DEPARTMENT OF ECONOMICS

Making the most of high inflation

Wojciech Charemza, University of Leicester, UK
Svetlana Makarova, UCL, SSEES, UK
Imran Shah, University of Bristol, UK

Working Paper No. 13/01
January 2013

MAKING THE MOST OF HIGH INFLATION

WOJCIECH W. CHAREMZA*), SVETLANA MAKAROVA**)

AND IMRAN SHAH***)

*) University of Leicester, UK, corresponding author:
Department of Economics
University road
Leicester LE1 7RH, UK
Phone: +44 116 252 2899; email: wch@le.ac.uk

**) University College London, SSEES, UK; email: s.makarova@ucl.ac.uk

***) University of Bristol, UK; email: Imran.Shah@bristol.ac.uk

JEL Code: E31, N15, O11

Keywords: high inflation episodes, real effects indicators, developing countries, impulse response analysis

ABSTRACT

The paper analyses inflationary real effects in situation where there are frequent episodes of high inflation. It is conjectured with the increase in high inflation, and when differences between the expected and output-neutral inflation become large, output stimulation through inflationary shocks is more effective than otherwise. It is shown that this conjecture is valid for most countries with high inflation episodes, where inflation is greater than 4.8% for at least 25% of quarterly observations. This leads to a simple policy prescription that anti-inflationary monetary decisions should be undertaken in periods where the expected inflation exceeds output-neutral.

ACKNOWLEDGEMENT

Financial support of the ESRC/ORA project RES-360-25-0003 *Probabilistic Approach to Assessing Macroeconomic Uncertainties* is gratefully acknowledged. This research used the ALICE High Performance Computing Facility at the University of Leicester. We are grateful to Adriana Agapie and Yuanyuan Wang for their help in collecting the data. We are solely responsible for all remaining deficiencies.

1. INTRODUCTION

Investigations of the nature and strength of the relationship between inflation and real sphere generates, so far, more questions than answers. On the theoretical side, there are two main streams of the literature: (1) following Tobin's (1965) argument that under high inflation wealth is likely to be reallocated from money to physical capital, which stimulates growth, and (2) following Sidrauski (1967), that the Tobin effect is offset by increased consumption (as holding real balances is costly), creating superneutrality of inflation. Even more pessimistic views have been developed from the early papers by Brock (1974) that endogenous labour supply stimulates a negative inflation-output relationship by reducing the cost of leisure and Stockman's (1981) 'cash in advance' approach, in which investment transactions becomes more costly under raising inflation, negatively affecting output.

The empirical findings are mostly on the side of the pessimists: the statement that loosely defined 'high' inflation is bad for growth is practically universal. This is evident from the comparative survey of early results by Braumann (2000) and also from later findings (see e.g. Mallik and Chowdhury, 2001; Grier and Grier, 2006, Gillman and Harris, 2010 for the developing and transition economies). However, early results by Bruno and Easterly (1996 and 1998) indicate that periods of high inflation (but not hyperinflation) were often followed by growth in the long-run. Also, for some Asian countries recent empirical findings point out at neutrality (Kun, 2012). It is then quite natural that the empirical literature focuses on finding the threshold above which inflation might be harmful for growth. Most of the research implicitly assumes that such threshold is common for a relatively large group of countries and applies the cross-sectional or panel data methods in order to identify it (see e.g. Sarel, 1995; Khan and Senhadji, 2001; Russeau and Wahtel 2002; Vaona and Schiavo, 2007; Bick, 2010; Kremer *et al*. 2012).

In this paper we have attempted to look at the eventual stimulative effects of high inflation more closely. The hypothesis is straightforward and well researched: positive real effects can indeed follow periods of high inflation, as the inflationary expectations generate inflation surprises. However, we look at the surprises in rather refined way, distinguishing between the output-active and output-neutral expected (core) inflations. Concluding from Fischer and Modigliani (1978) we have assumed that the institutional country-specific effects like taxation, financial systems, corruption levels, differences in reporting (resulting in different money illusion effects) etc. are important enough to create individual conditions for the development of inflationary real effects. Hence, we analyse such effects for separate countries rather than for panels.

The empirical methodology is simple. Using a two-equation vector autoregressive model for inflation and output we identify the shocks and estimate the expected and output-neutral (core) inflations (see Blanchard and Quah, 1989, Quah and Vahey,1995; Charemza and Makarova, 2006). Next, using intuitive conjecture that unexpected and not output-neutral inflation creates a real effect, we formulate the *inflationary real effect gauge* (*IREG*), which is defined as the difference between the expected and output-neutral inflations. We formulate the *IREG hypothesis* which states that inflationary shocks in the period of positive *IREG* create real effects greater than in the period of negative *IREG*. The hypothesis is tested through comparing cumulative asymmetric impulse responses which account separately for the periods of positive and negative *IREG*'s.

Finally, why the title? Suppose that a country experiencing episodes of high inflation decides to implement inflation targeting. Whether inflation targeting is successful for the developed countries is subject to a debate (see Ball and Sheridan, 2005; Willard, 2012); for the developing countries the results are more encouraging (Gonçalves and Salles, 2008; Lin and Ye, 2009; Kun, 2012). If the *IREG* hypothesis is confirmed then, if a country is within an episode of high inflation and *IREG* is positive, the monetary authorities can make the most of inflation by raising the interest rate. This would reduce inflation and won't affect output as strongly as if the decision is made when *IREG* is negative. Analogously, decreasing interest rate in the period where *IREG* is positive would stimulate output growth more than a similar decision made where *IREG* is negative.

From the initial set of 45 countries we have selected 17 where there were marked episodes of high inflation. By the *episodes of high inflation* we mean the cases where 0.75 quantile of annual inflation is equal to at least 7.5%. We use quarterly data and inflation has been defined as the annual inflation measured quarterly. For these countries *IREG*'s have been computed and asymmetric impulse responses of output to inflationary shocks evaluated separately for the periods where *IREG* is positive and negative. For the countries selected there is a strong positive correlation between the differences in these cumulative impulse responses and the logarithm of the 0.75^{th} quantile of inflation. In another words, we have shown that, if a country experiences periods of high inflation, it becomes relevant to pay attention to the differences between the expected and output-neutral inflation and make anti-inflationary decision in the periods where this difference is positive. The higher inflation becomes, the stronger is the conclusion above.

We have also checked whether such correlation is not just a facade for the high inflation effect, in the sense that episodes of high inflation simply coincide with the periods of positive *IREG*, and anti-inflationary decisions should be made when inflation is rising. For the selected 17 countries we have calculated correlation between the differences in asymmetric impulse responses for the cases where *IREG* is positive and for the cases where inflation is above its median, and the logarithm of the 0.75^{th} quantile of inflation. If *IREG* was a spurious concept, this correlation should be similar to the previous one, that is between differences in the cumulative impulse responses for periods of high and low inflation and the logarithm of the 0.75^{th} quantile of inflation. In fact it is markedly lower, suggesting the operational relevance of the concept of *IREG*. We have also experimented with softening the definition of 'episodes of high inflation' by gradually lowering the 7.5% threshold for the 0.75^{th} quantile. It turned out that our results are robust until the 4.8% threshold.

Further structure of the paper is as follows. Section 2 contains the main concepts and definitions, most notably for *IREG*. Section 3 briefly discusses the data and introduces our understanding of countries with high inflation episodes. Section 4 outlines results of the impulse response estimation and more detailed results for three benchmark countries: Indonesia, Malaysia and Pakistan. Section 5 gives the summary of the *IREG* estimates for countries with episodes of high inflation and the results of the possible lowering of the high inflation threshold and misspecification due to overlaps of periods of positive *IREG* with periods of high inflation. Section 6 provides a simple policy prescription.

2. EXPECTED AND NEUTRAL INFLATIONS AND IMPULSE RESPONSES

The intuition of output-neutral inflation and *IREG* can be explained by a simple short-run representation of a typical aggregate supply function, supported indirectly or directly, by a plethora of papers from the seminal works of Lucas (1972) and Bull and Frydman (1983) and to thoroughly microfounded approaches by Golosov and Lucas (2007) and Midrigan (2011):

$$y_t = \theta(\pi_t - \pi_t^n) \quad , \quad \theta > 0 \quad , \tag{1}$$

where y_t is a measure of output dynamics (net of systematic effects), π_t is headline (observed) inflation and output-neutral inflation is π_t^n. Evidently:

$$\pi_t = \pi_t^e + \upsilon_t \quad , \tag{2}$$

where υ_t is a shock unexpected at *t*-1. However, in an economy with sticky prices, some individual relative prices cannot be fully adjusted after a shock and could have long-lasting effects on output, even if fully expected. Consequently, another decomposition of π_t is:

$$\pi_t = \pi_t^n + \omega_t \quad , \tag{3}$$

where ω_t is the non-neutral component of inflation. The evaluation of π_t^n is also based on information available at time *t*-1. Referring to the seminal literature on inflation decomposition, π_t^e is similar to core inflation in the sense of Eckstein (1981), i.e. the systematic (predictable) component of the increase in production costs. In turn, π_t^n is analogous to core inflation in the sense of Quah and Vahey (1995), i.e. the component of expected inflation which does not cause a real effect in the medium and long-run.

Substituting (2) in (1) and bearing in mind that output-neutral component of inflation is evaluated on the basis of information available at time *t*-1, we get:

$$E_{t-1}y_t = \theta \cdot E_{t-1}(\pi_t^e + \upsilon - \pi_t^n) = \theta \cdot (\pi_t^e - \pi_t^n) \quad , \tag{4}$$

where E_{t-1} denotes an expected value conditional on observations available at time *t*-1.

The relationship (4)**Error! Reference source not found.** gives rise to defining the *inflationary real effect gauge, IREG,* as:

$$IREG_t = \pi_t^e - \pi_t^n \quad ,$$

so that, interpreting (4), the positive difference between the expected and output-neutral inflations indicates that an increase in output is expected for time *t*.

Simple linear form of *IREG* suggests that that its real effects might be particularly substantial when inflation is high. Inflationary expectations develop reasonably quickly, while output-neutral inflation can be lagging behind, due to the usual sluggishness, contracts and institutional constraints. Hence, it can be conjectured that the effects of *IREG* might be particularly evident in developing economies with a reasonably well developed, albeit inefficient, state sector.

One way of computing π_t^n is similar to that derived from the Quah and Vahey (1995) structural decomposition of a stationary vector autoregressive model. Suppose that such *VAR* model can be written as:

$$A(L)Z_t = K + U_t \quad , \tag{5}$$

where $Z_t^{'} = [y_t \quad \pi_t]$, $A(L)$ is the lag polynomial operator, $K' = [k_1 \quad k_2]$ the vector of constants and $U_t^{'} = [u_{1t} \quad u_{2t}]$ are innovations with zero expectations and variance-covariance matrix Σ.

Since Z_t is stationary, its moving average representation is unique and can be recovered by inverting (5) as:

$$Z_t = M + C(L)U_t \quad , \tag{6}$$

where L is the lag operator, $C(L) = A^{-1}(L) = I + C^{(1)}L + C^{(2)}L^2 + ...$, I being the identity matrix, and $M = [m_1 , m_2]' = EZ_t = C(1)K$. Then the expected inflation π_t^e defined by (2) can be recovered from (6) by applying operator E_{t-1} (so that $E_{t-1}(U_t) = 0$) and taking the second component, that is:

$$\pi_t^e = [0,1] \cdot \left(M + \sum_{i=1}^{t-1} C^{(i)} L^i U_i \right) \tag{7}$$

Recovering the output- neutral inflation π_t^n defined by (3) is based on the methodology suggested by Blanchard and Quah (1989) and then modified further by Gartner and Wehinger (1998) and Charemza and Makarova (2006). Under the assumption of long-run output neutrality of π_t^n, the stationary process Z_t can be decomposed into the unitary innovations given by:

$$Z_t = M + \Gamma(L)\Phi_t \quad , \tag{8}$$

where: $\Gamma(L) = \Gamma^{(0)} + \Gamma^{(1)}L + \Gamma^{(2)}L^2 + \cdots,$ $\Phi_t = [\varphi_{1t} , \varphi_{2t}]'$, $E\Phi_t \Phi_t' = I$ and, additionally, with zero restrictions imposed by the long-run output-neutrality of inflation on the upper-right element of the long-run matrix $\Gamma(1) = \sum_i \Gamma^{(i)}$, that is:

$$\Gamma(1) = \Gamma^{(0)} + \Gamma^{(1)} + \Gamma^{(2)} + \cdots = \begin{bmatrix} \gamma_{11} & 0 \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \quad . \tag{9}$$

Matrix $\Gamma(1)$ can be easily computed as the lower-triangular Cholesky factor of $C(1)\Sigma C(1)'$. The element φ_{2t} can be interpreted as output-neutral component of innovations in (8) and therefore vector $\Phi_t^n = [0 , \varphi_{2t}]'$ can be interpreted as output-neutral part of unitary innovations Φ_t. The corresponding output-neutral component U_t^n of moving average innovations U_t given by (6) can then be identified by comparing (6) with (8) as:

$$U_t^n = C^{-1}\Gamma\Phi_t^n = C^{-1}\Gamma \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix} \Gamma^{-1} C U_t \, . \tag{10}$$

Then output-neutral component of inflation is recovered by combining (6) with (10) as:

$$\pi_t^n = [0,1] \cdot \left(M + \sum_{i=1}^{t-1} C^{(i)} L^i U_i^n \right) \tag{11}$$

So that, $IREG_t$ can be estimated as:

$$IREG_t = \pi_t^e - \pi_t^n = [0,1] \cdot \sum_{i=1}^{t-1} C^{(i)} L^i \left(U_i - U_i^n \right) \quad . \tag{12}$$

Consequently, estimation of *IREG* consists of (*i*) estimation of the *VAR* model (5) and its moving average representation (6), (*ii*) computing the expected and output-neutral inflations using (7) and (11) and (*iii*) computing *IREG* from (12) .

In this paper the *IREG* hypothesis is tested by evaluating whether the cumulative real effect of inflationary shocks which appear in periods of positive *IREG* is different (possibly greater) than that in periods of negative *IREG*. Denote $\pi_t^+ = \pi_t$ if $\pi_{t+1}^e > \pi_{t+1}^n$; 0 otherwise, and $\pi_t^- = \pi_t$ if $\pi_{t+1}^e \le \pi_{t+1}^n$; 0 otherwise. Clearly $\pi_t = \pi_t^+ + \pi_t^-$. The conjecture is that if the cumulative impulse response of y_t on π_t^+ is positive and greater than that on π_t^-, it is a confirmation of the *IREG* hypothesis.

We traditionally define impulse response (*IR*) as a response of one variable to an impulse in another variable (see e.g. Hamilton, 1994, p. 319; Lütkepohl, 2006, p. 51). We are assuming stationarity here, so that *IR*'s are independent from time. Let the impulse response $IR_x(z,h)$ denotes an expected change in x in reaction to a unitary shock in z after h periods (h=1,2,…,H) and the cumulative impulse response be $CIR_x(z,H) = \sum_{h=1}^{H} IR_x(z,h)$. The *IREG* hypotheses can be formulated as $CIR_y(\pi^+,H) > CIR_y(\pi^-,H)$, where $\pi^+ = \{\pi_t^+\}$, $\pi^- = \{\pi_t^-\}$.

The general definition of impulse response gives room to various practical implementations and techniques, too numerous to list them here. In this paper we consider two alternative ways of computing impulse responses. The first one is that of Jordà (2005 and 2009), as a direct linear projection of the effect of shock in time t to $t+h$ by forecasting of y_{t+h} with and without a shock, and the second is more traditional orthogonal impulse response, through the moving average representation of a *VAR*, orthogonalizing its right-hand side and collecting relevant coefficients (see e.g. Lütkepohl, 2006, p.56-58). In each case identification of shocks has to be achieved, somewhat arbitrarily. Following the mainstream approach, in both methods we have identified shocks from the model residuals recursively, by applying Cholesky decomposition. Further in the text we denote the direct projection cumulative *IR*'s by $CIR_x^D(z,H)$ and orthogonal cumulative *IR*'s as $CIR_x^O(z,H)$.

In order to diversify effects of π_t^+ and π_t^- shocks we have applied the concept analogous to that of the asymmetric generalized impulse responses by Hatemi-J (2011). We have computed $CIR_y^D(\pi^+,H)$, $CIR_y^D(\pi^-,H)$, $CIR_y^O(\pi^+,H)$ and $CIR_y^O(\pi^-,H)$ from the 3-equation *VAR*'s formulated for y_t, π_t^+ and π_t^-. These *VAR*'s have been estimated by the multivariate least squares and the *IR*'s have been computed using software available.[1]

3. DATA AND COUNTRIES WITH HIGH INFATION EPISODES

Our main database consists of quarterly data on annual inflation and GDP growth (again, annual and measured quarterly) for 45 countries. All data end in 2011q4 and the length of the series varies between 124 observations (since 1981q1) for most countries to 60 (for Ireland, since 1997q1). Data, their sources and recalculations are described in Appendix A. For some countries data are far from perfect. For India and Pakistan it was necessary to interpolate some GDP quarterly data from annual figures. In these cases we use polynomial (quadratic) interpolation. For some countries, e.g Argentina, inflation data are deemed to be unreliable and biased (see Cavallo, 2012, and numerous reports in professional press, e.g. *The Economist* and *Wall Street Journal*). Despite of this we have decided to use the official data here, in order to keep the manipulation of the official data to minimum.

Within the main database we have identified countries with relatively frequent episodes of high inflation. We have initially defined such countries as where, within the data span, the 0.75$^{\text{th}}$ quantile of inflation was at least equal to 7.5%. In another words, a country with

[1] We have adopted GAUSS procedures written by Òscar Jordà for the computing direct *IR*'s and available at http://www.econ.ucdavis.edu/faculty/jorda/pubs.html and Thierry Roncalli's procedures for the orthogonal *IR*'s (see Roncalli, 1995).

frequent episodes of high inflation (*FEHI*) is where in at least 25% cases annual inflation was higher than 7.5%. Appendix A lists all these countries with the corresponding average and 0.75^{th} quantile of inflation.

Contrary to popular tradition, we did not test the series for unit roots. The evidence of stationarity (or not) of inflation and *GDP* growth is so mixed and inconclusive (see e.g. Christopoulos and Tsionas, 2004, Charemza, Hristova and Burridge, 2005; Basher and Westerlund, 2008, Beechey and Österholm, 2008, Cook, 2009, and others), that we have decided not to enter this dispute. As most of the contemporary evidence suggests stationarity, we have assumed that the series we use are stationary.

4. ESTIMATES OF *IREG* AND ASYMMETRIC IMPULSE RESPONSES

For each country in the database we have computed *IREG* from (12). The parameters of this *VAR* model have been traditionally estimated by the multivariate least squares method, and the moving average representation has been obtained from (6) by truncating after the $1{,}000^{th}$ elements. Regarding the selection of the optimal lag, we have deviated somehow from the established tradition of using information criteria (Akaike and Schwartz Bayesian criteria) and decided to select the *VAR* lags according to the criterion of the minimum autocorrelation of the residuals. For the estimation of *IREG* it is essential to have residuals with a minimum of autocorrelation, as this is the crucial assumption in identifying π_t^e and π_t^n from (7) and (11). Moreover, the optimal lag length under this criterion is usually shorter than that given by the information criteria, which is important for the relatively short series of data we use. More precisely, as the lag selection criterion we have used the maximum *p*-value of the Hosking (1980) modification of the multivariate Ljung-Box portmanteau test, which seems to have better small sample properties than the alternatives (see Hatemi-J, 2004; for description see Lütkepohl, 2006, p. 171). Summary of estimation results are given in Appendix B, with the lag lengths of the *VARs*, absolute values of the roots of the polynomials of the *VAR* parameters matrices (as measures of *VAR* stability, see Lütkepohl, 2006, p. 17), *p*-values for univariate and bivariate Ljung-Box autocorrelation portmanteau statistics, and *p*-values of Jarque-Bera normality statistics. For all countries the minimal root of the polynomial is outside the unit circle, which indicates stability. For the overwhelming majority of countries there is no indication of autocorrelation in residuals of individual series, although the results of the joint test are less favourable. Moreover, *p*-values of the normality statistics for the residuals often suggest non-normality, which in turn makes the results of further testing less reliable.

We have presented here more results of *IREG* estimation for three representative Asian countries describing different patterns of development and different attitudes towards the monetary policy: Indonesia, Malaysia, and Pakistan. During the period investigated Indonesia and Pakistan exhibit evidence of high inflation and, using the classification introduced in Section 3, are regarded as countries with frequent episodes of high inflation (*FEHI*), while Malaysia, with a markedly lower average inflation, is used as benchmark for comparison. Below we outline briefly the development of inflation and causes for its increases in these three countries.

Indonesia

Indonesia was in a deep economic recession due to the 1997-98 Asian financial crisis. As the result, Indonesia experienced a massive depreciation in its currency causing the stock market to collapse. The economy was in unstable financial position because of Indonesian corporations' foreign currencies borrowing practices without hedging against devaluation. The rate of inflation increased sharply and reached about 80% in mid-1997. In response, Bank of Indonesia raised the interest rate to around 70%. Indonesian GDP growth rapidly declined witnessing negative economic growth of over 13% in 1998. After the crisis Indonesia has introduced a wide range of institutional reforms and redirected monetary policy towards maintaining price and exchange rate stability. As the result, price stability has been, to an extent, reinstated. However, the annual economic growth rate in 2001 slipped to about 3.5% with the inflation rate of around 13%. In the fourth quarter of 2005 Indonesia experienced a minor crisis due to international oil shock coupled with high imports. The Indonesian government was forced by *IMF* to cut its oil subsidies to stabilize the economic situation, but the economy responded by sharp inflation rise of 17%. After that, economic growth started to increase. The Bank of Indonesia had officially launched its inflation targeting policy in July 2005. In the wake of the economic crisis, the Bank of Indonesia has been granted both goal and tool independence as a part of conditionality of the International Monetary Fund's rescue package. It is now regarded as a country belonging to the so-called inflation control group (see Lin and Ye, 2009 but definitions and classifications very; see e.g Brito and Bystedt, 2010).

Malaysia

Unlike Indonesia and Pakistan, Malaysian economy has not experienced episodes of substantially high inflation. Since 1991 inflation rate averaged 2.9%. In 1990, oil price shock as a result of Gulf war increased Malaysian inflation merely to 4.75% in 1991. Malaysia has been comparatively successful in balancing strong economic growth with moderate levels of inflation in the periods preceding and following the Asian financial crisis. During the Asian crisis in 1997-98 inflation was well controlled and increased only to around 5%. After facing an economic recession for about two years since 1997, Malaysian economy has begun to pick up again from the third quarter of 1999. Inflation rate started to accelerate slightly since 2005 when the world oil prices rose, but it exceeded 5% only occasionally.

Pakistan

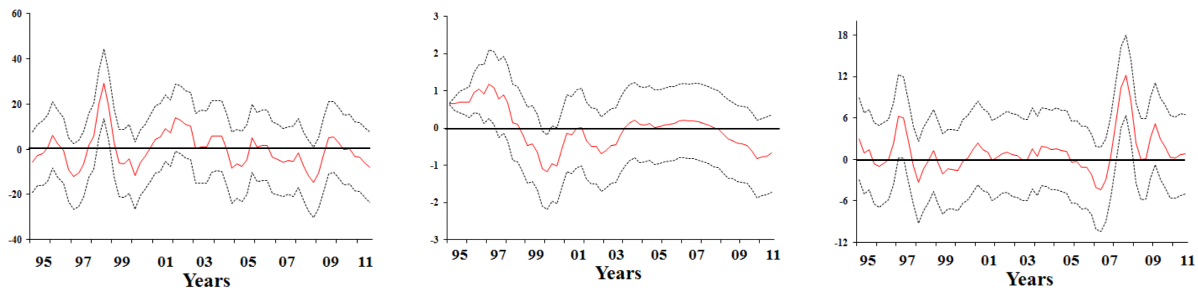
Low and moderate inflation had been typical for the Pakistan economy until the end of 2007. Average annual inflation was above 11% for only 8 out the past 28 years. Average annual real per capita income growth was 2.8%. However, years after 2007 have been more turbulent. Inflation triggered by increasing worldwide petrol prices reached 25% in the second half of 2008. In 2009-20011 inflation was slightly reduced, but still above 10%, due to increase in agriculture prices and industrial uncertainties caused by political instability. At the same time the GDP growth was remarkably stable, at around 7.5% with little variation.

Figure 1 shows confidence intervals (± two standard deviations around the computed value of *IREG*) obtained by pairwise bootstrap applied to the residuals of the *VAR* model for 1,000 resamplings. For most periods, the confidence intervals include zero, which means that the hypothesis that the true values of *IREG* is equal to zero cannot be rejected. However, for Indonesia, *IREG* is highly significant for the period 1998q3-1999q1. Inflation in this period was not markedly higher than for the remaining quarters of 1998 and 1999. For Malaysia there are some signs of significance for 1995q2-1997q3, and for Pakistan for 1997q2-q3 and 2007q3-2008q1. For Malaysia, as for Indonesia, inflation in the period of significant *IREG* was in line with inflation in the neighbouring quarters. For Pakistan, in 1997, *IREG* significance corresponds to a local peak in inflation, and for 2007q3-q4 it coincides with a period of gradually rising inflation, which reached its peak in the second half of 2008.

After evaluating of *IREG* for all 45 countries, cumulative (for 24 periods) asymmetric impulse responses of the inflationary shocks on output, separately for π_t^+ and π_t^-, have been

Figure 1: *IREG* and 2× st.dev. bootstrapped confidence intervals

Indonesia Malaysia Pakistan



computed by two methods introduced in Section 2, that is by direct projection and orthogonalization. Table C1 in Appendix C shows the cumulative impulse responses obtained by direct projection, that is $CIR_y^D(\pi^+,24)$, $CIR_y^D(\pi^-,24)$, cumulative variance decomposition of particular shocks in proportion of the total cumulative variance of y_t denoted as $V\{IR_y^D(\pi^+)\}$, $V\{IR_y^D(\pi^-)\}$, and Jordà's (2009) statistics (with *p*-values) for testing the null hypotheses that (*i*) $IR_y^D(\pi^+,h) = IR_y^D(\pi^-,h)$ jointly for all h (the *joint test*), and (*ii*) $CIR_y^D(\pi^+,24) = CIR_y^D(\pi^-,24)$ (the *cumulative test*). Table C2 shows the orthogonal cumulative impulse responses $CIR_y^O(\pi^+,24)$, $CIR_y^O(\pi^-,24)$ and corresponding variance decompositions $V\{IR_y^O(\pi^+)\}$, $V\{IR_y^O(\pi^-)\}$. The joint significance test rejects the null at the 10% level for only 4 countries: Hong Kong, Israel, Peru and Slovak Republic. The cumulative test rejects the null more frequently: for Belgium, Finland, Hong Kong, Ireland, Morocco, Philippines, Slovak Republic, Spain, Turkey,UK and USA. Likely reason for such surprisingly low level of significant results can be the underlying assumption that the impulse responses have joint multivariate normal distribution which, in case of relatively short time series and clearly non-normal distribution of *VAR* residuals, might be somewhat stretchy.

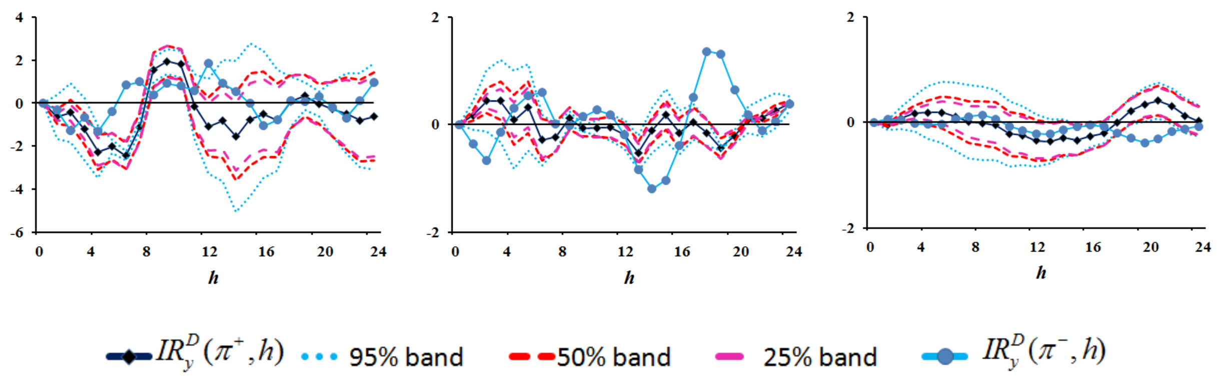
Figure 2 presents $IR_y^D(\pi^+,h)$ and $IR_y^D(\pi^-,h)$, h = 1, 2,…, 24, together with confidence intervals around $IR_y^D(\pi^+,h)$ for the representative countries: Indonesia, Malaysia and Pakistan. If $IR_y^D(\pi^-,h)$ band is outside the intervals, this suggests individual significance of the differences between $IR_y^D(\pi^+,h)$ and $IR_y^D(\pi^-,h)$ in the sense that the hypothesis $IR_y^D(\pi^+,h) = IR_y^D(\pi^-,h)$ is to be rejected for the particular h. We present the simultaneous Scheffé bands and conditional Jordà bands (for detailed description of both see Jordà, 2009). The Scheffé bands are in the form of a fan-chart (respectively with 95%, 50% and 25% confidence intervals) and Jordà bands are for the 90% confidence interval. The reason for plotting different Scheffé bands is that, due to their construction as simultaneous bands, particular different intervals might cross, so that presenting different confidence intervals gives a clearer picture of the uncertainties related to the impulse responses.

Despite of the fact that the conditional Jordà bands are narrower than the marginal bands (not reported here) or Scheffé bands, they still include zero for most of the cases. Pattern for

Figure 2: Direct projection impulse responses of y_t to shocks in π_t^+ and π_t^-

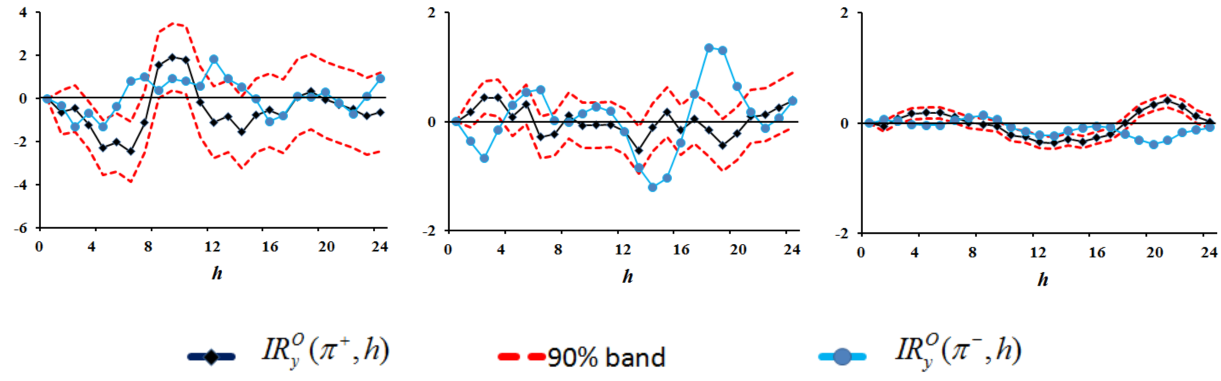
Scheffé bands

Indonesia Malaysia Pakistan



Jordà bands

Indonesia Malaysia Pakistan



Pakistan is clearly consistent with the *IREG* hypothesis. For the horizons of 3 to 5 quarters (according to Scheffé bands) and 21 to 23 quarters, according to both Scheffé and Jordà bands, $IR_y^D(\pi^+,h)$ increases and becomes significantly positive. For the same horizons, $IR_y^D(\pi^-,h)$ decreases and becomes negative. Conclusion for Pakistan is that the positive real effect of an inflationary shock which occurs in a period of a positive difference between the expected and output-neutral inflation occurs with average delay 3-5 quarters, with a possible additional long-delayed effect in 21-23 quarters. For two remaining countries the relationships are more complex. The *IREG* patters can be identified for Indonesia for the horizons of 8-10 quarters, with insignificant *IREG*, but it is proceeded by a reverse *IREG* effect (output-neutral inflation is higher than expected inflation and the difference is significant) for h = 5-7 quarters. For Malaysia, a country without high inflation episodes, *IREG* is significant after 3 and 4 quarters of the shock, while a reverse pattern is observed for the horizons of 16-20 quarters, where $IR_y^D(\pi^-,h)$ is significantly higher than $IR_y^D(\pi^+,h)$.

5. *IREG* AND HIGH INFLATION

Notwithstanding the mainly insignificant results for the differences between impulse responses for the periods of positive and negative *IREG*'s, we have attempted to test the possible relationship between gains (or losses) created by inflationary shocks in the period of positive *IREG* in relation to these in the period of negative *IREG* for the *FEHI* countries. In our dataset we have 17 countries where the 0.75th quantile of inflation is greater than 7.5%, which is where for 25% of quarters inflation was higher than 7.5% during the span of the sample. As an aggregate benchmark we define a simple measure of *IREG* gain (*IGAIN*) as $IGAIN^i = CIR^i_y(\pi^+,24) - CIR^i_y(\pi^-,24)$, i={D,O}, which is easily interpretable as the total real gain (in the sense of output) from inflationary shock which takes place in the period of positive *IREG* in relation to the same happening in the period of negative *IREG*. Table 1 indicates whether such gain was positive (by +1) or negative (by -1). It is accompanied by an indicator whether possible gain is accompanied by a smaller variance component. More precisely, in columns (1) and (3), the value of 1 indicates a situation where (in Appendix C) $CIR^i_y(\pi^+,24) > CIR^i_y(\pi^-,24)$, i={D,O} and -1 otherwise. Columns (2) and (4) display 1 if $V\{IR^i_y(\pi^+)\} < V\{IR^i_y(\pi^-)\}$, and -1 otherwise. One might look at one's in columns (1) and (3) as a weak confirmation of *IREG* hypothesis (with the alternative use of the direct projection and orthogonal *IR*'s) and 1's appearing in columns (1) and (2) or (3) and (4) simultaneously as its strong confirmation, as in this case greater real effect of inflation for π^+_t in relation to π^-_t is additionally accompanied by smaller output volatility.

Table 1: Positive and negative *IGAIN*'s for *FEHI* countries

Country, abbreviation	$IGAIN^D$		$IGAIN^O$	
	(1)	(2)	(3)	(4)
Argentina, AR	1	-1	-1	-1
Brazil, BR	1	-1	-1	-1
Columbia, CL	1	1	1	1
Hong Kong, HK	1	-1	1	1
Hungary, HU	1	-1	-1	-1
India, ID	-1	-1	-1	-1
Indonesia, IA	-1	-1	-1	-1
Mexico, ME	-1	-1	1	1
Pakistan, PK	1	-1	1	-1
Peru, PE	1	1	1	1
Philippines, PH	1	-1	1	1
Poland, PL	1	-1	1	1
Portugal, PR	1	-1	-1	-1
Romania, RO	1	-1	1	1
Russia, RU	1	-1	1	-1
Slovak Republic, SR	1	-1	1	1
Turkey, TR	1	-1	1	-1

Legend:

(1) 1 if $CIR^D_y(\pi^+,24) > CIR^D_y(\pi^-,24)$, -1 otherwise

(2) if $V\{IR^D_y(\pi^+)\} < V\{IR^D_y(\pi^-)\}$, -1 otherwise

(3) 1 if $CIR^O_y(\pi^+,24) > CIR^O_y(\pi^-,24)$, -1 otherwise

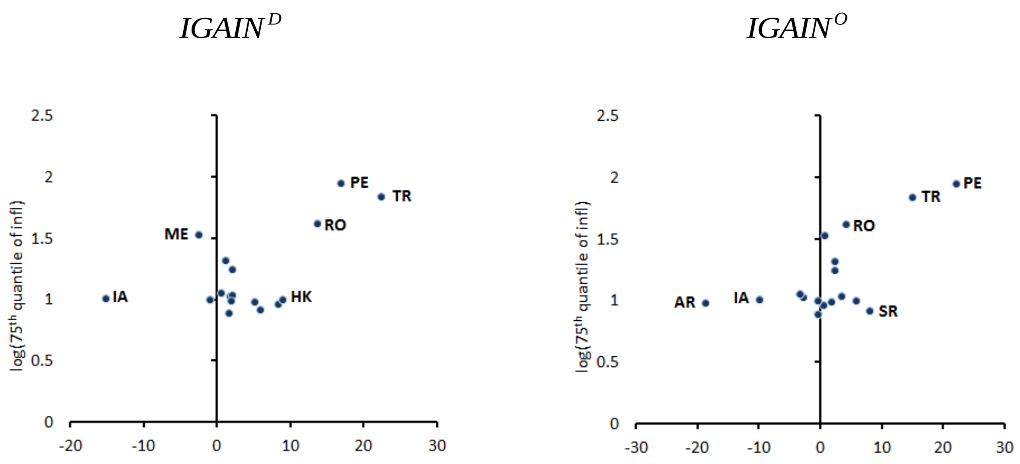
(4) 1 if $V\{IR^O_y(\pi^+)\} < V\{IR^O_y(\pi^-)\}$, -1 otherwise

Table 1 shows an interesting pattern. According to the direct projection *IR*'s, for 14 out of 17 countries inflationary shocks which appear in periods of positive *IREG* contribute positively to an increase in output more strongly than analogous shocks in periods of negative *IREG*. However, in most cases (with the exception of Columbia and Peru) this positive contribution is associated with the increase in output volatility caused by inflationary shocks. Results for the orthogonal *IR*'s are somewhat less extreme. There are only 11 showing advantage of positive *IREG* for output, but in 8 out of these 11 cases there is actual reduction of inflation-induced volatility. It can be therefore concluded that for most of *FEHI* countries positive inflationary shocks in periods when expected inflation exceeds output-neutral inflation (*IREG* > 0) are better for the real sphere than otherwise (*IREG* < 0). However, whether this accompanied by an increase or decrease in output volatility, is not clear.

Inquiring further for a possible relation between high inflation episodes are real effects we have computed correlation between the magnitude of *IGAIN* and the logartihm 0.75$^{\text{th}}$ quantile of inflation. Figure 3 shows the results in the form of correlation diagram. For visibly identified points, country symbols, as in Table 1, are printed. Positive relationship is clear here, especially for the direct projection *IR*s. However, one might argue that this is a spurious result, due to a possibility of mistaking high inflation effect with that of *IREG*. In another words, if positive *IREG*s coincide with the episodes of high inflation, it might be high inflation which generates positive real effect, regardless *IREG*.

In order to check this, let us define *high-inflation loss HLOSS*, in relation to *IREG*, as $HLOSS^i = CIR_y^i(\pi^+, 24) - CIR_y^i(\pi^M, 24)$, i={D,O}, where $CIR_y^i(\pi^M, 24)$ is a cumulative impulse response of output on inflationary shocks in the periods where, for each country, inflation is above its median. The technique used here is analogous to that explained in Section 2. For each country we have formulated a 3-equation *VAR* with y_t, π_t^+ and π_t^M, where $\pi_t^M = \pi_t$ if $\pi_t > median(\pi_t)$; and 0 otherwise. If all periods of positive *IREG* correspond to

Figure 3: Correlation between *IGAIN* and log of 0.75$^{\text{th}}$ quantile of inflation for *FEHI* countries

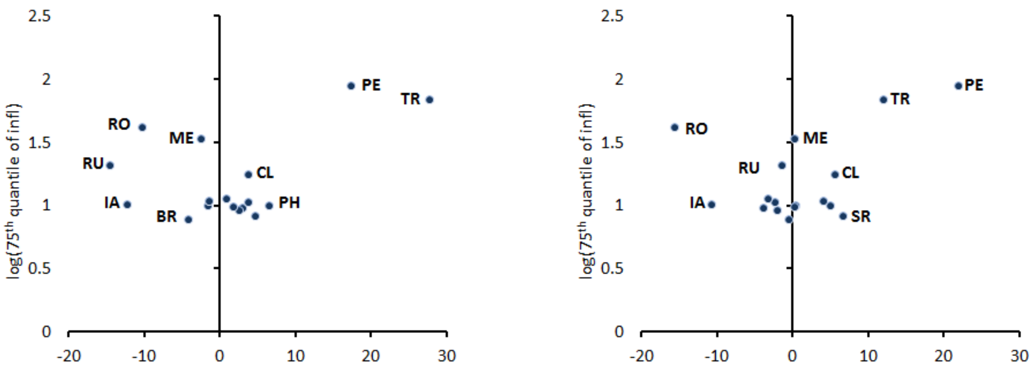


corr.coefficient = 0.61 corr.coefficient=0.66

these of inflation being above the median, there would be perfect mulicollinearity and the model would not estimate. If it does estimate, but the gains from shocks in times of high inflation dominate gains from shocks in times of positive *IREG* in the sense that the gains grew faster with the increase of inflation during high inflation episodes, correlation of *HLOSS* with the 0.75th quantile of inflations should be negative or close to zero. If shocks during the times of high inflation create the same real effect as π_t^-, the correlation should be the same as shown on Figure 3 as, in this case, *IGAIN=HLOSS*. Finally, if the increase in real effects during high inflation episodes is smaller than during the periods of negative *IREG*, this correlation should be smaller than that in Figure 3. As shown by Figure 4, these correlations are still positive, albeit markedly lower than these between *IGAIN* and the 0.75th quantile of inflation. This implies that the gains form high inflation raise slower than the gains from positive *IREG* with the increase in magnitude of inflation during high inflation episodes. Somewhat stylized reflection here could be that the best (in terms of output stimulation) situation occurs in *FEHI* countries where positive inflationary shock occurs in a period of positive *IREG*, regardless of the magnitude of inflation.

Fig. 4: Correlation between *HLOSS* and log of 0.75th quantile of inflation for *FEHI* group

$HLOSS^D$ $\qquad\qquad$ $HLOSS^O$



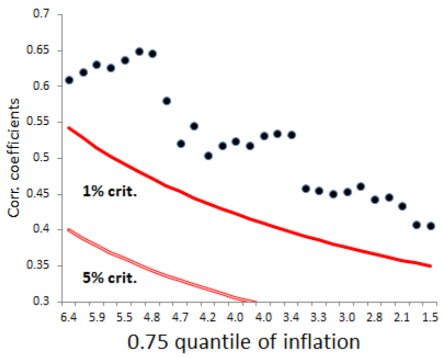
corr.coefficient = 0.43 $\qquad\qquad$ corr.coefficient=0.41

Finally, we have checked to what extent the results depend on our, rather arbitrary, definition of the episodes of high inflation. Perhaps the positive relationship between *IREG* and inflation holds regardless of the existence of such episodes? For checking this we have gradually relaxed the 7.5% limit for *FEHI* by lowering it systematically, so that the *FEHI* group incorporates more countries. First, the non-*FEHI* country with the highest 0.75th quantile of inflation is included (as discussed above), then the country with the second highest quantile is added, *etc*.. For these gradually enlarging groups we have computed correlation coefficients as in Figure 3, that is between *IGAIN* and the 0.75th quantile of inflation. The results are shown in Figure 5.

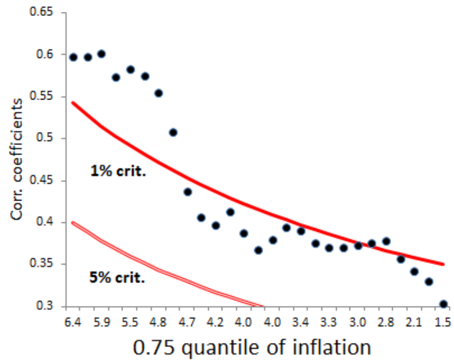
Solid upper line represents the upper critical bound of the correlation coefficient around zero at 1% level of significance, and the double line (lower) at 5% level of significance. It indicates that, generally, the higher is the 0.75th quantile of inflation, the higher is correlation of its logarithm with the inflationary real effect for periods of positive *IREG*, in comparison with periods of negative *IREG*. It also shows that the results are reasonably tolerant regarding the definition of *FEHI*. If we relax the definition and redefine the *FEHI* country as such where the 0.75th quantile of inflation is greater than 4.8% rather than 7.5%, the main result of the study, that is correlation between the logarithm this quantile and *IGAIN*, remains high. However, if we relax the *FEHI* definition further still, this correlation weakens markedly.

Fig. 5: Correlation coefficients of *IGAIN* and log of 0.75th quantile of inflation: *FEHI* group is increasing

$IGAIN^D$



$IGAIN^O$



6. CONCLUSIONS AND SIMPLE POLICY PRESCRIPTIONS

While agreeing with most of the mainstream literature that high inflation is an evil phenomenon, our results suggest a way of making the most of it by undertaking anti-inflationary monetary decisions in periods where the difference between the expected and output-neutral inflation is positive. In such cases the real sector pain caused by a negative inflationary shock resulted, for instance, from an increase in interest rate, would be lower than in the period where such difference is negative. The effect of such shock would be reasonably quickly absorbed, reducing inflation but not hurting the real sector badly. Reversely, if, in the period where inflationary expectations exceed output-neutral inflation, an output-stimulating decision is made, its real effect would be greater than in the case of otherwise. We have shown that it is not enough just to watch high inflation episodes and react to the observed level on inflation. Sometimes it might pay to wait with the monetary decision until inflationary expectations are above output-neutral inflation even if the observed inflation is high.

So where is a catch? We have identified three. Firstly, our findings are valid for most countries with markedly high inflation (over 4.8% in at least every fourth quarter on average) and are less effective for countries with intrinsically lower inflation. Secondly, it is not clear whether inflationary shocks in the periods when expected inflation exceeds output neutral inflation, increases or decreases output volatility. Our results are conflicting here and cannot be generalised. Thirdly, our results, although statistically sound, are rather limited in terms of monetary policy and might be prone to misinterpretation. All we shown are some symptomatic evidences supporting the hypothesis that is pays to undertake monetary decision when the difference between the expected and output-neutral inflation is positive and additional evidence that this relationship becomes stronger with the increase in inflation. All beyond this is speculation.

The model we use is very simple and with an obvious room for improvement. Output neutral inflation can be computed in a much more sophisticated way from disaggregated components of output and inflation. Impulse response analysis and testing can be done more precisely if a disaggregated model is used and, presumably, when the assumption of the multivariate normal distribution is relaxed. We are leaving this for further research.

REFERENCES

Ball, L. and N. Sheridan (2005), 'Does inflation targeting matter?', in Ben S. Bernanke and Michael Woodford, eds. *The Inflation Targeting Debate* (University of Chicago Press), 249-276.

Basher, S.A. and J. Westerlund (2008), 'Is there really a unit root in the inflation rate? More evidence from panel data models', *Applied Economics Letters* **15**, 161-164.

Beechey, M. and P. Österholm (2008), 'Revisiting the uncertain unit root in GDP and CPI: testing for non-linear trend reversion', *Economics Letters* **100**, 221-223.

Bick, A.(2010), 'Threshold effects on economic growth in developing countries', *Economics Letters* **108**, 126-129.

Blanchard, O. and D. Quah (1989), 'The dynamic effects of aggregate demand and supply disturbances', *American Economic Review* 79, 655-673.

Brito, R.D. and B. Bystedt (2010), 'Inflation targeting in emerging economies: panel evidence', *Journal of Development Economics* **91**, 198-210.

Braumann, B. (2000), 'Real effects of high inflation', *IMF Working Paper* No: WP/00/85.

Brock, W. (1974), 'Money and growth: the case of long-run perfect foresight', *International Economic Review* **15**, 750-765.

Bruno, M. and W. Easterly (1996), 'Inflation and growth: In search of stable relationship', *Federal Reserve Bank of St. Louis Review* **78,** 139-146.

Bruno, M. and W. Easterly (1998), 'Inflation crises and long-run growth', *Journal of Monetary Economic* **41**, 3-36.

Bull, C. And R. Frydman (1983) 'The derivation and interpretation of the Lucas supply function', *Journal of Money, Credit and Banking* **15**, 82-95.

Cavallo, A. (2012), 'Measuring Argentina's inflation', MIT, http://www.mit.edu/~afc/papers/Cavallo-Argentina.pdf.

Charemza, W., D. Hristova and P. Burridge (2005), 'Is inflation stationary?', *Applied Economics* **37**, 901-903.

Charemza, W. and S. Makarova (2006), '*Ex-ante* dynamics and real effects of monetary policy: theory and evidence for Poland and Russia, 2001-2003', *Comparative Economic Studies* **48,** 458-479.

Christopoulos, D.K. and E.G. Tsionas, (2004), 'Financial development and economic growth: evidence from panel unit root and cointegration tests', *Journal of Development Economics* **73**, 55-74.

Cook, S, (2009) 'A re-examination of the stationarity of inflation', *Journal of Applied Econometrics* **24**, 1047–1053.

Eckstein, O. (1981), 'Core Inflation', *Prentice-Hall Englewood*.

Fischer, S. and F. Modigliani (1978), 'Towards an understanding of the real effects and costs of inflation', *Weltwirtschaftliches* Archiv **114**, 810-833.

Gartner, C and G.D. Wehinger (1998) 'Core inflation in selected European Union countries', Working Paper No. 33, Oesterreichische Nationalbank, Vienna.

Gillman, M. And M. Harris (2010), 'The effect of inflation on growth: Evidence from a panel of transition countries', *Economics of Transition* **48**, 697-714.

Golosov, M. and R.E. Lucas Jr. (2007) 'Menu costs and Phillips curves', *Journal of Political Economy* **122**, 171-199.

Gonçalves, C.E.S. and J.M. Salles (2008), 'Inflation targeting in emerging economies: what do the data say?', *Journal of Development Economics* **85**, 312-318.

Grier, R. and K.B. Grier (2006), 'On the real effects of inflation and inflation uncertainty in Mexico', *Journal of Development Economics* **80**, 478-500.

Hamilton, J. (1994), *Time series analysis,* Princeton UP.

Hatemi-J., A. (2004), 'Multivariate tests for autocorrelation in the stable and unstable VAR models', *Economic Modelling* **21**, 661-683.

Hatemi-J., A. (2011), 'Asymmetric generalized impulse response and variance decomposition with an application', *MPRA Paper* No 31700.

Hosking, J.R.M. (1980), 'The multivariate portmanteau statistic', *Journal of American Statistical Association* **75**, 602-608.

Jordà, Ò. (2005), 'Impulse responses by local projections', *American Economic Review* **95**, 161-182.

Jordà, Ò. (2009), 'Simultaneous confidence regions for impulse responses', *The Review of Economics and Statistics* **91**, 629-647.

Khan, M.S. and S.A. Senhadji (2001), 'Threshold effects in the relationship between inflation and growth', *IMF Staff Papers* **48**, 1-21.

Kremer, S., A. Bick and D. Nautz (2012), 'Inflation and growth: new evidence from a dynamic panel threshold analysis', *Empirical Economics*, 1-18.

Kun, S.S. (2012), 'Evaluating the performance of inflation targeting regime in three Asian economies', *International Econometric Review* **4**, 82-98.

Lin, S. and H. Ye (2009), 'Does inflation targeting make a difference in developing countries?', *Journal of Development Economics* **89**, 118-123.

Lucas, R. E.Jr. (1972), 'Expectations and the neutrality of money', *Journal of Economic Theory* **4**, 103-124.

Lütkepohl, H. (2006), *New introduction to time series analysis*, Springer.

Mallik, G. and A. Chowdhury (2001), 'Inflation and economic growth: evidence from four South Asian countries', *Asia-Pacific Development Journal* **8**, 123-135.

Midrigan, V. (2011), 'Menu costs, multiproduct firms, and aggregate fluctuations', *Econometrica* **79**, 1139-1180.

Quah, D. and S. Vahey (1995), 'Measuring core inflation', *Economic Journal* **105**, 1130-1144.

Roncalli, T. (1995), *Applications à la finance at à l'econométrie, vol 2*. RITME Informatique.

Rousseau, P.L. and P. Wachtel (2002), 'Inflation thresholds and the finance-growth nexus', *Journal of International Money and Finance* **21**, 777-793.

Sarel, M., (1995), 'Nonlinear effects of inflation on economic growth', *IMF Staff Papers*, **43**, 199–215.

Sidrauski, M. (1967), ‘Rational choice in patterns of growth in a monetary economy’, *American Economic Review: Papers and Proceedings* **57**, 534-544.

Stockman, A. (1981), ‘Anticipated inflation and the capital stock in a cash-in-advance economy’, *Journal of Monetary Economics* **8**, 387-393.

Tobin, J. (1965), ‘Money and economic growth’, *Econometrica* **33**, 671-684.

Vaona, A. and S. Schiavo (2007), ‘Nonparametric and semiparametric evidence on the long-run effects of inflation on growth’, *Economics Letters* **94**, 452-458.

Willard, L.B. (2012), ‘Does inflation targeting matter? A reassessment’, *Applied Economics* **44**, 2231-2244.

APPENDIX A: BASIC CHARACTERISTICS OF THE DATASET

The dataset consists of GDP growth and inflation for each country. The GDP growth is defined as the percentage change of the real GDP in a given quarter over the real GDP in the corresponding quarter of the previous year. Inflation is defined by the percentage change of the consumer price index (CPI) over the last year's level in the corresponding quarter. Real GDP figures have been computed by deflating the nominal GDP by each country's GDP deflator (source: from IMF International Financial Statistics, IFS, http://esds80.mcc.ac.uk/wds_ifs/) except for Indonesia, where the consumers' price index, CPI, has been used as the deflator. For countries other than that of OECD and Brazil, India, Indonesia, Russia and South Africa, inflation has been computed from the original CPI data. Data on inflation for the 30 OECD countries and 5 non-OECD countries listed above are from the OECD (http://stats.oecd.org/). The GDP deflators for all 45 countries are from the IFS. Data for the nominal GDP for the non-OECD countries except for Brazil, India, Russia and South Africa have been obtained from the IFS, and for the remaining countries from OECD. For India and Pakistan some quarterly GDP data are converted from annual to quarterly frequencies using the polynomial quadratic interpolation. For India, annual GDP is interpolated for the period from 1991q1 to 1996q1, with the remaining data in this series from OECD. The annual nominal GDP series for India and Pakistan have been obtained from the OECD and IFS respectively, while the GDP deflators from IFS.

Basic data characteristics and sources

Country	N. obs.	First obs.	Last obs.	Inflation		Data source for:		
				Average	0.75 quantile	Inf.	Deflator	Nom. GDP
Argentina	76	1993q01	2011q04	6.650	9.553	B	B	B
Australia	124	1981q01	2011q04	4.420	6.855	A	B	A
Austria	124	1981q01	2011q04	2.617	3.395	A	B	A
Belgium	124	1981q01	2011q04	2.927	3.375	A	B	A
Brazil	68	1995q01	2011q04	14.440	7.794	A	B	A
Canada	124	1981q01	2011q04	3.318	4.150	A	B	A
Chile	64	1996q01	2011q04	3.781	4.835	A	B	A
Czech Republic	68	1995q01	2011q04	0.975	1.502	A	B	A
Columbia	72	1994q01	2011q04	10.060	17.770	B	B	B
Denmark	124	1981q01	2011q04	3.358	3.977	A	B	A
Finland	124	1981q01	2011q04	3.349	4.658	A	B	A
France	124	1981q01	2011q04	3.228	3.261	A	B	A
Germany	124	1981q01	2011q04	2.208	2.835	A	B	A
Hong Kong	121	1981q04	2011q04	4.570	9.164	B	B	B
Hungary	68	1995q01	2011q04	9.680	10.600	A	B	A
India	84	1991q01	2011q04	7.760	10.130	A	B,D	A,D
Indonesia	88	1990q01	2011q04	11.080	10.210	A	B,E	B
Ireland	60	1997q01	2011q04	2.585	4.649	A	B	A
Israel	68	1995q01	2011q04	3.965	5.913	A	B	A
Italy	124	1981q01	2011q04	5.152	6.066	A	B	A
Japan	124	1981q01	2011q04	0.842	2.083	A	B	A
Korea	124	1981q01	2011q04	4.877	5.603	A	B	A
Luxembourg	68	1995q01	2011q04	2.088	2.728	A	B	A
Malaysia	84	1991q01	2011q04	2.897	3.712	B	B	B
Mexico	124	1981q01	2011q04	30.220	33.770	A	B	A
Morocco	88	1990q01	2011q04	2.973	4.220	B	B	B
Netherland	124	1981q01	2011q04	2.306	2.777	A	B	A
New Zealand	99	1987q02	2011q04	3.145	3.977	A	B	A
Norway	124	1981q01	2011q04	3.923	5.517	A	B	A
Pakistan	124	1981q01	2011q04	8.510	10.920	B	B,D	B,D
Peru	124	1981q01	2011q04	421.00	88.080	B	B	B
Philippines	124	1981q01	2011q04	8.944	10.030	B	B	B
Poland	68	1995q01	2011q04	7.287	9.886	A	B	A
Portugal	124	1981q01	2011q04	8.107	11.490	A	B	A

Country	N. obs.	First obs.	Last obs.	Inflation		Data source for:		
				Average	0.75 quantile	Inf.	Deflator	Nom. GDP
Romania	69	1994q04	2011q05	29.9575	42.2708	B,C	B,C	B,C
Russia	68	1995q01	2011q04	32.100	20.950	A	B	A
Slovak Republic	76	1993q01	2011q04	7.134	8.331	A	B	A
Spain	124	1981q01	2011q04	1.257	1.921	A	B	A
South Africa	124	1981q01	2011q04	2.245	3.286	A	B	A
Sweden	124	1981q01	2011q04	3.792	6.442	A	B	A
Switzerland	124	1981q01	2011q04	2.019	3.002	A	B	A
Thailand	76	1993q01	2011q04	3.453	5.092	B	B	B
Turkey	100	1987q01	2011q04	47.600	69.800	A	B	A
United Kingdom	124	1981q01	2011q04	3.626	4.767	A	B	A
United States	124	1981q01	2011q04	3.310	3.971	A	B	A

Legend:
A: data source: OECD
B: data source: IFS, inflation recomputed from CPI data
C: 1995q1-2000q4: data obtained directly from the Romanian Central Statistical Office
D: Interpolated from annual data
E: CPI index used as the deflator

APPENDIX B: SUMMARY OF VAR ESTIMATION RESULTS

Country	VAR lag	Root	Ljung-Box, P-values			Jarque-Bera, P-values	
			Output	Inflation	Joint	Output	Inflation
Argentina	7	1.093	0.812	0.981	0.391	0.000	0.000
Australia	6	1.052	0.926	0.629	0.071	0.207	0.000
Austria	7	1.131	0.161	0.820	0.010	0.000	0.000
Belgium	8	1.137	0.666	0.492	0.000	0.000	0.208
Brazil	5	1.266	0.954	0.096	0.369	0.000	0.000
Canada	8	1.081	0.190	0.598	0.000	0.068	0.197
Chile	5	1.132	0.906	0.899	0.051	0.002	0.858
Czech Republic	6	1.086	0.939	0.087	0.097	0.107	0.379
Columbia	6	1.113	0.193	0.585	0.002	0.587	0.367
Denmark	8	1.102	0.007	0.369	0.000	0.487	0.508
Finland	8	1.066	0.781	0.732	0.032	0.000	0.724
France	8	1.094	0.100	0.301	0.000	0.043	0.980
Germany	8	1.096	0.812	0.466	0.002	0.000	0.000
Hong Kong	8	1.071	0.918	0.823	0.150	0.081	0.002
Hungary	3	1.108	0.375	0.398	0.047	0.003	0.735
India	8	1.063	0.960	0.901	0.173	0.000	0.095
Indonesia	8	1.078	0.196	0.931	0.006	0.000	0.000
Ireland	2	1.165	0.229	0.365	0.307	0.017	0.458
Israel	6	1.093	0.619	0.644	0.017	0.305	0.077
Italy	8	1.115	0.359	0.866	0.021	0.011	0.001
Japan	8	1.067	0.168	0.370	0.001	0.000	0.008
Korea	8	1.082	0.521	0.043	0.001	0.000	0.000
Luxembourg	6	1.113	0.674	0.989	0.337	0.739	0.937
Malaysia	8	1.118	0.543	0.980	0.091	0.000	0.000
Mexico	8	1.054	0.456	0.984	0.010	0.000	0.000
Morocco	5	1.050	0.044	0.672	0.006	0.119	0.000
Netherland	7	1.138	0.192	0.499	0.020	0.000	0.896
New Zealand	6	1.213	0.942	0.514	0.007	0.745	0.000
Norway	8	1.045	0.232	0.431	0.004	0.385	0.003
Pakistan	8	1.096	0.001	0.701	0.000	0.000	0.000
Peru	8	1.084	0.245	0.670	0.000	0.000	0.000
Philippines	8	1.140	0.475	0.823	0.250	0.000	0.000
Poland	4	1.096	0.906	0.444	0.090	0.038	0.598
Portugal	4	1.099	0.027	0.000	0.000	0.000	0.000
Romania	4	1.250	0.912	0.492	0.049	0.000	0.000
Russia	5	1.255	0.632	0.955	0.028	0.046	0.000
Slovak Republic	7	1.131	0.982	0.730	0.096	0.000	0.000
Spain	8	1.001	0.135	0.995	0.003	0.000	0.419
South Africa	7	1.050	0.181	0.486	0.006	0.010	0.107
Sweden	8	1.069	0.811	0.337	0.000	0.000	0.000

Country	VAR lag	Root	Ljung-Box, P-values			Jarque-Bera, P-values	
			Output	Inflation	Joint	Output	Inflation
Switzerland	7	1.105	0.633	0.691	0.036	0.027	0.745
Thailand	6	1.116	0.642	0.401	0.022	0.478	0.258
Turkey	4	1.040	0.176	0.037	0.002	0.000	0.000
United Kingdom	8	1.113	0.058	0.504	0.001	0.163	0.000
United States	8	1.095	0.202	0.904	0.000	0.389	0.000

APPENDIX C: IMPULSE RESPONSES AND TEST RESULTS

C1: Impulse responses from direct projections

Country	(1)	(2)	(3)	(4)	Joint test		Cumulative test	
					F-stat	*p*-Value	F-stat	*p*-value
Argentina	11.359	6.225	0.311	0.304	24.510	0.474	0.171	0.682
Australia	-2.145	0.270	0.595	0.354	16.782	0.838	1.810	0.182
Austria	-0.021	-0.165	0.659	0.349	18.564	0.757	0.008	0.929
Belgium	6.033	-7.574	0.571	0.195	16.000	0.868	4.501	0.037
Brazil	2.661	1.009	0.449	0.250	38.819	0.120	0.786	0.384
Canada	-3.023	0.663	0.432	0.492	23.464	0.504	2.747	0.102
Chile	-0.028	-0.341	0.395	0.345	31.538	0.265	0.072	0.791
Czech Republic	0.317	0.133	0.457	0.508	39.574	0.117	0.008	0.930
Columbia	1.877	-0.237	0.296	0.345	19.410	0.699	0.638	0.431
Denmark	0.366	-1.475	0.491	0.196	24.026	0.476	0.871	0.354
Finland	1.363	-8.251	0.516	0.164	20.960	0.635	4.527	0.037
France	1.553	0.154	0.518	0.233	20.357	0.666	0.679	0.413
Germany	-1.222	0.896	0.424	0.329	26.724	0.351	0.779	0.380
Hong Kong	7.226	-1.020	0.647	0.507	38.556	0.064	2.800	0.099
Hungary	5.177	3.426	0.347	0.174	30.099	0.278	0.551	0.464
India	-1.622	-0.581	0.535	0.180	32.699	0.198	0.414	0.524
Indonesia	-12.537	2.578	0.385	0.320	23.403	0.515	1.964	0.169
Ireland	-3.771	13.093	0.534	0.363	13.580	0.913	4.013	0.057
Israel	-1.204	0.260	0.512	0.592	44.445	0.072	0.405	0.531
Italy	-1.414	-0.557	0.528	0.229	28.562	0.279	0.517	0.475
Japan	-0.271	-2.641	0.561	0.681	11.762	0.974	0.348	0.557
Korea	6.688	5.493	0.493	0.336	30.544	0.213	0.035	0.852
Luxembourg	-0.663	0.143	0.453	0.272	23.203	0.533	0.094	0.762
Malaysia	0.175	1.526	0.618	0.355	28.560	0.314	0.311	0.581
Mexico	-0.422	2.156	0.576	0.316	16.384	0.853	0.263	0.610
Morocco	1.879	-5.756	0.564	0.462	18.333	0.758	3.932	0.053
Netherland	2.232	-2.339	0.605	0.311	15.697	0.879	2.545	0.115
New Zealand	-3.327	-1.852	0.337	0.434	14.890	0.899	0.294	0.590
Norway	-1.448	0.210	0.767	0.451	15.962	0.869	0.772	0.382
Pakistan	-0.272	-2.300	0.554	0.171	27.482	0.320	0.782	0.379
Peru	5.059	-11.855	0.358	0.812	56.614	0.003	2.386	0.127
Philippines	4.037	-4.809	0.519	0.190	26.053	0.380	5.568	0.021
Poland	0.844	-1.106	0.382	0.343	17.175	0.795	0.536	0.471
Portugal	1.110	0.537	0.672	0.434	16.161	0.863	0.048	0.826
Romania	-8.289	-21.994	N/A	0.174	20.312	0.658	0.174	0.680
Russia	2.023	0.921	0.559	0.091	34.767	0.182	0.064	0.802
Slovak Republic	1.289	-4.518	0.735	0.344	45.594	0.050	3.649	0.066
Spain	-0.006	-4.953	0.728	0.447	20.106	0.679	2.905	0.092
South Africa	-1.205	-2.179	0.563	0.666	18.293	0.770	0.104	0.748
Sweden	2.454	1.693	0.710	0.199	26.706	0.352	0.169	0.683
Switzerland	-0.867	-0.462	0.476	0.207	23.057	0.525	0.051	0.822
Thailand	0.098	2.798	0.488	0.311	24.754	0.462	0.508	0.481
Turkey	15.824	-6.553	0.435	0.252	30.643	0.221	3.538	0.065
United Kingdom	3.751	-5.682	0.620	0.102	32.135	0.170	11.819	0.001
United States	-5.028	-0.527	0.497	0.512	21.435	0.610	3.844	0.054

Legend: (1) $CIR_y^D(\pi^+, 24)$, (2) $CIR_y^D(\pi^-, 24)$, (3) $V\{IR_y^D(\pi^+)\}$, (4) $V\{IR_y^D(\pi^-)\}$

C2: Orthogonal impulse responses

Country	(1)	(2)	(3)	(4)
Argentina	4.536	23.227	0.017	0.414
Australia	−1.484	0.031	0.129	0.009
Austria	0.236	−0.665	0.034	0.093
Belgium	−1.527	−4.818	0.038	0.168
Brazil	−1.044	−0.593	0.037	0.175
Canada	−2.500	1.033	0.061	0.050
Chile	−1.179	−3.157	0.109	0.375
Czech Republic	−0.311	−4.541	0.050	0.119
Columbia	0.073	−2.181	0.139	0.186
Denmark	−0.082	−4.676	0.010	0.237
Finland	−0.585	−10.661	0.056	0.238
France	−0.915	−1.231	0.041	0.284
Germany	−0.546	−0.029	0.081	0.073
Hong Kong	0.416	−0.036	0.033	0.075
Hungary	−1.856	0.953	0.024	0.020
India	−2.273	−1.755	0.189	0.181
Indonesia	−12.957	−2.933	0.255	0.111
Ireland	1.133	−4.438	0.012	0.108
Israel	−1.203	0.783	0.065	0.098
Italy	−1.086	0.449	0.072	0.057
Japan	−0.519	−3.084	0.058	0.222
Korea	1.810	−1.193	0.018	0.038
Luxembourg	1.710	−2.929	0.030	0.082
Malaysia	−3.225	−0.256	0.145	0.263
Mexico	1.225	0.550	0.012	0.039
Morocco	0.133	−2.090	0.039	0.058
Netherland	−1.160	−0.915	0.019	0.026
New Zealand	0.322	−4.563	0.014	0.168
Norway	−2.710	0.331	0.067	0.014
Pakistan	0.505	−2.832	0.107	0.069
Peru	5.388	−16.713	0.147	0.236
Philippines	1.298	−4.521	0.042	0.051
Poland	−0.498	−2.313	0.067	0.140
Portugal	−0.101	3.260	0.046	0.117
Romania	−37.515	−41.623	0.048	0.072
Russia	0.667	−1.619	0.024	0.021
Slovak Republic	0.839	−7.061	0.063	0.224
Spain	−0.764	−3.015	0.012	0.071
South Africa	−1.886	−3.496	0.077	0.193
Sweden	2.290	−3.658	0.066	0.092
Switzerland	−2.120	−1.719	0.042	0.071
Thailand	−1.209	−1.083	0.087	0.070
Turkey	6.620	−8.318	0.136	0.023
United Kingdom	1.992	−4.350	0.071	0.162
United States	−2.134	0.432	0.122	0.063

Legend: (1) $CIR_y^O(\pi^+, 24)$, (2) $CIR_y^O(\pi^-, 24)$, (3) $V\{IR_y^O(\pi^+)\}$, (4) $V\{IR_y^O(\pi^-)\}$