Advances in Management & Applied Economics, vol. 3, no.4, 2013, 21-35
ISSN: 1792-7544 (print version), 1792-7552(online)
Scienpress Ltd, 2013

The Effectiveness of Stock Prices on the Phase of Short-term Interest Rates: Evidence from Eastern European Countries

Nurtac Yıldırım[1*], Oguzhan Ozcelebi[2] and Aydan Kansu[3]

Abstract

In recent years the issue of the role of asset prices in monetary setting has become increasingly topical since booms and busts in asset market are associated with the fluctuations in overall economic activity through its impacts on aggregate spending. In this study, we use Smooth Transition Regression (STR) models to explore whether stock prices may have a major role on the phase of the short-term interest rates in Eastern European countries implementing inflation targeting regime, namely Czech Republic, Poland, Russian Federation and Turkey. Empirical results point out that stock prices have an impact on short term interest rates in Czech Republic, Poland, Russian Federation and Turkey but the effect is statistically significant only for the case of Turkey. The result implies that Central Bank of the Republic of Turkey (CBRT) may respond to the changes in stock prices as long as the response does not generate any disturbance in the other areas of the overall economic activity.

JEL classification numbers: E31, E32, E43, E44, E58.
Keywords: Stock prices, Economic activity, Interest rates, Monetary policy

1 Introduction

The role of asset prices in monetary policy design has long been of interest both to scholars and policy makers. The reason this issue has drawn so much attention is that asset price bubbles have historically had devastating effects on real economy. It has been

[1]Istanbul University, Faculty of Economics, Department of Economics, * Corresponding author.
[2]Istanbul University, Faculty of Economics, Department of Economics.
[3]Istanbul University, Faculty of Economics, Department of Economics.

Article Info: *Received :* February 17, 2013. *Revised :* March 28, 2013.
Published online : July 1, 2013

observed since the dawn of modern capitalist era that swings in asset prices point the way of financial and economic crises both in developed and developing countries. The recent global crisis initially arisen in US and then in other countries is also acknowledged as a prototype for crises triggered by the burst of asset bubbles. The lessons from the crisis have reemphasized the importance of understanding the consequences of asset price bubbles on monetary policy.

Our goal in this article is to add to this ongoing discussion on the role of asset prices which we take as stock prices in monetary policy setting by examining the effects of stock prices on the monetary policy rule set by the central bank. The monetary policy rule hypnotized here is Taylor-type interest rate rule with an additional stock price term. In accordance with the aim of our study, we particularly explore whether stock prices have an impact on the phase of the short-term interest rates in Eastern European countries implementing inflation targeting regime, namely Czech Republic, Poland, Russian Federation and Turkey by employing Smooth Transition Regression (STR) models. We conducted the empirical exercise by using data at the quarterly frequency from 2004:1 to 2012:3 and all series are obtained from the OECD database. For all four cases, monetary policy stance is proxied by the 3-month interbank rate, $irtcze_t$, $irtpol_t$, $irtrus_t$, $irttur_t$ whereas output gaps; $outcze_t$, $outpol_t$, $outrus_t$, $outtur_t$ are used for indicating the real economic activity[4]. Inflation expectations; $inecze_t$, $inepol_t$, $inerus_t$, $inetur_t$ are represented by adaptive expectations[5]. In order to explore the effect of stock prices in monetary policy setting and the response of the monetary authority to the variability in stock prices, growth rate of stock prices indices; $stpcze_t$, $stppol_t$, $stprus_t$, $stptur_t$ are also included[6]. All series are stationary at least at the 10% level[7].

The remainder of the paper is structured as follows: Section 2 develops the theoretical framework by tracing briefly the role of asset prices in monetary policy setting. Section 3 presents the model proposed here for testing whether the monetary authority in the countries under examination should take into account the variability in stock prices. Empirical findings are discussed in section 4 and section 5 discusses policy implications and concludes the paper.

2 Literature Review

There has been an extensive debate over the issue of whether central banks should incorporate asset prices into monetary policy rule in order to achieve the targeted levels of

---

[4] We used the percentage GDP gap that is the actual GDP minus the potential GDP divided by the potential GDP. Potential GDP is computed using actual GDP series with Hodrick-Prescott filter (λ of 1,600) since data is quarterly, see Lütkepohl (2004) for the details.

[5] We derived the adaptive inflation expectations series using the Holt-Winters exponential smoothing method.

[6] Growth rate of stock prices indices are expressed in percentage changes over the same month of previous year.

[7] Unit root tests' results are available upon request.

economic variables such as inflation and output gap. This refers to the effect of asset prices on monetary policy which has so far proved rather complex to deal with due to conflicting views and empirical findings. According to one set of studies, targeting asset prices should not be a task of central banks unless asset price bubbles have direct and precise impacts on inflation and economic activity. According to another set of studies, a monetary policy should include stock prices and central banks should respond actively to changes in stock prices under the condition of their possible effects on targeted variables.

One of the influential studies on this debate is conducted by Bernanke and Gertler (1999) arguing that central banks should set the monetary policy to maintain price stability preferably in a framework of implicit or explicit flexible inflation targeting regime and avoid responding to changes in asset prices. They build their arguments on two main reasons: First, asset price fluctuations may also take its source from non-fundamental factors such as poor regulatory practice and irrational behavior by investors as well as these swings may arise from fundamental factors. The authors argue that it is not possible for policy makers to ascertain that whether these changes arise from fundamental or non-fundamental factors. Second, the inflation targeting regime helps central banks achieving both macroeconomic stability and financial stability as long as policy makers make a strong commitment to stabilize price inflation. It is therefore unjustifiable for the central bank to respond to changes in asset prices unless they generate inflationary or deflationary pressure. The authors admit that it is also not easy to determine the effect of these changes on aggregate demand, yet it is seen as easier than to ascertain the exact factor of asset price movements and as not much problematic as leading a financial panic and hence a financial disorder by attempting to burst the bubble. In an attempt to explain their views empirically, they run various simulations by which the effects of incorporating stock prices into the reaction functions for US and Japan data for the 1979-1997 periods can be compared with the situation where reaction functions do not include stock prices. The results of this study which were later reinforced in their another study using the same model with some modifications regarding policy evaluation approach (Bernanke and Gertler, 2001) indicate that the simulation scenario which does not include stock prices outperforms the other one which includes stock prices. This implies that an aggressive inflation targeting rule with a strong commitment to price stability rather than accommodative one is more effective to stabilize the inflation and output gap when asset prices are volatile. Moreover, the response of interest rates to the changes in stock prices turns out to produce reverse results driving up the stock prices particularly if the commitment to price stability is rather weak. Accordingly, the authors conclude that inflation-targeting central banks do not need to respond to stock prices.

Following the study of Bernanke and Gertler (1999), a wide range of theoretical and empirical studies and descriptive articles on the debate were produced both in favor of and against the view held in this paper. On the empirical ground, Rigobon and Sack (2003) support the authors' main point, using identification technique based on the heteroskedasticity of stock market returns. They attempt to measure the response of monetary policy to the changes in stock prices in U.S covering the period from 1985 to 1999. The results of the study demonstrate that an increase in stock prices by 5% leads to a 25 basis point tightening in monetary aggregates. The authors regard this response as preceded by equal effect of increase in stock prices on aggregate demand, revealing the notion that policy makers respond to stock prices to the extent their effect on aggregate demand and thus economic activity. Cassola and Morana (2004) investigate the role of stock market in transmission of monetary policy in the Euro area, using a structural vector

error correction model (SVECM) for 1987-2000 periods. They found that stock prices have an important role in transmission of monetary policy. They also found that monetary shocks have significant but temporary impacts on stock prices on the contrary to inflation on which the impact of monetary shocks is seen as permanent. Besides, much of the variations in stock prices can be attributed to productivity shocks. From these findings, the authors conclude that if policy makers attempt to target the stock market, this policy may conflict with the goal of price stability. However, if they target price stability, the monetary policy is likely to affect stock prices positively though it is not plausible to expect from monetary policy to avoid fluctuations in stock prices.

Blinder (2006, 2010) presents some other arguments against the active response of central banks to asset price volatility all of which he regards as relevant for the US stock market bubble in 1998-2000. First, according to the author, central banks do not have an informational advantage over the other economic agents in the market to find out the bubble. Second, central banks do not have appropriate instrument to address bursting the bubble without generating another disturbance in the overall economy. As in the case in US stock market bubble, a rise in interest rates as a response to asset price bubble to be effective may be so high that the overall economic activity would likely collapse (Bernanke, 2002; Blinder and Reis, 2005). As to the response of central banks to the bubble in practice, Blinder (2010) distinguishes between two types of bubbles; equity-like bubbles and debt-financed bubbles. When the bubble is identified as equity-like bubbles, then central banks should "mop up after" the burst-that is to say, they should react to effects of bubbles on economic activity after they burst rather than to react to these movements themselves- whereas if the bubble is debt-financed, central banks should respond to bubble since in this case central banks have substantial informational advantage over the market. Gruen et. al (2005) also point out the informational requirements for a response of central banks to be effective. In situations where policy makers cannot achieve adequate information about the bubble process, typical inflation targeting is likely to be the best way of maintaining the stability whereas if policy makers have adequate information, it may be proper to respond to asset price bubbles. Mishkin (2008) also supports the recipe suggested by Bernanke and Gertler (1999) asserting that it is not asset price movements per se that central banks should respond to, but it is their impacts on inflation and aggregate demand that central banks should attempt to moderate. As reasons for this strategy, he points out that - in addition to the difficulty of identifying a bubble, uncertainty associated with the effect of interest rates on asset price bubbles - monetary policy affects asset prices in general and it is not possible to direct this effect towards only asset prices in a bubble. Instead of reacting directly to the asset price fluctuations, he argues that implementation of regulatory policies and supervisory practices may help to reduce the possibility of asset price bubbles and the heavy cost to the economy associated with the burst of these bubbles.

In accordance with the new lessons from the 2007-2009 financial crisis, Ito (2010) examines the effectiveness of interest rate policy so as to avoid asset price booms and busts. He points out that a sufficiently large increase in interest rates to moderate asset price boom may lead to consumer price deflation which is in turn likely to cause economic downturn. Central banks should therefore follow flexible inflation targeting strategy as suggested by Bernanke and Gertler (1999) and make interest rate adjustments as a second-best policy if the financial regulations cannot be realized. Likewise, Kuttner (2011) attempts to reexamine the model employed by Bernanke and Gertler (1999) in order to find out the relationship between the behavior of interest rates and stock prices

after the 2007-2009 financial crisis. On the purpose of investigating whether the monetary policy can be effective in avoiding asset price booms, he employs some regressions with monthly data for stock prices, short term interest rates and consumer prices obtained from 32 countries including Turkey. The main findings of this study indicate that interest rate adjustments by central banks do not prove to be effective tools for moderating asset price booms, suggesting that other tools, i.e. financial reform policies will be more effective than interest rate policy for financial stability.

The counter approach to the issue, which is called by Kohn (2006) as "extra action" due to the low possibility of its implementation in ordinary circumstances, is presented by the proponents of the central bank's monetary strategy comprised of systematic response to stock price fluctuations. Their arguments are based on the view that the financial turmoil is important either for its impact on targeted variables such as inflation and output gap or for its impacts on factors other than aggregate demand such as collateral constraints and misallocated resources (Kuttner, 2011). As a striking response to the view of Bernanke and Gertler (1999), Cecchetti et.al (2000, 2002) hold the view that central banks should take into account not only inflation and output gap but also asset prices in their monetary policy in order to improve economic performance. The authors explain the reasons why central banks should "lean against the wind" of asset price movements by referring the counter-arguments. As a response of the argument by opponents of "lean against the wind" strategy, they assert that even if it is difficult to measure the asset price bubbles, it is not much more difficult than to measure the output gap or equilibrium value of real interest rate. For this purpose, central banks may employ the tools such as productivity growth and the equilibrium equity risk premium which are also used for the estimation of output gap. Likewise, identification problem should not deter policy makers from taking into account asset prices, rather they should try to use all available information to find out the underlying shocks leading to asset price misalignments. The authors also underline the importance of taking into account the informational role of asset prices in estimating future inflation as stressed by many authors including some of the opponents. Cecchetti et. al. (2000) conduct a large number of simulations with two models one of which was used by Bernanke and Gertler (1999) in order to explore this case empirically. The simulation results of Cecchetti et. al. (2000) show that reaction function of central banks which include stock prices has more influence on smoothing output and inflation variability and it is a plausible strategy to respond to stock price bubbles through interest rate adjustments.

Stating that the financial imbalances are likely to occur in an economic environment with low inflation and sound macroeconomic conditions[8], Borio and Lowe (2002) underline the need for an appropriate response to these imbalances incorporating them into monetary policy rules. The authors claim that the counter arguments cited above are not ignorable but may not be so much exaggerated that they turn out to trip up the policy makers seeking the way for avoiding costly asset price bubbles. As for identification problem presented by the opponents, this would not continue to pose any problem to policy makers if asset price fluctuations are seen as a part of richer set of information on other symptoms of vulnerabilities and risks such as credit expansion and above-average capital accumulation. Therefore, however powerful the objections to the use of monetary

[8] Bordo and Wheelock (2004, 2007) conclude that most of the stock market booms in US and other countries occur during the periods of price stability, output growth and productivity.

policy may be, it would not be plausible to eliminate the policy response to the asset price bubbles.

In their dynamic new Keynesian model in which swings in asset prices lead to over accumulation of capital and debt, Bordo and Jeanne (2002) stress the potential costs and benefits associated with the two conflicting approaches to the determination of monetary policy response to asset price booms. If the policy makers ignore the boom cycle, it will end with a bust leading to credit crunch. If, on the other hand, the policy makers attempt to pursue a tight monetary policy to avoid credit crunch risk, it will be accompanied by an economic slowdown. The optimal monetary policy will then depend on which of these costs and benefits have precedence over the others in terms of their effect on the overall economy. Bordo and Jeanne (2002) do not attach so much importance to the question of whether asset price fluctuations come from bursting bubble fundamentals. The authors challenge the view that asset price bubbles matter to the extent their effects on inflation and output stability. When the boom-bust cycle in asset prices is realized as very costly, the direct response to these movements is of crucial importance in order to avoid the credit crunch which acts as a supply shock in their model. However, the authors warn policy makers that this policy requires an accurate identification of asset price bubbles and also the costs and benefits associated with the monetary strategy. Dupor (2002) develops a perspective for studying optimal response of monetary policy to distortionary shocks to firms' investment demand which is assumed to be based on irrational expectations. He introduces a model with nominal price rigidity, investment adjustment cots and endogenous capital accumulation. In this context, it is likely for firms to overestimate the future returns to capital and to increase physical investment, driving up asset prices. That is to say, fluctuations in asset prices arisen from non-fundamental factors are reliable signals for distortions in capital market which otherwise cannot be detected through consumer price inflation. In this case, inflation targeting policy is assumed to induce over accumulation of capital since it fails to respond adequately to distortionary shocks to firms' investment demand. Therefore, as also implied by Bordo and Jeanne (2002), Dupor (2002) concludes that monetary policy should be designed to respond to asset price movements when these come from non-fundamental sources no matter how this policy leads to nominal price deflation introducing a trade-off between inflation and asset price stabilization.

Filardo (2000, 2001) focuses on the role of monetary policy on asset price bubbles within the context of a small-scale macroeconomic model and several simulations. He asserts that if the effects of asset price bubbles on inflation and output are known for sure by a policy maker, it will be a plausible strategy to respond to asset price bubbles particularly in order to reduce output and inflation variability. However, expected costs associated with responding asset prices may exceed the benefits if the effects of asset price bubbles cannot be certainly detected. The author states that the monetary policy should react to asset price bubbles particularly when these exert negative effects on macroeconomic stability. Filardo (2004) expanded his earlier researches to indicate that monetary authority should concentrate on responding to non-fundamental part of asset prices. He also underlines the use of fiscal policies to reduce the distortionary effects of asset price bubbles on consumption and investment decisions and also suggests the use of prudential policies together with monetary policy.

Although there is a number of study in the literature analyzing the effects of monetary policy and asset prices separately, particularly in developing countries there is relatively small number of empirical study attempting to explore the effect of monetary policy on

stock prices and stock prices on monetary policy setting in the very same analysis. Bjornland and Leitemo (2009) examine the simultaneous interaction between monetary policy and asset prices in U.S. using monthly data from 1983:1 to 2002:12 within the framework of VAR model. The results of the study indicate that change in stock prices has an effect on inflation and output which provides stimulation for central banks to respond to a change in stock prices through interest rate setting. The authors conclude strongly that monetary policy affects stock prices as well as stock prices are one of the reliable signals for variations in inflation and output so as to be a guide for monetary policy.

Following this study, Iglesias and Haughton (2011) employ structural VARs with the annual data from 1990 to 2009 in an attempt to examine interaction between stock prices and monetary policy in Barbados, Jamaica, and Trinidad and Tobago to compare the results with those of U.S. The combined results of this study which are also similar to those of Bjornland and Leitemo (2009) reveal that an increase in stock prices by 1% increases the Treasure bill rate by 700 basis points and on the other hand, an increase in interest rates cause stock price to diminish by 0.027%. These results also support both the view that monetary policy has an impact on stock prices transmitted to the other variables such as inflation and output and the view that monetary response to changes in stock prices will be effective way of controlling the adverse effects of stock price changes on the same variables cited above.

3 Empirical Methodology

Linear approximations to nonlinear macroeconomic phenomena have served researchers and policy makers well, but in many cases nonlinear specifications have turned out to be useful. To this end, the switching regression model, various Markov-switching models and the smooth transition regression models are applied by choosing a linear model as their starting-point and considering nonlinear extensions (Teräsvirta, 2007: p. 222). Among all these models, smooth transition regression models have been widely used for analyzing the nonlinear relationship among economic variables (Teräsvirta, 1998; Aslanidis, Osborn and Sensier, 2002; Camacho, 2004; Saikkonen and Choi, 2004; González, Teräsvirta and van Dijk, 2005; Ibarra and Trupkin, 2007; Fouquau, Hurlin and Rabaud, 2008; Chen and Maringer, 2011; Lee and Chiu, 2011; Mehrara, Hemati and Sayehmiri, 2011; Cainelli, Fracasso and Marzetti, 2012; Kadilli and Markov, 2012; Nieh and Yao, 2013). The standard STR model with a logistic transition function can be expressed as below;

$$y_t = \phi' \mathrm{z}_t + \theta' \mathrm{z}_t G(\gamma, c, s_t) + u_t$$
$$G(\gamma, c, s_t) = (1 + \exp\{-\gamma \prod_{k=1}^{K} (s_t - c_t)\})^{-1}, \gamma > 0 \quad (1)$$

where $\mathrm{z}_t = (\mathrm{w}_t' \mathrm{w}')'$ is an $((m+1)\times 1)$ vector of explanatory variables with

$w_t^{'} = (1, y_{t-1}, ..., y_{t-p})^{'}$ and $x_t^{'} = (x_{1t}, ..., x_{kt})^{'}$ [9]. Besides, parameter vectors are; $\phi = (\phi_0, \phi_1, ..., \phi_m)^{'}$ and $\theta = (\theta_0, \theta_1, ..., \theta_m)^{'}$ and they are $((m+1)\times 1)$ parameter vectors, while $G(\gamma, c, s_t)$ is a bounded function of the continuous transition variable s_t. γ is the slope parameter and $c = (c_1, ..., c_K)^{'}$, which is a vector of location parameters $c_1 \le ... \le c_K$ (Terasvirta,2007: p. 223).

Equation (1) defines a logistic STR (LSTR) model and LSTR1 or LSTR2 models can be formed according to the choice of K. The LSTR model with $K = 1$ (LSTR1 model) describes processes whose dynamic properties are different in expansions from what they are in recessions, and the transition from one extreme regime to the other one is smooth. On the other hand, the LSTR2 model ($K = 2$) is appropriate in situations in which the local dynamic behavior of the process is similar at both large and small values of s_t and different in the middle (Terasvirta, 2007: p. 224).

In order to construct a STR-type of model, the linear AR model is supposed to be selected by allowing to one endogenous variable y_t and an arbitrary number of exogenous (x_t) and deterministic variables. The maximum lag order for y_t and x_t determines the number of lags to be included. On the other hand, a constant term and seasonal dummies can be incorporated into the model and the linear part must be stationary. The transition variable s_t must be a part of the selected variables or lags of these variables if it is not a trend (JMulti Help System, 2008).

By applying F test, whether there is a nonlinearity of the STR type in the model is checked. The test also helps to determine the transition variable and whether LSTR1 or LSTR2 should be used. Within this context, the following auxiliary regression is applied if s_t is an element of z_t;

$$y_t = \beta_0^{'} z_t + \sum_{j=1}^{3} \beta_j^{'} z_t s_t^j + u_t^* \tag{2}$$

with $z_t = (1, z_t)^{'}$. In case s_t is not part of z_t, $y_t = \beta_0^{'} z_t + \sum_{j=1}^{3} \beta_j^{'} z_t s_t^j + u_t^*$. The null hypothesis of linearity is $H_0 : \beta_1 = \beta_2 = \beta_3 = 0$, if linearity has been rejected, it is chosen whether a LSTR1 or a LSTR2 model should be specified (JMulti Help System, 2008). The choice can be based on the test sequence:

$$\begin{aligned} &1.\text{test } H_{04} : \beta_3 = 0 \\ &2.\text{test } H_{03} : \beta_2 = 0 \mid \beta_3 = 0 \\ &3.\text{test } H_{02} : \beta_1 = 0 \mid \beta_2 = \beta_3 = 0 \end{aligned} \tag{3}$$

[9] y_t is an endogenous variable, while $x_t^{'} = (x_{1t}, ..., x_{kt})^{'}$ is a vector of exogenous variables.

The test is based on the same auxiliary regression (1) as the linearity test. The variable with the strongest test rejection (the smallest p -value) can be used as a decision rule for choosing an appropriate s_t (JMulti Help System, 2008).

4 Empirical Findings

In this study, we employed 4 STR models for the cases of Czech Republic, Poland, Russian Federation and Turkey to explore the possible effects of inflation expectations, output gap and stock prices on short-term interest rates within the inflation targeting framework[10]. Within this context, it is particularly analyzed whether stock prices have an impact on the phase of short-term interest rates proxied by 3-month interbank rate in these selected countries. All models are estimated by using a lag length of 2 for both endogenous (3-month interbank rate) and exogenous (inflation expectations, output gap, stock price index) variables. The linearity test suggested the transition variables as $outcze_{t-1}$, $irtpol_{t-2}$, $outrus_{t-2}$ and $stptur_t$ and the estimation of LSTR1 for Czech Republic, Poland, Russian Federation and Turkey. Empirical results are presented below. As shown in Table 1-4, all R^2 statistics are relatively high for all LSTR1 estimations.

Table 1: LSTR1 Model Results for Czech Republic

Variables	**Linear Part**	**Non-Linear Part**	p **-value**
constant	0,12	-0,12	0,02
$irtcze_{t-1}$	0,82	-0,82	0,04
$irtcze_{t-2}$	1,74	-1,74	0,03
$gdpcze_t$	0,72	-0,72	0,01
$gdpcze_{t-1}$	0,94	-0,94	0,00
$gdpcze_{t-2}$	0,35	-0,35	0,04
$inecze_t$	0,69	-0,69	0,06
$inecze_{t-1}$	1,24	-1,24	0,07
$inecze_{t-2}$	0,54	-0,54	0,05
$stpcze_t$	0,05	-0,05	0,19
$stpcze_{t-1}$	0,04	-0,04	0,21
$stpcze_{t-2}$	0,06	-0,06	0,28

[10] Following Cecchetti et. al. (2000), we define the monetary policy rule as; $r_t^T = [\psi_1(E\pi_{t+1}) + \psi_2(y_t - \bar{y}_t) + \psi_3 s_{t-1}]$, where ψ_1 , ψ_2 and ψ_3 are the policy coefficients, r_t^T is the policy rate, $E\pi_{t+1}$ is the expected inflation, $(y_t - \bar{y}_t)$ is the outputgap and s_{t-1} is the first lag of stock prices. If the short-term interest rate (r_t) is assumed to follow the path; $r_t = (1-\rho_R)r_t^T + \rho_R r_{t-1} + \varepsilon_t^r$, the policy rule can be expressed as; $r_t = \rho_R r_{t-1} + (1-\rho_R)[\psi_1(E\pi_{t+1}) + \psi_2(y_t - \bar{y}_t) + \psi_3 \Delta s_{t-1}] + \varepsilon_{r,t}$, where the unsystematic component of monetary policy is represented as $\varepsilon_{r,t}$ and $\rho \in [0,1]$ captures the degree of the interest rate smoothing.

Parameters			
γ		7,33	
c_1		31,89	
R **-Squared:** 0,84 **Adjusted** R **-Squared:** 0,83			

Table 1, 2 and 3 imply that lagged values of 3-month interbank rate and current and lagged values output gap and inflation expectations may have a positive impact on the current value of 3-month interbank rate in Czech Republic, Poland and Russian Federation. Among all variables, output gap has a major effect on the phase of 3-month interbank rate in Czech Republic and Russian Federation. According to LSTR1 model estimations, stock prices affect 3-month interbank rate positively in Czech Republic and Russian Federation, however these effects are statistically insignificant. This implies that Czech National Bank (CNB) and Central Bank of Russia (CBR) should not include stock prices index in its monetary policy formulation since no significant effect on 3-month interbank rate is detected.

Table 2: LSTR1 Model Results for Poland

Variables	**Linear Part**	**Non-Linear Part**	p **-value**
constant	0,05	-0,05	0,03
$irtpol_{t-1}$	-1,08	1,08	0,04
$irtpol_{t-2}$	1,24	-1,24	0,00
$gdppol_t$	1,01	-1,01	0,03
$gdppol_{t-1}$	1,17	-1,17	0,02
$gdppol_{t-2}$	1,28	-1,28	0,03
$inepol_t$	2,75	-2,75	0,01
$inepol_{t-1}$	2,20	-2,20	0,01
$inepol_{t-2}$	1,21	-2,21	0,00
$stppol_t$	0,12	-0,12	0,13
$stppol_{t-1}$	0,10	-0,10	0,12
$stppol_{t-2}$	0,09	-0,09	0,17
γ		5,96	
c_1		42,53	
R **-Squared:** 0,96 **Adjusted** R **-Squared:** 0,95			

LSTR1 model estimation for Poland exposes that lagged values of 3-month interbank rate have an important explanatory power on the phase of itself. Similar to the cases of Czech Republic and Russian Federation, the effect of current and lagged values stock price index on the current value of 3-month interbank rate is statistically insignificant. This result may be interpreted by the fact that stock market investments are not a substitute for money market accounts and thus capital and money market interactions are relatively lower in Czech Republic, Poland and Russian Federation. Nevertheless, the role of stock prices in monetary policy implementation should be determined by the CNB, National Bank of

Poland and CBR for maintaining financial stability when the development of financial markets particularly over the last decade is concerned.

Table 3: LSTR1 Model Results for Russian Federation

Variables	**Linear Part**	**Non-Linear Part**	***p* -value**
constant	1,8	-1,8	
$irtrus_{t-1}$	1,96	-1,96	0,03
$irtrus_{t-2}$	0,89	-0,89	0,06
$gdprus_{t}$	2,1	-2,17	0,04
$gdprus_{t-1}$	3,9	-3,91	0,08
$gdprus_{t-2}$	1,3	-1,36	0,00
$inerus_{t}$	1,1	-1,15	0,04
$inerus_{t-1}$	2,2	-2,2	0,11
$inerus_{t-2}$	0,8	-0,88	0,09
$stprus_{t}$	0,22	-0,22	0,13
$stprus_{t-1}$	-0,06	0,06	0,08
$stprus_{t-2}$	0,12	-0,12	0,21
γ		8,13	
c_1		30,63	
R **-Squared:** 0,96 **Adjusted** R **-Squared:** 0,95			

Similar to Czech Republic, Poland and Russian Federation lagged values of 3-month interbank rate and current and lagged values output gap and inflation expectations affect the current value of 3-month interbank rate positively in Turkey. However, in contrast to the other cases, the positive impact of current and lagged values of stock price index on the current value of 3-month interbank rate is statistically significant. Moreover, the current value of stock price index is critically important for the phase of 3-month interbank rate. Therefore, Central Bank of the Republic of Turkey (CBRT) aiming at controlling economy-wide interest rates should take into account the possible effects of stock market variations on short-term interest rates when determining its policy interest rates. CBRT should also include stock prices into its monetary policy formulation as well as output gap and inflation expectations since bubbles in the stock market may contain reliable information about current and future inflation. Nevertheless, CBRT should determine the overall effect of the response to the variability in stock prices through short term interest rates since the response may introduce a disturbance in the other areas of the economic activity.

Table 4: LSTR1 Model Results for Russian Turkey

Variables	**Linear Part**	**Non-Linear Part**	***p* -value**
constant	-0,74	0,74	0,02
$irttur_{t-1}$	0,43	-0,43	0,04
$irttur_{t-2}$	0,78	-0,78	0,05
$gdptur_t$	2,74	-2,74	0,09
$gdptur_{t-1}$	3,79	-3,79	0,11
$gdptur_{t-2}$	2,42	-2,42	0,07
$inetur_t$	0,4	-0,4	0,20
$inetur_{t-1}$	1,4	-1,4	0,10
$inetur_{t-2}$	3,75	-3,75	0,07
$stptur_t$	2,60	-2,60	0,01
$stptur_{t-1}$	0,34	-0,34	0,06
$stptur_{t-2}$	1,79	-1,79	0,04
γ		10,00	
c_1		43,83	
R **-Squared:** 0,92 **Adjusted** R **-Squared:** 0,91			

5 Conclusion

Since a prudential macroeconomic environment may not by itself assure to avoid financial turmoil and to achieve financial stability, monetary policy responses turn out to be more hotly argued issue both in academic and central banking circles. Some authors stress that central banks should take the changes in asset prices as a signal for variations in inflation and output and a guide for monetary policy. Besides the changes in inflation and output gap, central banks should therefore respond to the variability in asset prices through interest rates, namely they should "lean against the wind" of asset price movements. On the contrary, some other authors argue that since it is not possible for policy makers to find out the exact sources of the bubble and central banks do not have appropriate instrument to respond to bubble without exerting negative influence on the overall economy, central banks should not respond to the changes in asset prices unless they generate inflationary or deflationary pressure. Instead of responding to the variability in asset prices, they should pursue inflation targeting regime with a strong commitment to stabilize price inflation and react to the effects of bubbles on economic activity after they burst, namely "mop up after" the burst.

In this paper, we attempt to test whether changes in interest rates are associated with changes in stock prices, accordingly, to explore whether monetary policy decisions of central banks of Czech Republic, Poland, Russian Federation and Turkey are led by stock price movements which may imply the active response of central banks to these movements. Our findings expose that effects of stock prices on short-term interest rates proxied by 3-month interbank rate is statistically insignificant in Czech Republic, Poland and Russian Federation. This result may imply that the response of central banks of these countries to the variations in stock prices through short term interest rates does not

have an influence on the goal of maintaining the overall macroeconomic and financial stability. On the other hand, changes in stock prices exhibit a statistically significant effect on 3-month interbank rates in Turkey. Moreover, the current value of stock price index has an impact on the phase of the 3-month interbank rate in Turkey. The result reveals the fact that the Central Bank of the Republic of Turkey (CBRT) may respond to the changes in stock prices so as to maintain the overall economic stability as long as the response does not generate any disturbance in the other areas of the overall economic activity.

References

[1] A. J. Filardo, Monetary Policy and Asset Prices, *Federal Reserve Bank of Kansas City Economic Review*, Third Quarter, (2000), 11-37.

[2] A. J. Filardo, Should Monetary Policy Respond to Asset Price Bubbles? Some Experimental Results, July, *Federal Reserve Bank of Kansas City Working Paper*, **01-04**, (2001).

[3] A. J. Filardo, Monetary Policy and Asset Price Bubbles: Calibrating the Monetary Policy Trade-Offs, *BIS Working Papers*, **155**, (2004).

[4] A. S. Blinder and R. Reis, Understanding the Greenspan Standard, *CEPS Working Papers*, **114**, (2005).

[5] A. S. Blinder, Monetary Policy Today: Sixteen Questions and about Twelve Answers, *CEPS Working Papers*, **129**, (2006).

[6] A. S. Blinder, Commentary: Rethinking Monetary Policy in Light of the Crisis, Economic Policy Symposium, "Macroeconomic Challenges: The Decade Ahead", (2010), 1-7, http://www.kc.frb.org/publicat/sympos/2010/blinder-remarks.pdf

[7] A. Gonzalez, T. Teräsvirta and D. Van Dijk, Panel Smooth Transition Regression Models, *Quantitative Finance Research Centre Research Paper*, **165**, (2005).

[8] A. Kadilli and N. Markov, A Panel Smooth Transition Regression Model for the Determinants of Inflation Expectations and Credibility in the ECB and the Recent Financial Crisis, 31th CIRET Conference – Vienna- Austria, (2012), 1-37. https://www.ciret.org/conferences/vienna_2012/papers/upload/p_6-845358.pdf

[9] B. Bernanke and M. Gertler, Monetary Policy and Asset Price Volatility, Economic Review, Fourth Quarter, Federal Reserve Bank of Kansas City's symposium, New Challenges for Monetary Policy, August 26-28, (1999), 17-51. http://www.kc.frb.org/publicat/econrev/PDF/4q99bern.pdf

[10] B. Bernanke and M. Gertler, Should Central Banks Respond to Movements in Asset Prices?, *American Economic Review, Papers and Proceedings*, **91(**2), (2001), 253–257.

[11] B. Bernanke, Asset Price Bubbles and Monetary Policy, Remarks before the New York Chapter of the National Association for Business Economics, October 15th. (2002). http://www.federalreserve.gov/boarddocs/speeches/2002/20021015/default.htm

[12] B. Dupor, Nominal Price versus Asset Price Stabilization, Centre for Economic Policy Research, (2002), http://www.cepr.org/meets/wkcn/1/1521/papers/dupor.pdf

[13] C. Borio and P. Lowe, Asset Prices, Financial and Monetary Stability: Exploring the Nexus, *BIS Working Papers*, **114**, (2002).

[14] C. Lee and Y. Chiu, Electricity Demand Elasticities and Temperature: Evidence from Panel Smooth Transition Regression with Instrumental Variable Approach, *Energy Economics*, **33**(5), (2011), 896-902.

[15] C. Nieh and H. Yao, Threshold Effects in the Capital Asset Pricing Model Using Panel Smooth Transition Regression (PSTR) Evidence from Net Oil Export and Import Groups, *Advances in Management & Applied Economics*, **3**(2), (2013), 179-192.

[16] D. Gruen, M. Plumb and A. Stone, How Should Monetary Policy Respond to Asset-Price Bubbles? *International Journal of Central Banking*, **1**(3), December (2005), 1-31.

[17] D. L. Kohn, Monetary Policy and Asset Prices, Speech At Monetary Policy: A Journey from Theory to Practice, a European Central Bank Colloquium Held in Honor of Otmar Issing, Frankfurt, Germany, (2006), http://www.federalreserve.gov/newsevents/speech/kohn20060316a.htm

[18] E. M. Iglesias and A. Y. Haughton, Interaction between Monetary Policy and Stock Prices: A Comparison Between the Caribbean and the US, *Applied Financial Economics*, **23**(6), (2013), 515-534.

[19] F. S. Mishkin, How Should We Respond to Asset Price Bubbles?, Speech At the Wharton Financial Institutions Center and Oliver Wyman Institute's Annual Financial Risk Roundtable, Philadelphia, Pennsylvania, (2008), http://www.federalreserve.gov/newsevents/speech/mishkin20080515a.htm

[20] G. Cainelli, A. Fracasso and G. V. Marzetti, Spatial Agglomeration and Productivity in Italy: A Panel Smooth Transition Regression Approach, *Openloc Working Paper*, **4**, (2012), 1-27.

[21] H. C. Bjornland and K. Leitemo, Identifying the Interdependence between US Monetary Policy and the Stock Market, *Journal of Monetary Economics*, **56(**2), (2009), 275-282.

[22] H. Lütkepohl, Univariate Time Series Analysis in Applied Time Series Econometrics, ed. By Helmet Lütkepohl and Markus Kratzig, Applied Time Series Econometrics, Cambridge, Cambridge University Press, pp. 8-85, (2004).

[23] I. Choi and P. Saikkonen, Testing Linearity in Cointegrating Smooth Transition Regressions, *Econometrics Journal*, **7(**2), (2004), 341-365.

[24] J. Fouquau, C. Hurlin and I. Rabaud, The Feldstein-Horioka Puzzle: a Panel Smooth Transition Regression Approach, *Economic Modelling*, **25(**2), (2008), 284-299.

[25] JMulTi Time Series Analysis with Java Software Help System, (2008), Version.4.23.

[26] K. Kuttner, Monetary Policy and Asset Price Volatility: Should We Refill the Bernanke-Gertler Prescription?,Department of Economics Working Papers, **4**, (2011).

[27] M. Bordo and O. Jeanne, Monetary Policy and Asset Prices: Does Benign Neglect Make Sense? *International Finance*, **5**(2), December (2002), 139-64.

[28] M. Bordo and D. C. Wheelock, Monetary Policy and Asset Prices: A Look Back at Past U.S. Stock Market Booms, NBER Working Paper, **10704**, (2004).

[29] M. Bordo and D. C. Wheelock, Stock Market Booms and Monetary Policy in the 20th Century, *Federal Reserve Bank of St. Louis Review*, **89**(2), (2007), 91-122.

[30] M. Camacho, Vector Smooth Transition Regression Models for US GDP and the Composite index of Leading Indicators, *Journal of Forecasting*, **23**, (2004), 173-196.

[31] M. Mehrara, A.Hemati and A. Sayehmiri, On the Relationship between Water Withdrawal and Income: Smooth Transition Regression (STR) Approach, *Modern Economy*, **2**, (2011), 729-734.
[32] N. Aslanidis, D.R. Osborn and M. Sensier, "Smooth Transition Regression Models in UK Stock Returns", Royal Economic Society Annual Conference 2002 from Royal Economic Society, **11**, (2002), pp.1-31.
[33] N. Cassola and C. Morana, Monetary Policy and Stock Market in the Euro Area, *Journal of Policy Modeling*, **26(**3), (2004), 387-399.
[34] R. Ibarra and D. Trupkin, The Relationship between Inflation and Growth: A Panel Smooth Transition Regression Approach for Developed and Developing Countries, Facultad de Ciencias Empresariales y Economia. Universidad de Montevideo Documentos de Trabajo/Working Papers, **1107**, (2011).
[35] S. G. Cecchetti, H. Genberg, J. Lipsky and S. Wadhwani, Asset Prices and Central Bank Policy, Report prepared for the conference Central Banks and Asset Prices organised by *the International Centre for Monetary and Banking Studies in Geneva*, **2**, (2000), 1-142. http://down.cenet.org.cn/upfile/8/2010318204458149.pdf
[36] S. G. Cecchetti, H. Genberg and S. Wadhwani, Asset Prices in a Flexible Inflation Targeting Framework, NBER Working Papers, **8970**, (2002).
[37] R. Rigobon and B. Sack, Measuring the Reaction of Monetary Policy to the Stock Market, *The Quarterly Journal of Economics*, **118**(2), (2003), 639-669.
[38] T. Ito, Monetary Policy and Financial Stability: Is Inflation Targeting Passé?, Asian Development Bank Economics Working Paper Series, **206**, (2010).
[39] T. Teräsvirta, Modeling Economic Relationships with Smooth Transition Regressions, in Handbook of Applied Economic Statistics, ed. By Aman Ullah and David E.A. Giles, Handbook of Applied Economic Statistics, New York, Dekker, pp.507-552, (1998).
[40] T. Teräsvirta, Smooth Transition Regression Modeling, in Applied Time Series Econometrics, ed. By Helmet Lütkepohl and Markus Kratzig, Applied Time Series Econometrics, Cambridge, Cambridge University Press, pp 222-242, (2004).
[41] X. Chen and D. Maringer, Detecting Time-variation in Corporate Bond Index Returns: A Smooth Transition Regression Model, J*ournal of Banking & Finance*, **35**(1), (2011), 95-103.