Estimating the Inflation-Output Gap Trade-Off with Triangle Model in Pakistan

Sharif, Bushra and Qayyum, Abdul

Pakistan Institute of Development Economics (PIDE), Islamabad, Pakistan, Pakistan Institute of Development Economics (PIDE), Islamabad, Pakistan

2018

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Bushra Sharif and Abdul Qayyum

Abstract

In this study, we attempt to estimate Inflation-Output Gap Trade-off with Triangle model using Time Series data over the periods of 1971-2016 in case of Pakistan. For this purpose we used a three step methodology to estimate inflation-output trade-off with triangle model such as Unit root Analysis, cointegration Analysis and Error Correction Model. Dynamic of inflation has significant impact on output containing different two shock dummy variables in inflation. Empirical finding of this thesis shows that long run and significant relationship exist between inflation and supply shocks variables such as oil prices and nominal exchange rate but no long run relationship exist between inflation and output gap. Output gap has positive and significant impact on inflation in short run but supply shock variables have no impact on inflation dynamic in short run. The dynamic inflation is important to determine the relationship between inflation-output.

Keywords: Inflation; Output Gap; Trade-off; Triangle Model; Pakistan

1. Introduction

The main objective of the Pakistan economy is to achieve sustained economic growth and stable inflation rate is the main indicator of macroeconomic stability. Over the last few decades, a number of developing countries has adopted the inflation-targeting rate as a monetary policy tool and that monetary policy can affect the economic growth and maintain the low level of inflation rate in the long run. The adaptation of monetary policy tool has persistent effects of inflation on economic growth and inflation rate is stable and low.

1. Bushra Sharif, Pakistan Institute of Development Economics (PIDE), Islamabad, Pakistan; Email; <bushrasharif50@gmail.com>
2. Dr. Abdul Qayyum, Joint Director, Pakistan Institute of Development Economics (PIDE), Islamabad, Pakistan; Email; qayyumdr@gmail.com

Some empirically studies shows that long term inflation-targeting monetary policy have exposed the long run trade-off between inflation and output and the negative short run trade-off between inflation and output (Debelle, 1999). Most economist have criticised the inflation-targeting adaptation monetary policy for being that only inflation is targeted and notable output is still ignoring (Friedman and Kuttnerr,1996).

The dynamic of inflation have changed substantially in many economies over the last few periods, principal to renewal of importance of Phillips curve. Many empirically and theoretically studies documented that inflation is highly persistent phenomena (O'Reilly and Whelan, 2005, Pivetta and Reis, 2007) and inflation is less reactive to variation in output (Robinson, 2010, Gorden, 2011).

The usual estimation of traditional Phillips curve has been challenged where researcher fail in accounting inflation and mistakenly define it as an inflation is a persistent phenomina (Musso, stracca and van Dijik, 2009: Russell and Chowdhury, 2013) and Phillips curve have many shapes like convexity, concavity (Dolado et al). Many empirically studies found that nonlinear theory in the inflation and output relationship. Many empirically and theoretically studies helps the downward nominal wage rigidity have been support the long phase as an explanation of Phillips curve. If inflation is low then downward nominal wage rigidity model lead to long run trade-off between inflation and output gap.

In this perspective, firstly Phillip discovered the theory of Phillips curve in 1957 and explain the inverse relationship between inflation and unemployment and observe that one stable curve represents the trade-off between inflation and unemployment. The main aim of central bank is to achieve price stability level. It is difficult to empirically to evaluate the functional form of Phillips curve and main objective of monetary policy is to recognize to price rigidity. If Phillips curve is nonlinear then monetary policy must be nonlinear (Dolado et al. (2005).

A great change in price substance in the inflation-output trade-off is also dangerous for the rationality of new Keynesian model. The presence of monetary policy influence on the short run has become fundamental role in the new Keynesian structure.

Pakistan researcher have done a lot of work on inflation and economic growth but still no study has come in front about the instability of inflation-output Trade-off with Triangle Model.

The aim of this paper is to estimate the Inflation-Output Trade-off with Triangle Model in Pakistan and also estimate a time instability of Phillips Curve during different episodes of inflation in Pakistan. In this study, we use a three steps Methodology Univariate Analysis, Multivariate Analysis and Error Correction Model to estimate Inflation-Output trade-off with Triangle model in Pakistan.

In section 2 we discuss the literature review. In section 3 we discuss the Methodology estimation and in section 4 we discussed the result and discussions.

2. Literature Review

We see different studies and literature which shows the significant and some studies shows that insignificant relationship between inflation and output.

2.1 Review of International Studies

Locus (1973) estimate a trade-off between inflation and output with built on annual data was taken for eight countries from the period of 1951-1967. This study also estimates a natural rate hypothesis that output invariant with the time pattern change in inflation. Empirical finding of this study shows that no association found between average inflation and average output.

Tylor (1994) reinvestigate the trade-off between the variability of inflation-output by introducing a stochastic optimal control technique. The trade-off exist because of the sluggish variation of price. This study compare the trade-off among variability inflation and output with other types of trade-offs. Evidence of this study shows that no long run trade-off exist between inflation and output gap. Empirical finding of this gap that no negative trade –off exist between inflation and output at different historical periods of United States and other countries. In history countries far from the trade-off because of inadequate monetary policy.

Villavicencio and Mignon (2015) investigate that the time variability of Philips curve in inflation environment, price stickiness. Quarterly data from the periods of 1960Q1 TO 2013Q2 was taken for the five countries to investigate the varying nature of Philips curve

during the different periods of inflation. Finding of the study shows that the mean inflation and the threshold mean inflation are period varying. The inflation atmosphere is a main element of the inflation–output affiliation, rejecting the proof of a flat curve and renovating the inflation–output trade-off above definite inflation beginnings. After WWII Benati and Berrn (2015) examined a long run trade-off among inflation and output with the application of classical and Bayesian structural VAR identified based on long run restriction in the US, Euro area and UK and Canada after the WWII periods. Results of classical Var shows that one inflation shock doesn't allow to reject the null hypothesis long run vertical Phillips curve and the results of Bayesian VAR presents that four inflations shocks. Johnson cointegration between inflation and output for all countries exist with long run Phillips curve being negative and substantial.

2.2 Pakistan Review

Many Pakistani researchers have done their studies on monetary policy, inflation and GDP growth rate. As money supply effect on inflation and output with some lags was checked by Shahid (2006). The Results of his paper showed that the result of monetary policy conveys into inflation with a lag of half of a year and then yield another year to extent at the top and also described that in successive high inflation monetary authority's degree of slope in contradiction of the wind is nearly zero. In another study Ahmed and Shahid (2011) checked the consistency of the Taylor (1993) rule in case of Pakistan with the clear objective of interest rate smooth out and exchange rate control. Their research approved the consistency of Taylor (1993), except for the last two years, during which a price hike and the massive depreciation of domestic currency led to a substantial variation in the parameters of the policy response function.

Satti, et. al., (2007) estimate the New Keynesian Phillips Curve explain with the dynamic of actual inflation as it possess different policy implication regarding disinflation. The study employed a GMM econometric technique to estimate the NKPC .Annual data of Pakistan country is used from the period of 1976-2005. The study proposed that variables such as real marginal cost, inflation, GDP is used to find the results of final demonstration. Which clearly displays that there is progressive correlation among inflation and real marginal cost and also indicate that there existence a high degree of price stickiness but on the other hand a very low fraction of firms using backward – looking rule found in the setting of price in case of Pakistan?

Bhatti and Qayyum (2016) used annual time series data from 1971 to 2016 of real output and inflation rate to quantity the real cost of disinflation and used main indicator of sacrifice ratio to measures the real cost of disinflation. The results of research display that the estimate the sacrifice ratio are subtle to diverse estimation method and tight monetary policy has insignificant welfare loss. From policy point of view, it clearly indicates that small sacrifices ratio marks it helpful for policy maker to change the inflation into one number without fear of substantial output decrease.

3. Methodology

Villavicencio and Mignon (2015) using the Gordon (1982, 1997) augmented Phillips curve and they use supply shocks model also called triangle- model and write the function form of triangle model retain

$$\boldsymbol{\pi_t = f(y *_t, oil_t, s_t, \varepsilon_t)} \quad \textbf{(1)}$$

Gordon's (1988) triangle model sees inflation as a function of three components: inertia as a lagged inflation; output gap; and supply shocks. Gordon triangle model is better explaining the historical data. Now we write the model are backward-looking Phillips curve as augmented Phillips curves and use with supply shock wave also called the Triangle Model as follows

$$\boldsymbol{\pi_t = \alpha + \Sigma_{i=1}^{n} \beta_i \pi_{t-i} + \gamma Y *_t + \theta \Delta oil_t + \phi \Delta s_t + \varepsilon_t} \quad \textbf{(2)}$$

In this model where

π_t = inflation rate

Y^* = Yt-Y_{HPF} and it is output gap

oil_t= oil prices rupee per tons

s_t= Nominal exchange rate per unit of dollar

ε_t~N $(0,\sigma^2{}_\epsilon)$

In this triangle model inflation as function of three components, inertia as lagged inflation, output gap and supply shocks. In this model there are two supply shocks and

this is oil price shocks and exchange rate shocks .Russell, et. al., (2010) display a high no of unacceptable breaks and Russell and Chowdhury (2013) examined the relation between the m numbers of breaks in the inflation and minimize the sum of the squared residuals.

Now we use the two-regime smooth transition regression model with shifting mean.

$$\boldsymbol{\pi_t} = \boldsymbol{\alpha} + \sum_{i=1}^{n} \boldsymbol{\beta}_i \boldsymbol{\pi_{t-i}} + \gamma y_t^* + [\dot{\gamma}^*(y_t^*) \times g\,(r_t;\xi,c)] + \theta \Delta oil_t + \phi \Delta s_t + \sum_{m=1}^{m} \Psi m\, Dm + \boldsymbol{\varepsilon_t} \quad (3)$$

Dt = Represents the dummies and inflation depends on dummies and t is the inflation period

g (r_t;ξ,c) = represent the transition purpose in which ξ is the slope parameter and processes the speed of transition among regimes and r_t is transition variables and c is threshold parameter. This equation examined the nonlinear least squares that allow the measures the output-inflation Trade-off with different periods of inflation.

I use the HP filter technique to measures the Output gap, the output gap, it is Measuring by the Hodrick-Prescott filter and The HP filter technique as introduced into Economics in Hodrick and Prescott (1980, 1997) measures the output gap and the output gap correspond to the difference between the percentage points among the real GDP and the Potential GDP.

$$\sum_{t=1}^{T}(Yt - Tt)^2 + \lambda \sum_{t=2}^{T}(\tau_{t+1} - 2\tau_{t+}\tau_{t-1})^2$$

This formula is related to HP filter and this would be used to measures the output gap. 1st we check the series is stationary or not if series is not stationary then we transform this series into stationary and develop long run relationship

$$\mathbf{X_t=\sum_{i=1}^{k} \Pi_i X_{t-i} +\mu +\Phi D_t + \varepsilon_t} \qquad (4)$$

Where

$$X_t = \begin{bmatrix} \pi_t \\ Y*_t \\ oil_t \\ s_t \end{bmatrix} \text{ and}$$

μ = is a constant term

$\varepsilon_t \sim$ iid (0, ∧)

If the time series data is generated are generated by non-stationary process therefore VAR can be first differenced form. From general model using Δ-1-L, anywhere L is the lag operator, we able to get the following dynamic error correction model;

$$\Delta \boldsymbol{X_t} = \Gamma_1 \Delta \boldsymbol{X_{t-1}} + \cdots .. + \Gamma_{k-1} \Delta \boldsymbol{X_{t-k-1}} + \prod \boldsymbol{X_{t-k}} + \boldsymbol{\mu} + \boldsymbol{\Phi D} + \boldsymbol{\epsilon_i} \ldots\ldots\ldots.. (5)$$

Where

Γ_i=-I+Π_t+…..+Π_i, i=1, 2,…, k

4. Result and Discussion

4.1. Result of Unit Root

To check the theory of unit root we used Augmented Dickey-Fuller Test to checked the variables is stationary or not .we transformed the oil prices variables into log form and check the stationary

The outcomes are presented in Table 1 displays that the ADF test results at level and IST differences. For oil prices lag to remove the problems of autocorrelation then Dickey Fuller test become Augmented Dickey-Fuller test. The results suggests that Output

gap variables is stationary at level and this variables are small memory and not include in the cointegration analysis and the other remaining variables such as such as π□,$loil$□ and s□ are stationary at first difference and these three variables have same order of integration. These result suggest that cointegration may exist in the series. These three variables are same order of integration and stationary at first difference indicate that these variables have long run relationship among and cointegration may be exist by using the cointegration test.

Table 1: Augmented Dickey Fuller Test of Unit Root (Annual Data (T=46))

Variables		C	T	L	t-value	Critical Values	Level-of-integrati	Result
Inflation	πt_t	-	-	0	-1.58	-1.96	I(1)	Unit root
	$\Delta\pi t_t$	-	-	0	-6.657	-1.96	I(0)	No Unit root
Output gap	Yt^*_t	-	-	0	-4.09	-3.52	I(0)	No Unit root
Oil Price	$loilt_t$	C	Trend	0	1.07	-3.52	I(1)	Unit root
	$\Delta loil_t$	C	Trend	0	-4.09	-3.52	I(0)	No Unit root
NER	s_t	C	Trend	1	-2.797	-3.52	I(1)	Unit root
	Δs_t	C	-	0	-9.60	-2.95	I(0)	No Unit root

4.2. Cointegration Analysis

For the analysis of cointegration we used the Johnson Maximum Likelihood Method to estimate of the autoregressive process. First we estimate the unrestricted vector autoregressive (VAR) and these unrestricted VAR model has estimated with three variables π_t,$loil_t$ ands_t, output Gap (Y^*_t) variable include as exogenous variables because output gap has stationary at level and has no long run relationship and two dummy variables D74 and D09 also include as exogenous variables. Results are presented in the table in 2

Table 2. Likelihood Ratio Trace and Maximal Eigenvalue Test for Cointegrating Rank

(λ Trace Test)			
Null Hypothesis	Alternative Hypothesis	Trace statistics	5% Critical value
r=0	r>0	33.20186*	24.27596
r<1	r≥1	8.134588	12.32090
r<2	r≥2	1.443742	4.129906
(λ Maximal Eigenvalue Test)			
r=0	r>0	25.06727*	17.79730
r<1	r≥1	6.690846	11.22480
r<2	r≥2	1.443742	4.129906

*indicates significant at 5 %

The results are presented in the table 4.2.1 display that trace statistics shows that a one cointegrating association between the variables. The results of Trace statistics shows that null hypothesis r=0 is rejected at the 5% Significance against the alternative hypothesis r>0 and one cointegrating relationship among the variables in trace statistics. According to Max Eigen value statistics shows that one cointegrating relationship among the variables. The results of max Eigen value statistics show that reject null hypothesis at r=0 at 5% significance level against the alternative hypothesis r>0 and one cointegrating relationship among the variables.

4.3. Long Run Results of Johnson Maximum Likelihood Method

Now we estimate the long-run relationship among inflation rate, oil price and nominal exchange rate. The results are given in below equation (6) where long run normalized coefficients are given and Chi Square values are given in parentheses in following equation

$$\pi_t = \underset{(12.34)}{1.04^{*}} loil_t + \underset{(0.030)}{5.58^{*}} s_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

In equation 6 Show that the long- run co integrating relationship between the inflation rate, oil prices and nominal exchange rate. We include output gap variables and two dummy variables include as an exogenous variable because output gap variable stationary at level and no long run relationship among inflation and output gap. These results show that output gap is not significant in Pakistan. Examine the cointegration equation (4.3.1) report that oil prices has positive influence on inflation rate and nominal exchange rate also positive influence on inflation rate. Oil price and nominal exchange rate variable shows positive long run relationship with inflation rate variables. Pakistan imports mostly consist of petroleum products so oil is overpriced product and positively impact on inflation rate. So oil prices has positive impact on inflation rate about 1.04 % observed long run relationship. The relationship between inflation and nominal exchange rate have significant positive. The nominal exchange rate has significant positive relationship on inflation about 5.58% of Pakistan.

4.4. Dynamic Short Run Error Correction Model

Previously discussed long run co integrating association between variables, now we evaluate the dynamic short run relationship between the variables. We estimate the Dynamic Error Correction Model. Dynamic Error Correction Model we used the first differenced form of variables and the term of error correction model (ECM) approve the long run relationship between the variables. We used the general to specific methodology. In general to specific methodology we drop the insignificant variables in the model one by one. This model is called parsimonious model. The short run dynamic equation are given below, we used the one lag in the parsimonious model,

Estimated equation (7) are given in below (t statistics are given in parentheses)

$$\Delta\pi_t = 0.28^{*}Y^{*}_{t-i} + \underset{(6.52)}{19.06D1_{1974}} + \underset{(3.48)}{9.80D2_{2009}} - \underset{(-6.25)}{0.45^{*}ECM_{t-i}} \quad \ldots\ldots \quad (7)$$
(2.47)

Diagnostic Test

$R^2 = 0.72$ Adjusted $R^2 = 0.70$ Breusch Godfrey LM test of Autocorrelation = 0.04

Jarque Bera test of Normality $\chi^2_{(2)}$ = 41.21(0.00)

Breusch Pagan Godfrey Heteroscedasticity test = 7.58(0.05) ARCH TEST = 0.24(0.62)

We performed the diagnostic test such as LM test, normality test and heteroscedasticity test to check the rationality of the model. To check the constancy of the parameter of dynamic model through the plot of CUSUM and CUSUM of squared (Brown, et al 1975). All diagnostic tests in which Breusch Godfrey LM test of Autocorrelation where calculated value shows that there is no auto correlation problems and p value greater than 0.05 then accept Ho and no autocorrelation problems exist. Breusch Pagan Godfrey Heteroscedasticity test, calculated value is 7.58 and p value 0.05 and problem of Heteroscedasticity exist. For the normality test we check the Jarque Bera test of Normality $\chi^2_{(2)}$ we can't accept Ho and problems of autocorrelation exist.

Equation (7) reports the result of Error Correction Model (ECM). Coefficient of ECM term is negative and significant is 0.45 % which indicate that four percent of adjustment per year. The parameter of ECM term is significant at 5% level, it means that long run cointegrating relationship between inflation, oil prices and nominal exchange rate. Other variables in the model such as output gap, two dummy variables D74, D09 have significance values and short run impact on inflation.

5. Conclusions

In this study we estimate inflation-Output trade-off with triangle model and also estimate a time instability of Phillips curve during different periods of inflation in Pakistan from 1971-2016. We examine how dynamic of inflation affects inflation-output trade-off.

Three steps methodology univariate analysis, multivariate analysis and short run Error Correction Model are used to estimate the long run and short run relationship among inflation-output trade-off then supply shock variables such as oil prices and nominal exchange rate and shock dummies also included in this gorden triangle model. In Pakistan no study has found to estimate a inflation-output trade-off with triangle model and output gap estimate by Hodrick Presott formula using HP filter technique.

Empirical finding of this thesis can be review that dynamic inflation is important to determine the inflation-output trade-off in case of Pakistan .phillips curve of inflation and output depends on average inflation and Phillips curve change overtime. Not at all long run relationship found between inflation and output. A long run relationship found between inflation and two supply shocks such as oil.

Price and nominal exchange rate. In short run dynamic of inflation have significant impact on output gap and shock dummies have positive and significant impact on inflation.

References

Ahmed, A. M., and Malik, W. S. (2011) The economics of inflation, issues in the design of monetary policy rule, and monetary policy reaction function in Pakistan.

Akbari, A. H., and Rankaduwa, W. (2006) Inflation targeting in a small emerging market economy: The case of Pakistan. *SBP Research Bulletin*, *2*(1), 169-190.

Akerlof, G. A., Dickens, W. T., Perry, G. L., Gordon, R. J., and Mankiw, N. G. (1996) The macroeconomics of low inflation. *Brookings papers on economic activity*, *1996*(1), 1-76.

Benigno, P., and Ricci, L. A. (2011). The inflation-output trade-off with downward wage rigidities. *The American Economic Review*, *101*(4), 1436-1466.

Benati, L. (2015). The long-run Phillips curve: A structural VAR investigation. *Journal of monetary economics*, *76*, 15-28.

Ball, L., Mankiw, N. G., Romer, D., Akerlof, G. A., Rose, A., Yellen, J., and Sims, C. A. (1988) The new Keynesian economics and the output-inflation trade-off. *Brookings papers on economic activity*, *1988*(1), 1-82.

Bhatti, Z., and Qayyum, A. (2016) The Cost of Low Inflation in Case of Pakistan. *Journal of Economics Library*, *3*(2), 257.

Debelle, G. (1999). *Inflation targeting and output stabilisation*. Sydney: Reserve Bank of Australia.

Defina, R. H. (1991) International evidence on a new Keynesian theory of the output-inflation trade-off. *Journal of Money, Credit and Banking*, *23*(3), 410-422.

Dolado, J. J., María-Dolores, R., and Naveira, M. (2005). Are monetary-policy reaction functions asymmetric?: The role of nonlinearity in the Phillips curve. *European Economic Review*, *49*(2), 485-503.

Fuhrer, J. C. (1997) Inflation/output variance trade-offs and optimal monetary policy. *Journal of Money, Credit, and Banking*, 214-234.

Giannoni, M., and Eggertsson, G. (2013). The Inflation Output Trade-Off Revisited. In *2013 Meeting Papers* (No. 1120). Society for Economic Dynamics.

Gottschalk, J., and Fritsche, U. (2005). *The New Keynesian Model and the Long-Run Vertical Phillips Curve: Does It Hold for Germany?* (No. 521). DIW Discussion Papers.

Johansen, S., and Juselius, K. (1990) Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and statistics*, *52*(2), 169-210.

Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2013). Is there a trade-off between inflation and output stabilization?. *American Economic Journal: Macroeconomics*, *5*(2), 1-31.

Levi, M. D., and Makin, J. H. (1980) Inflation uncertainty and the Phillips curve: Some empirical evidence. *The American Economic Review*, 1022-1027.

Lopez, Villavicencio, A., and Mignon, V. (2015) Instability of the Inflation–Output Trade Off and Time Varying Price Rigidity. *Oxford Bulletin of Economics and Statistics*, *77*(5), 634-654.

Lucas, R. E. Jr, (1977) Some International Evidence on Output-Inflation Tradeoffs: Reply. *American Economic Review*, *67*(4).

Lucas, R. E, Jr, (1973) Some International Evidence on Output-Inflation Tradeoffs, American Economic Review, American Economic Association, vol. 63(3), pages 326-334, June.

Mallik, G., and Chowdhury, A. (2001) Inflation and economic growth: evidence from four south Asian countries. *Asia-Pacific Development Journal*, *8*(1), 123-135.

Malik, W. S., and Ahmed, A. M. (1961). The Taylor Rule and the Macroeconomic Performance in Pakistan. *Working Papers & Research Reports*, *2007*, 2007-34.

Malik, W. S., and Khawaja, M. I. (2006) Money, Output, and Inflation: Evidence from Pakistan [with Comments]. *The Pakistan Development Review*, 1277-1286.

Mendoza, A. (2003) The Inflation Output Volatility Trade-off and Exchange Rate Shocks in Mexico and Turkey. *Central Bank Review*, *1*, 27-51.

Nasir, M., and Malik, W. S. (2011). The contemporaneous correlation of structural shocks and inflation-output variability in Pakistan. *The Pakistan Development Review*, 145-162.

Ormerod, P., Rosewell, B., and Phelps, P. (2013) Inflation/unemployment regimes and the instability of the Phillips curve. *Applied Economics*, *45*(12), 1519-1531.

P h i l l i p s , W. (2011). *Structural Breaks and Dynamic Characteristics of Inflation and Growth Rates of Monetary Aggregates* (No. 15). Belarusian Economic Research and Outreach Center (BEROC).

Primiceri, G., Tambalotti, A., and Justiniano, A. (2011) Is there a trade-off between inflation and output stabilization?. In *2011 Meeting Papers* (No. 280). Society for Economic Dynamics.

Razzak, W. A. (1997) The inflation-output trade-off: Is the Phillips curve symmetric? A policy lesson from New Zealand.

Satti, Ahsan ul Haq, Malik, W. S., and Saghir, G. (2007) New Keynesian Phillips Curve for Pakistan. *The Pakistan Development Review*, 395-404.

Šergo, Z., Saftić, D., and Težak, A. (2012). Stability of Phillips curve: the case of Croatia. *Economic research-Ekonomska istraživanja*, (1), 65-85.

Taylor, J. B. (1994) The inflation/output trade-off revisited. *Goals, Guidelines and Constraints Facing Monetary Policymakers, Federal Reserve Bank of Boston, Boston, Massachusetts*, 21-38.

Teräsvirta, T. (1994). Specification, estimation, and evaluation of smooth transition autoregressive models. *Journal of the American Statistical Association*, *89*(425), 208-218.

Qayyum, A. (2002) Demand for bank lending by the private business sector in Pakistan. *The Pakistan Development Review*, 149-159.

Villavicencio, Antonia López- and Valérie Mignon, 2015. "Instability of the Inflation–Output Trade-Off and Time-Varying Price Rigidity," Oxford Bulletin of Economics and Statistics, Department of Economics, vol. 77(5), pages 634-654, October.