finding in relation to inflation and output variability, that "the move to inflation targeting came with an overall improvement in efficiency." Our findings also agree with Arestis, Caporale and Cipollini (2002), where they find that the adoption of inflation targets might have resulted in a more favourable monetary policy trade-off for most countries in their sample of inflation targeters but not for non-inflation targeters. They are also similar to Levin, Natalucci and Piger (2004) who observe that "inflation targeting economies do not seem to display heightened volatility of real GDP growth relative to non-inflation targeting economies......This suggests that inflation targeting has improved the tradeoffs policymakers face in these countries" (pp 61-62).

5. Summary and Conclusion

While many existing theoretical discussions suggest that inflation targeting moves an economy along an inflation-output variability efficiency tradeoff towards lower inflation variability coupled with higher output variability, most empirical findings show that inflation targeting economies have seen a lower inflation and output variability in contrast to the empirical observation that non-inflation targeting economies that have reduced inflation variability have experienced an increase in output volatility.

Using a New Keynesian model with unemployment, we analyse the effects of an explicit and credible inflation targeting framework on the inflation-unemployment variability trade-off. The clarity provided by adopting an explicit inflation targeting framework to the objectives of monetary policy (through increased transparency in policymaking including the public dissemination of information through measures such as the publication of inflation reports and inflation forecasts) is shown to improve monetary policy efficiency. On the other hand, merely placing more emphasis on inflation with less clear or unannounced monetary policy objectives, moves an economy along the variability frontier. Also, we look at some empirical evidence comparing inflation and unemployment variability before and after inflation targeting in inflation targeting countries, and for two periods in non-inflation targeting countries, and find that the existing empirical findings with regard to inflation and output variability also hold in relation to inflation and unemployment variability. More specifically, we find that for many inflation targeting economies, both inflation and unemployment variability have reduced after adopting inflation targeting as the monetary policy framework indicating a shift in the inflation-unemployment variability efficiency frontier towards greater efficiency, while for a majority of non-inflation targerters, the reduction in volatility of inflation (unemployment) seems to have come at the cost of an increase in the variability of unemployment (inflation) indicating a possible movement along a variability frontier.

These results appear to shed some light on resolving the conflict between the existing theoretical and empirical observations regarding inflation targeting and the volatility of the real economy and suggest that in terms of the inflation-unemployment variability trade-off, explicit inflation targeting could result in a superior outcome.

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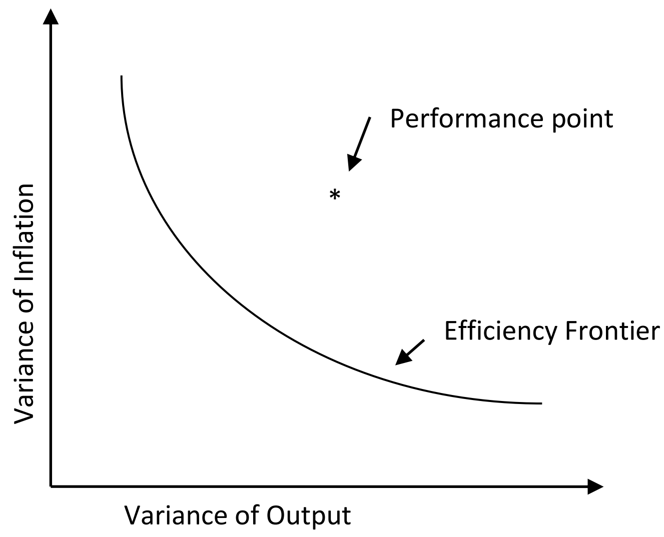


Fig. 1: Inflation-Output Variability Efficiency Frontier

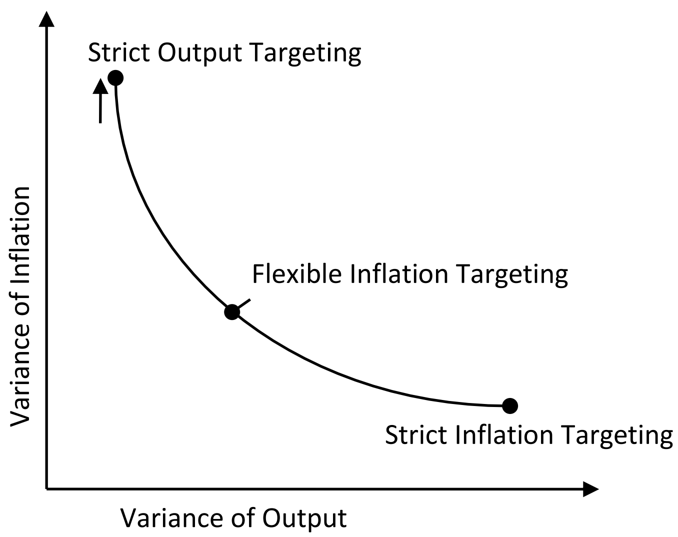


Fig. 2: Standard Relationship between Inflation Targeting and the Efficiency Frontier

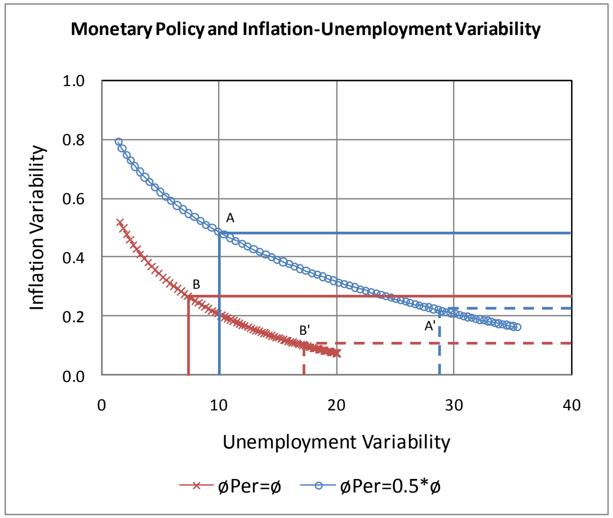


Fig. 3.a

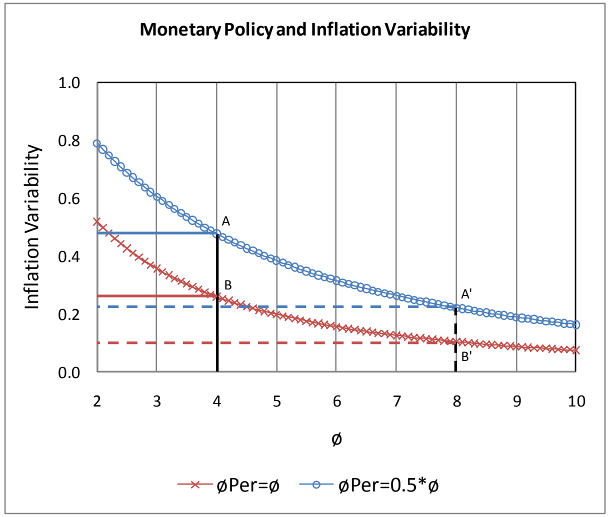


Fig. 3.b

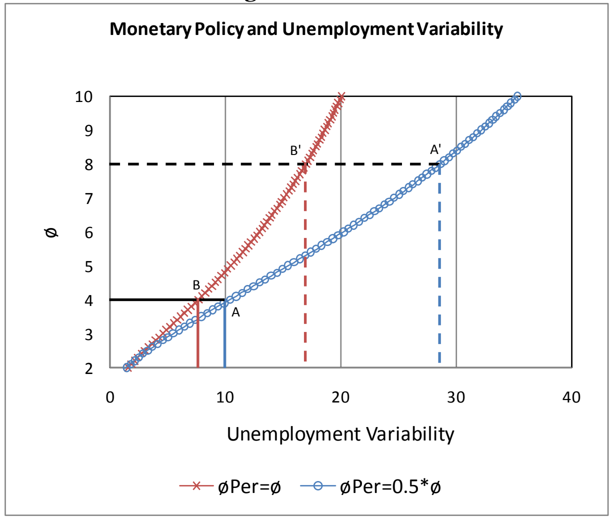


Fig. 3.c

Fig. 3: Monetary Policy and Inflation-Unemployment Variability

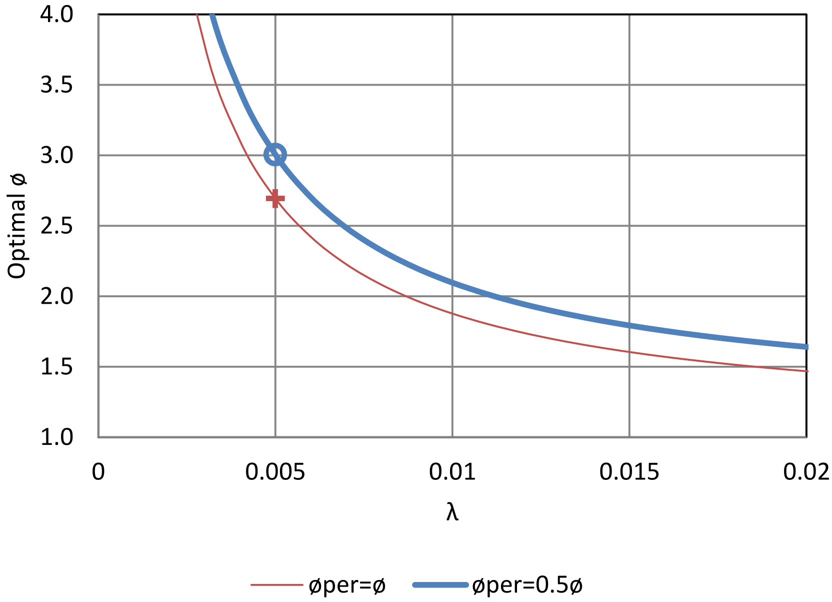


Fig. 4: Public Perception and Optimal Policy Weights

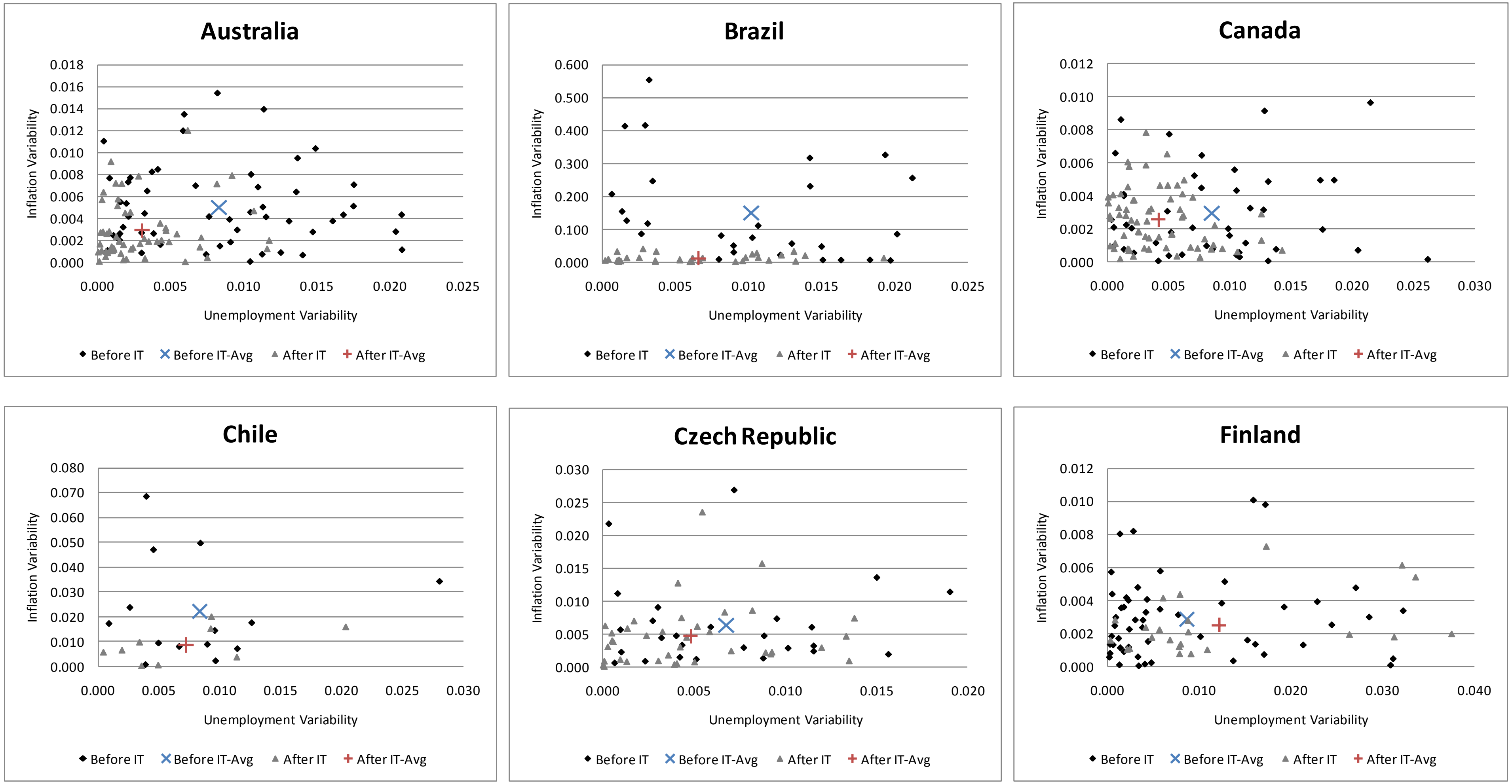


Fig. 5: Inflation and Unemployment Variability - Inflation Targeters

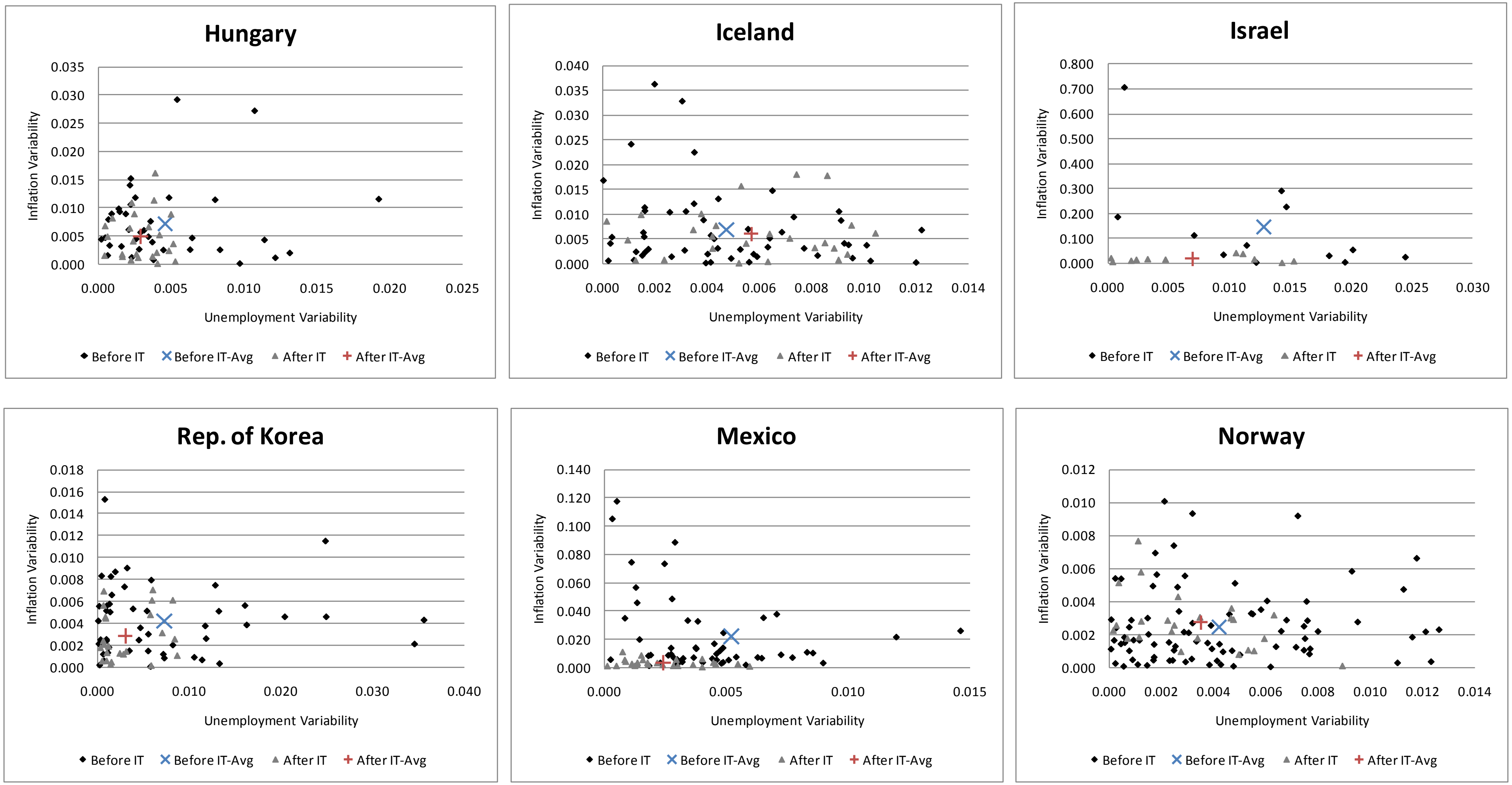
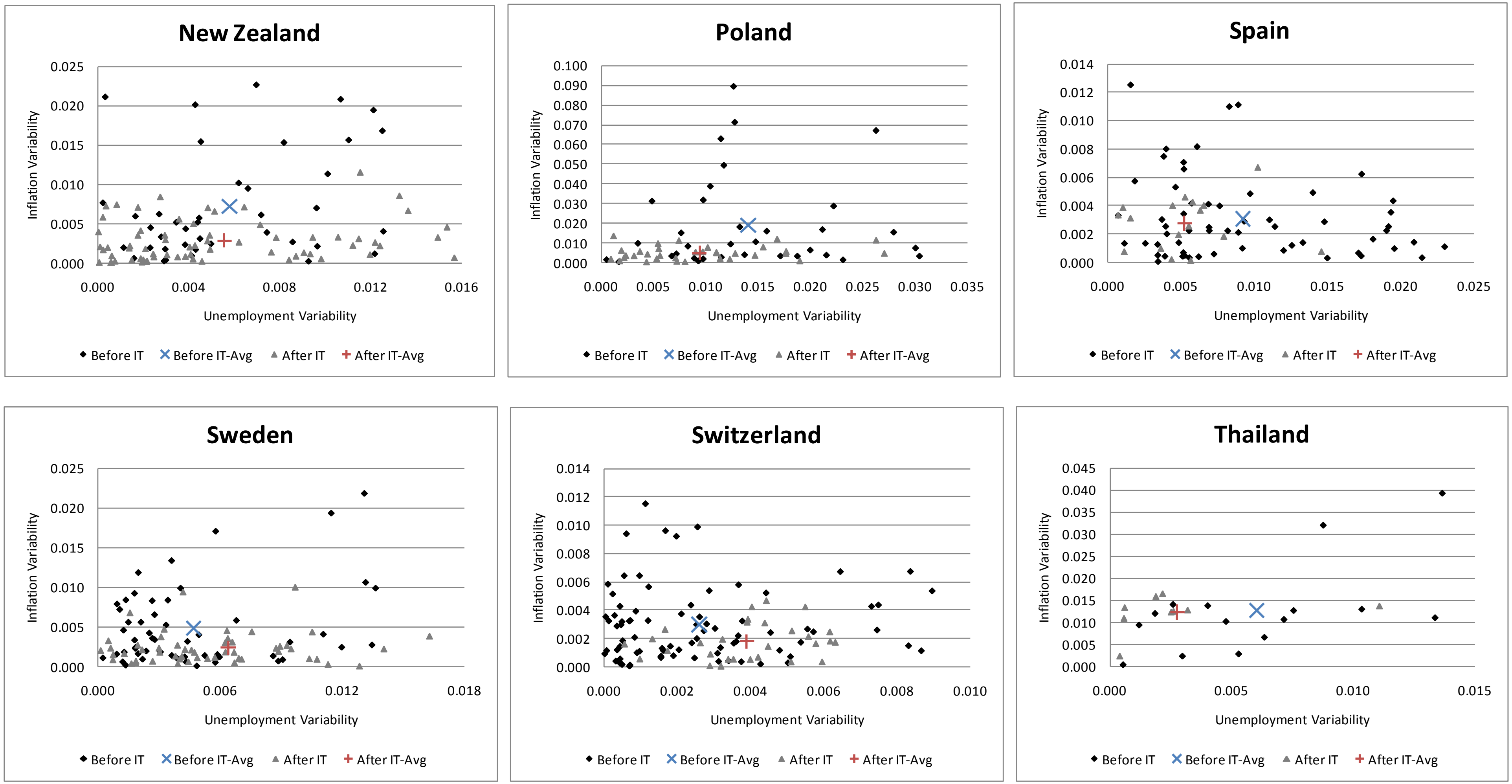


Fig. 5 ctd...: Inflation and Unemployment Variability - Inflation Targeters



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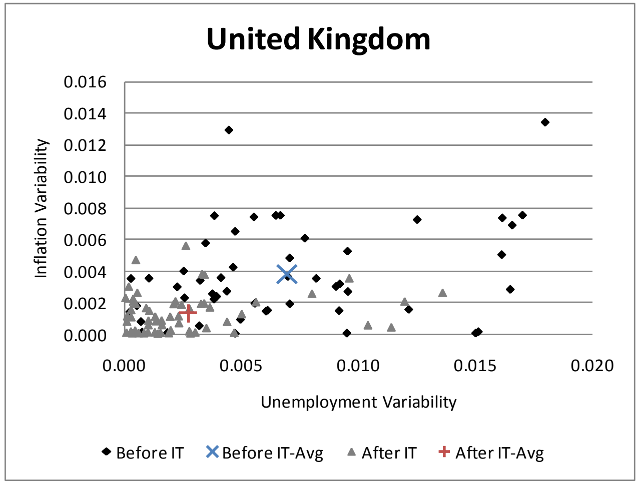

Fig. 5 ctd...: Inflation and Unemployment Variability - Inflation Targeters

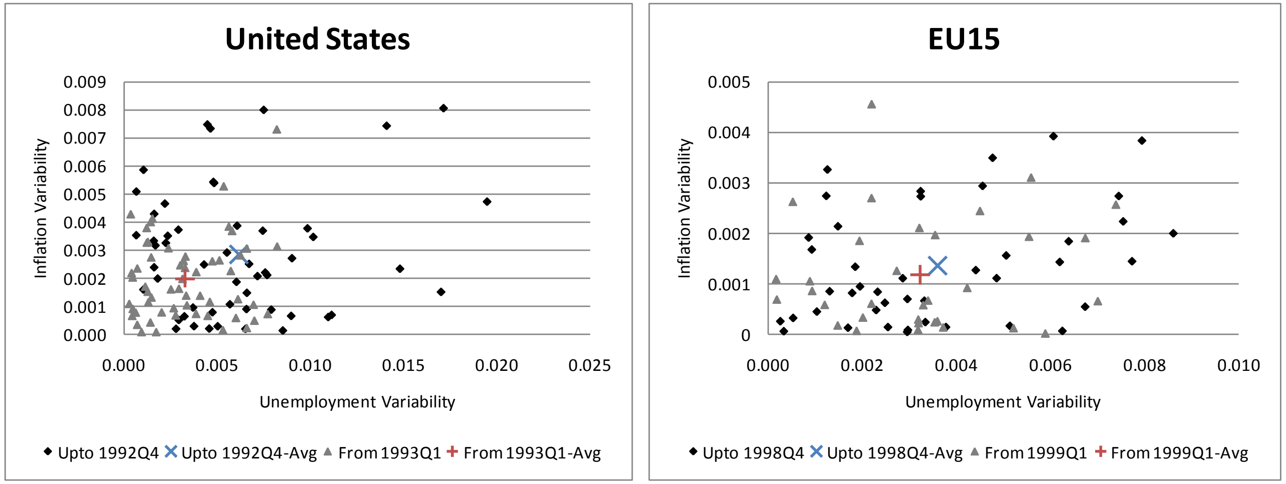

Fig. 6: Inflation and Unemployment Variability – USA and EU15

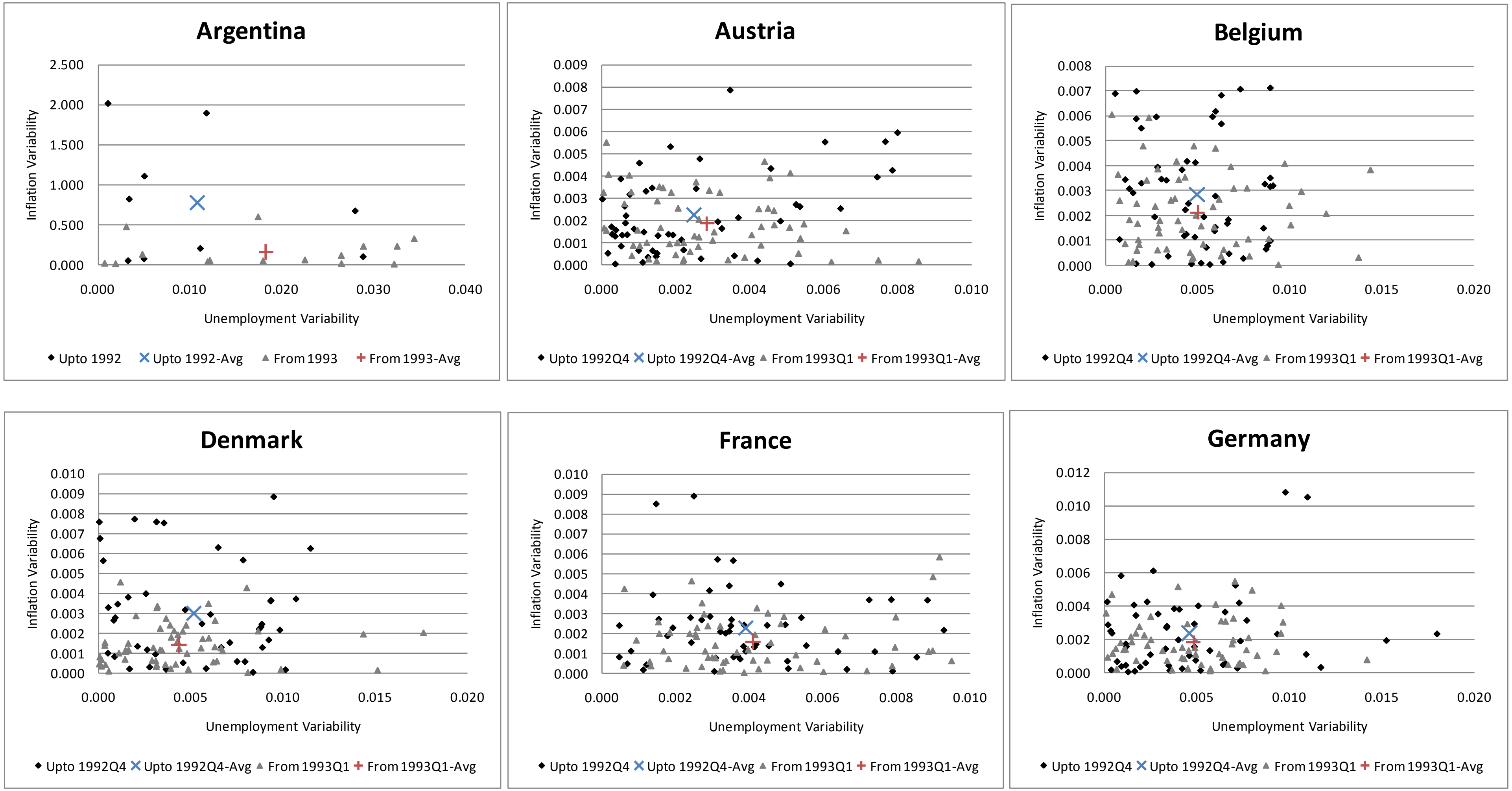

Fig. 7: Inflation and Unemployment Variability – Non-Inflation Targeters

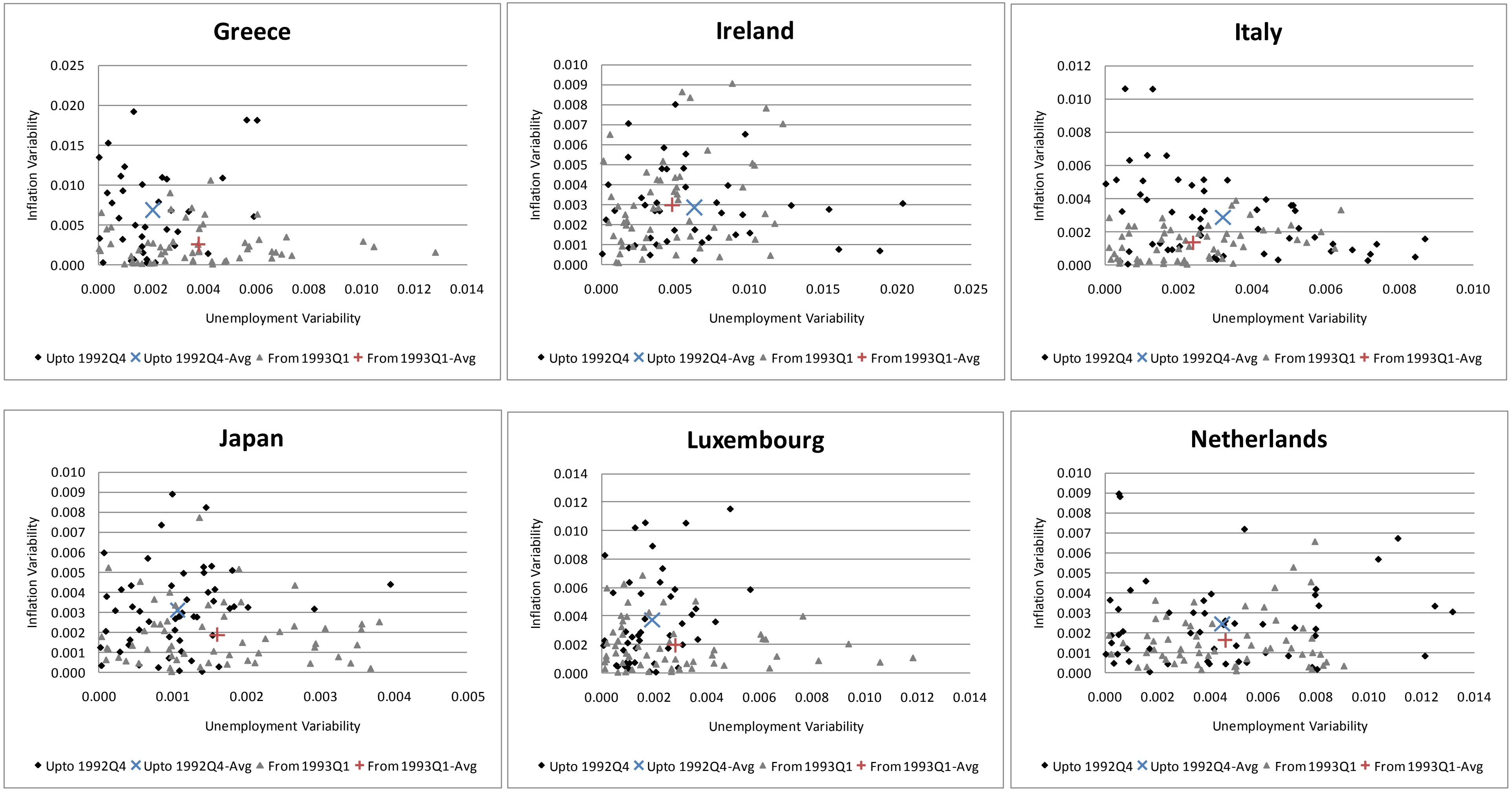

Fig. 7 ctd…: Inflation and Unemployment Variability – Non-Inflation Targeters

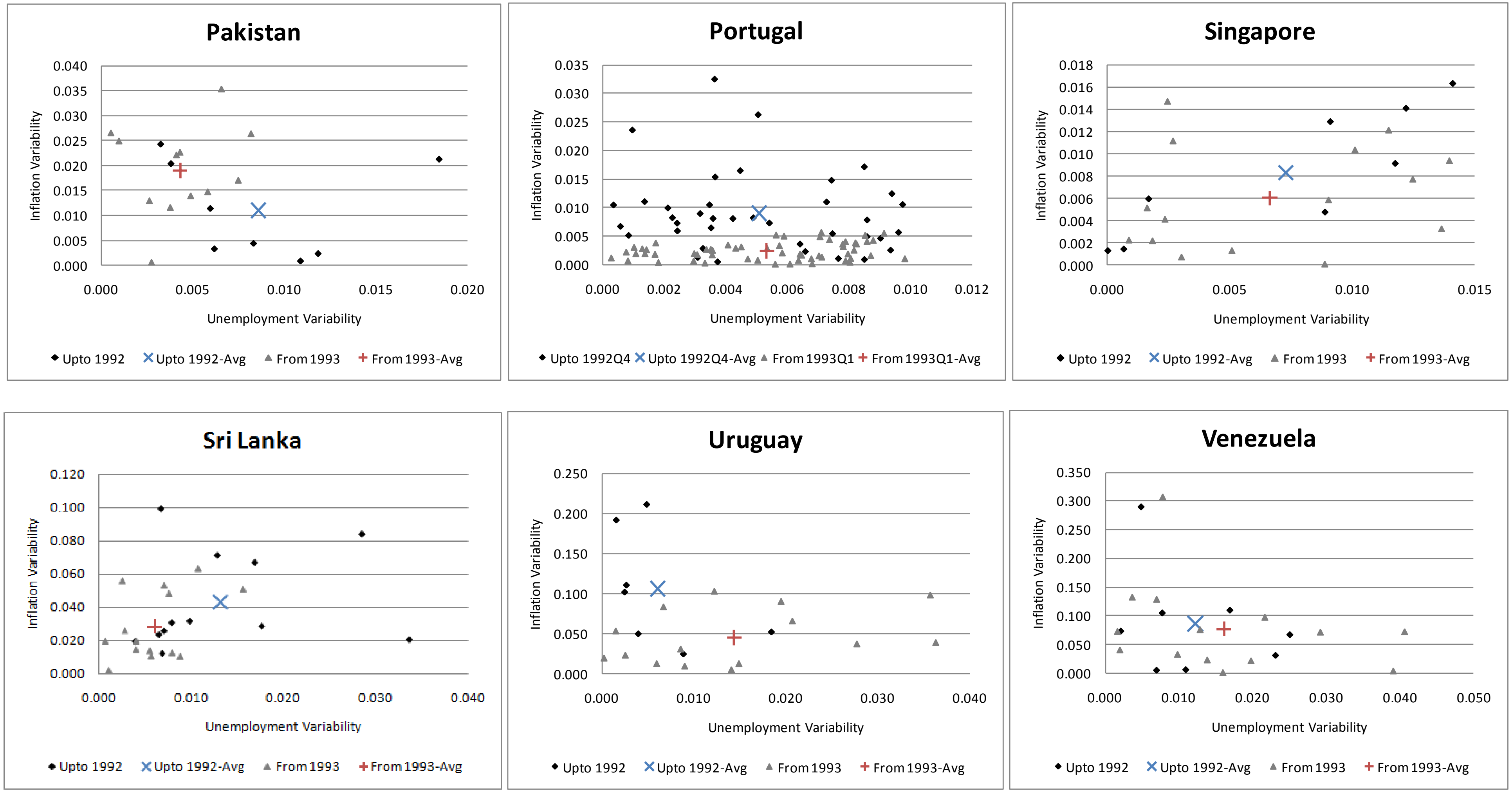

Fig. 7 ctd…: Inflation and Unemployment Variability – Non-Inflation Targeters

Table 1: Parameter Values

Parameter	Value
ω	0.75
β	0.99
γ	0.9
ψ	0.5
Γ	0.5
N	0.9
χ	1
η	5
σ	1.5
m	1.2
A	1

Table 2.a: Pooled Difference-in-Difference Estimates for Average Inflation Variability

Dependent Variable: Inflation Variability				
	Coefficient	Std. error	t-statistic	Prob. value
Constant	0.0191634	0.0014826	12.93	0.000
Post	-0.0015298	0.0013221	-1.16	0.247
IT	0.0033234	0.0011669	2.85	0.004
Industrial	-0.0157347	0.0012264	-12.83	0.000
Euro	0.0001081	0.0015383	0.07	0.944
Post*IT	-0.0063383	0.0017359	-3.65	0.000
No. of obs.	2762			
F-statistic	51.78			
Prob. of F-stat	0.0000			
R-squared	0.0859			
Adj. R-squared	0.0842			

Notes:

1. Countries included are: in the IT sample, Australia, Brazil, Canada, Czech Rep., Finland, Hungary, Iceland, Rep. Korea, Mexico, Norway, New Zealand, Poland, Spain, Sweden, Switzerland, and UK; in the non-IT sample, Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, Portugal and USA.
2. Inflation variability is measured as the cyclical component of log differenced CPI after detrending using a standard Hodrick-Prescott Filter.
3. Post is a dummy variable=1 for the period after introducing IT for IT countries, and for the period from 1993Q1 for non-IT countries. IT is a dummy variable=1 for inflation targeting countries. Industrial is a dummy variable=1 except for Brazil, Czech Rep. Hungary, Rep. Korea, Mexico, and Poland. Euro is a dummy variable=1 for the period from 1999Q1 for the Eurozone economies. Post*IT is the interactive dummy for post IT period.
4. For Finland and Spain, which were inflation targeters before joining the Eurozone, data from 1999Q1 are removed.
5. Data are quarterly and broadly cover the period from 1980 to 2007. The sources are Main Economic Indicators of the OECD.

Table 2.b: Pooled Difference-in-Difference Estimates for Average Unemployment Variability

Dependent Variable: Unemployment Variability				
	Coefficient	Std. error	t-statistic	Prob. value
Constant	0.0050853	0.0003299	15.41	0.000
Post	-0.0004359	0.0002942	-1.48	0.139
IT	0.0022367	0.0002597	8.61	0.000
Industrial	-0.0010843	0.0002729	-3.97	0.000
Euro	0.0005429	0.0003423	1.59	0.113
Post*IT	-0.0011902	0.0003863	-3.08	0.002
No. of obs.	2762			
F-statistic	36.83			
Prob. of F-stat	0.0000			
R-squared	0.0626			
Adj. R-squared	0.0609			

Notes:

1. Countries included are: in the IT sample, Australia, Brazil, Canada, Czech Rep., Finland, Hungary, Iceland, Rep. Korea, Mexico, Norway, New Zealand, Poland, Spain, Sweden, Switzerland, and UK; in the non-IT sample, Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, Portugal and USA.
2. Unemployment variability is measured as the cyclical component of unemployment after detrending using a standard Hodrick-Prescott Filter.
3. Post is a dummy variable=1 for the period after introducing IT for IT countries, and for the period from1993Q1 for non-IT countries. IT is a dummy variable=1 for inflation targeting countries. Industrial is a dummy variable=1 except for Brazil, Czech Rep. Hungary, Rep. Korea, Mexico, and Poland. Euro is a dummy variable=1 for the period from 1999Q1 for the Eurozone economies. Post*IT is the interactive dummy for post IT period.
4. For Finland and Spain, which were inflation targeters before joining the Eurozone, data from 1999Q1 are removed.
5. Data are quarterly and broadly cover the period from 1980 to 2007. The sources are Main Economic Indicators of the OECD.

Table 3.a: Pooled Estimates for Average Inflation Variability in Inflation Targeting Countries

Dependent Variable: Inflation Variability

	Coefficient	Std. error	t-statistic	Prob. value
Post	-0.0098205	0.0014785	-6.64	0.000
Australia	0.0089618	0.0026243	3.41	0.001
Brazil	0.0801254	0.0035072	22.85	0.000
Canada	0.0085493	0.0026622	3.21	0.001
Czech Rep.	0.0111046	0.0034164	3.25	0.001
Finland	0.0057270	0.0030414	1.88	0.060
Hungary	0.0101466	0.0034079	2.98	0.003
Iceland	0.0097468	0.0030270	3.22	0.001
Rep. Korea	0.0070738	0.0031110	2.27	0.023
Mexico	0.0192411	0.0029495	6.52	0.000
Norway	0.0046883	0.0025449	1.84	0.066
New Zealand	0.0106663	0.0026807	3.98	0.000
Poland	0.0196285	0.0032402	6.06	0.000
Spain	0.0051743	0.0030264	1.71	0.088
Sweden	0.0086892	0.0026283	3.31	0.001
Switzerland	0.0052642	0.0025426	2.07	0.039
UK	0.0077022	0.0026323	2.93	0.003

No. of obs.	1397
F-statistic	35.47
Prob. of F-stat	0.0000
R-squared	0.3041
Adj. R-squared	0.2955

Notes:

1. Countries included are Australia, Brazil, Canada, Czech Rep., Finland, Hungary, Iceland, Rep. Korea, Mexico, Norway, New Zealand, Poland, Spain, Sweden, Switzerland, and UK.
2. Inflation variability is measured as the cyclical component of log differenced CPI after detrending using a standard Hodrick-Prescott Filter.
3. Post is a dummy variable=1 for the period after introducing IT.
4. For Finland and Spain, which were inflation targeters before joining the Eurozone, data from 1999Q1 are removed.
5. Data are quarterly and broadly cover the period from 1980 to 2007. The sources are Main Economic Indicators of the OECD.

Table 3.b: Pooled Estimates for Average Unemployment Variability in Inflation Targeting Countries

Dependent Variable: Unemployment Variability				
	Coefficient	Std. error	t-statistic	Prob. value
Post	-0.0019594	0.0002996	-6.54	0.000
Australia	0.0065927	0.0005317	12.40	0.000
Brazil	0.0092811	0.0007106	13.06	0.000
Canada	0.0070716	0.0005394	13.11	0.000
Czech Rep.	0.0067565	0.0006922	9.76	0.000
Finland	0.0102775	0.0006162	16.68	0.000
Hungary	0.0046728	0.0006905	6.77	0.000
Iceland	0.0056706	0.0006133	9.25	0.000
Rep. Korea	0.0064638	0.0006303	10.26	0.000
Mexico	0.0049373	0.0005976	8.26	0.000
Norway	0.0044091	0.0005156	8.55	0.000
New Zealand	0.0068914	0.0005431	12.69	0.000
Poland	0.0130678	0.0006565	19.91	0.000
Spain	0.0087893	0.0006132	14.33	0.000
Sweden	0.0065942	0.0005325	12.38	0.000
Switzerland	0.0034596	0.0005151	6.72	0.000
UK	0.0057275	0.0005333	10.74	0.000
No. of obs.	1397			
F-statistic	115.96			
Prob. of F-stat	0.0000			
R-squared	0.5882			
Adj. R-squared	0.5831			

Notes:

1. Countries included are Australia, Brazil, Canada, Czech Rep., Finland, Hungary, Iceland, Rep. Korea, Mexico, Norway, New Zealand, Poland, Spain, Sweden, Switzerland, and UK.
2. Unemployment variability is measured as the cyclical component of unemployment after detrending using a standard Hodrick-Prescott Filter.
3. Post is a dummy variable=1 for the period after introducing IT.
4. For Finland and Spain, which were inflation targeters before joining the Eurozone, data from 1999Q1 are removed.
5. Data are quarterly and broadly cover the period from 1980 to 2007. The sources are Main Economic Indicators of the OECD.

Table 4.a: Pooled Estimates for Average Inflation Variability in Non-Inflation Targeting Countries

Dependent Variable: Inflation Variability				
	Coefficient	Std. error	t-statistic	Prob. value
Post	-0.0015736	0.0001377	-11.43	0.000
Austria	0.0028587	0.0002528	11.31	0.000
Belgium	0.0032740	0.0002528	12.95	0.000
Denmark	0.0029863	0.0002634	11.34	0.000
France	0.0027214	0.0002528	10.77	0.000
Germany	0.0028758	0.0002528	11.38	0.000
Greece	0.0051606	0.0002755	18.73	0.000
Ireland	0.0040837	0.0002634	15.50	0.000
Italy	0.0028760	0.0002528	11.38	0.000
Japan	0.0032651	0.0002528	12.92	0.000
Luxembourg	0.0035948	0.0002634	13.65	0.000
Netherlands	0.0028249	0.0002528	11.18	0.000
Portugal	0.0060452	0.0002693	22.45	0.000
USA	0.0032006	0.0002528	12.66	0.000
No. of obs.	1365			
F-statistic	126.75			
Prob. of F-stat	0.0000			
R-squared	0.5677			
Adj. R-squared	0.5633			

Notes:

1. Countries included are Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, Portugal and USA.
2. Inflation variability is measured as the cyclical component of log differenced CPI after detrending using a standard Hodrick-Prescott Filter.
3. Post is a dummy variable=1 for the period from 1993Q1.
4. Data are quarterly and broadly cover the period from 1980 to 2007. The sources are Main Economic Indicators of the OECD.

Table 4.b: Pooled Estimates for Average Unemployment Variability in Non-Inflation Targeting Countries

Dependent Variable: Unemployment Variability				
	Coefficient	Std. error	t-statistic	Prob. value
Post	-0.0002141	0.0001591	-1.35	0.179
Austria	0.0027924	0.0002920	9.56	0.000
Belgium	0.0050991	0.0002920	17.46	0.000
Denmark	0.0048264	0.0003044	15.86	0.000
France	0.0041216	0.0002920	14.11	0.000
Germany	0.0048222	0.0002920	16.51	0.000
Greece	0.0032456	0.0003184	10.19	0.000
Ireland	0.0055436	0.0003044	18.21	0.000
Italy	0.0028861	0.0002920	9.88	0.000
Japan	0.0014634	0.0002920	5.01	0.000
Luxembourg	0.0025221	0.0003044	8.29	0.000
Netherlands	0.0046037	0.0002920	15.76	0.000
Portugal	0.0055409	0.0003111	17.81	0.000
USA	0.0048063	0.0002920	16.46	0.000
No. of obs.	1365			
F-statistic	191.12			
Prob. of F-stat	0.0000			
R-squared	0.6645			
Adj. R-squared	0.6610			

Notes:

1. Countries included are Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, Portugal and USA.
2. Unemployment variability is measured as the cyclical component of unemployment after detrending using a standard Hodrick-Prescott Filter.
3. Post is a dummy variable=1 for the period from 1993Q1.
4. Data are quarterly and broadly cover the period from 1980 to 2007. The sources are Main Economic Indicators of the OECD.

Table B1: Dates of Adopting Inflation Targeting

Country	Inflation Targeting introduced in
Australia	1993Q2
Brazil	1999Q2
Canada	1991Q1
Chile	1999Q3
Czech Republic	1998Q1
Finland	1993Q2
Hungary	2001Q2
Iceland	2001Q1
Israel	1997Q2
Mexico	2001Q1
New Zealand	1990Q1
Norway	2001Q1
Poland	1998Q4
Republic of Korea	2001Q1
Spain	1994Q4
Sweden	1993Q1
Switzerland	2000Q1
Thailand	2000Q2
United Kingdom	1992Q4

Notes:

Based on information from national central bank websites, Ball and Sheridan (2005), Corbo, Moreno and Schmidt-Hebbel (2000), and Neumann and Von Hagen (2002)

Data and Sources

Data series are mainly from OECD Main Economic Indicators and IMF International Financial Statistics. For the analysis, unemployment and inflation are expressed as e.g., 0.05 (for 5% unemployment), while inflation is not annualised. For quarterly data where the original series are not seasonally adjusted at source, they have been adjusted using Census X12- ARIMA. Extreme values are replaced by the average of the previous and subsequent values.

Argentina

Unemployment: 21367R..ZF UNEMPLOYMENT RATE (Units: Percent per Annum), Annual – IMF

Prices: 21364...ZF CONSUMER PRICES (Units: Index Number), Annual – IMF

Australia

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [AUS.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [AUS.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Austria

Unemployment: Unemployment rate: survey-based (all persons) seasonally adjusted [AUT.UNRTSUTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [AUT.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Belgium

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [BEL.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [BEL.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Brazil

Unemployment: Unemployment rate: survey-based (all persons) seasonally adjusted [BRA.UNRTSUTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: Consumer price index: total [BRA.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Canada

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [CAN.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [CAN.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Chile

Unemployment: 22867R..ZF UNEMPLOYMENT RATE (Units: Percent per Annum), Annual – IMF

Prices: 22864...ZF CONSUMER PRICES (CPI:SANTIAGO-ALL INC) (Units: Index Number), Annual – IMF

Czech Republic

Unemployment: Unemployment rate: registered (all persons) seasonally adjusted [CZE.UNRTRG01.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All Items [CZE.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Denmark

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [DNK.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [DNK.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

European Union

Unemployment: E15 Standardised unemployment rate: all persons seasonally adjusted [E15.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: E15 CPI All items [E15.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Finland

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [FIN.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [FIN.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

France

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [FRA.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [FRA.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Germany

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [DEU.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: DEW/DEU CPI All items [DEU.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Greece

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [GRC.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [GRC.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Hungary

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [HUN.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [HUN.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Iceland

Unemployment: Unemployment rate: registered (all persons) seasonally adjusted] [ISL.UNRTRG01.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [ISL.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Ireland

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [IRL.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [IRL.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Israel

Unemployment: 43667R..ZF UNEMPLOYMENT RATE (Units: Percent per Annum), Annual – IMF

Prices: 43664...ZF CONSUMER PRICES (CPI URBAN FAMILIES) (Units: Index Number), Annual – IMF

Italy

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [ITA.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [ITA.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Japan

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [JPN.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [JPN.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Republic of Korea

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [KOR.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [KOR.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Luxembourg

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [LUX.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [LUX.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Mexico

Unemployment: Unemployment rate: survey-based (all persons) seasonally adjusted [MEX.UNRTSUTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [MEX.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Netherlands

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [NLD.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [NLD.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

New Zealand

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [NZL.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [NZL.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Norway

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [NOR.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [NOR.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Pakistan

Unemployment: 56467R..ZF UNEMPLOYMENT RATE (Units: Percent per Annum), Annual – IMF

Prices: 56464...ZF CONSUMER PRICES (CPI:12MAJOR CITIES ALL INC.) (Units: Index Number), Annual – IMF

Poland

Unemployment: Unemployment rate: registered (all persons) seasonally adjusted [POL.UNRTRG01.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [POL.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Portugal

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [PRT.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [PRT.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Singapore

Unemployment: 57667R..ZF UNEMPLOYMENT RATE (Units: Percent per Annum), Annual – IMF

Prices: 57664...ZF CONSUMER PRICES (CPI) (Units: Index Number), Annual – IMF

Spain

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [ESP.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [ESP.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Sri Lanka

Unemployment: National sources including the Department of Census and Statistics and the Central Bank of Sri Lanka (Units: Percent per Annum)

Prices: CCPI Rebased to 2000=100, National sources including the Department of Census and Statistics and the Central Bank of Sri Lanka

Sweden

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [SWE.UNRTSDTT.STSA] [Units: %], Quarterly – OECD

Prices: CPI All items [SWE.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Switzerland

Unemployment: Unemployment rate: survey-based (all persons) seasonally adjusted] [CHE.UNRTSUTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [CHE.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Thailand

Unemployment: 57867R..ZF UNEMPLOYMENT RATE (Units: Percent per Annum), Annual – IMF

Prices: 57864...ZF CONSUMER PRICES (CPI: URBAN) (Units: Index Number), Annual – IMF

United Kingdom

Unemployment: Standardised unemployment rate: all persons seasonally adjusted] [GBR.UNRTSDTT.STSA] [Units: %] [Power of ten: 0], Quarterly – OECD

Prices: CPI All items [GBR.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

USA

Unemployment: Standardised unemployment rate: all persons seasonally adjusted [USA.UNRTSDTT.STSA], Quarterly – OECD

Prices: CPI All items [USA.CPALTT01.IXOB] [Units: 2000Y] [Power of ten: -2], Quarterly – OECD

Uruguay

Unemployment: 29867R..ZF UNEMPLOYMENT RATE (Units: Percent per Annum), Annual – IMF

Prices: 29864...ZF CONSUMER PRICES (CPI:MONTEVIDEO-EMPLOYEES) (Units: Index Number), Annual – IMF

Venezuela

Unemployment: 29967R..ZF UNEMPLOYMENT RATE (Units: Percent per Annum), Annual – IMF

Prices: 29964...ZF CONSUMER PRICES (CPI ALL INCOME GROUPS CARACAS) (Units: Index Number), Annual – IMF