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Are Central Banks In CEE Countries Concerned About The Burden Of Public Debt?

Abstract

The aim of this study is to analyze the monetary policy rules in the Czech Republic, Hungary and Poland, with public debt as an additional explanatory variable. We estimate linear rules by the GMM estimation and non-linear rules, using the Markov-switching model. Our findings suggest that in the Czech Republic and Poland the monetary authorities respond to growing public debt by lowering interest rates, while in Hungary the opposite may be observed. Moreover, we distinguish between passive and active monetary policy regimes and find that the degree of interest rate smoothing is lower and the response of the central banks to inflation and/or output gap is stronger in an active regime. In the passive regime, the output gap seems to be statistically insignificant.

Keywords*: monetary policy, general government debt, Taylor rule, regime switching*

1. Introduction

In recent years many countries have witnessed a substantial increase in fiscal imbalances. The fiscal consolidation measures undertaken to counteract the worsening of fiscal situations has proven in many cases to be insufficient and/or ineffective. The perspectives are also not very optimistic taking into account the ageing of the population in many countries, in particular in the more advanced ones.

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In this context the question arises about the consequences of the fiscal stance on the effectiveness of monetary policy. Monetary policy has undergone significant institutional changes during the recent decades, which substantially improved its quality. One of the most important changes is the institutional independence granted to the central banks. Independent monetary authorities should be able to conduct sound monetary policy, ensuring price stability, without being inclined or forced by the government to monetize the debt. However, this view was contradicted in the literature, firstly by an "unpleasant monetarist arithmetic" by Sargent and Wallace (1981), and then by the fiscal theory of the price level (Woodford 1994, 1995, 1996, 1998, 2001; Sims 1994, 2001; Leeper 1991; Cochrane 2000, 2001). According to these concepts, monetary policy is not sufficient to ensure price stability; a sound fiscal policy is also required. The FTPL claims that the intertemporal government budget constraint may be satisfied in two ways: through adjustment of the primary surplus – which is called the Ricardian or monetary dominant regime; or through the endogenous adjustment of the price level – which is called the non-Ricardian or fiscal dominant regime. Therefore, fiscal imbalances and a lack of adjustments in fiscal policy may threaten price stability. In this situation, even independent central banks may be forced to take the public finances and the possible impact of interest rate changes on government debt into account when deciding about interest rates.

The literature on monetary-fiscal policy interactions is rich. Leeper (1991) introduced a theoretical DSGE model of monetary-fiscal interactions and showed that there exists a bounded unique rational expectations equilibrium if one of the policies is active and the other passive. Davig and Leeper (2006) estimated Markov-switching rules for monetary and fiscal policies in the USA and found numerous switches that allow to distinguish between those regimes with monetary and those regimes with fiscal policies being dominant. Davig and Leeper (2011), using the Markov-switching monetary and fiscal rules in the DSGE model, also showed that the results depend on the regimes of the two policies. Many of the empirical studies on monetary-fiscal interaction use the VAR analysis. For example, Muscatelli at al. (2002) used the VAR and Bayesian VAR models to examine the interactions between fiscal and the monetary policy, concluding that fiscal shocks had a significant effect. More recently, Franta et al. (2012), adopting a time-varying-parameter VAR approach, found that central banks started to offset debt-financed fiscal shocks by increasing interest rates after the adoption of the inflation targeting framework.

The aim of this paper is to verify whether fiscal policy stances may directly influence the interest rate-setting behavior of central banks. We analyze three central European countries: the Czech Republic, Hungary and Poland. In all these countries the public debt-to-GDP ratio has been on the rise throughout

the 2000s. The attempts to improve the fiscal situation were ruined by the outbreak of the global financial crisis. The most serious fiscal problems were experienced by Hungary, although it seems that it is the only country analyzed in the paper that was successful in stabilizing the debt.

All the examined central European countries are inflation targeters with independent central banks, and their primary goal is to achieve price stability. Therefore, we would expect that the inflation rate would be their primary concern, i.e. inflation would be a significant variable with a high coefficient in the estimated monetary policy rule. However, if the monetary authorities perceive the public finances as unsustainable and threatening the overall macroeconomic stability, or price stability in particular, they may also respond to changes in the debt ratio. Therefore, we estimate the Taylor rules for these countries, where the short-term interest rate set by the central bank is explained by the lagged interest rate (interest rate smoothing), expected inflation, the output gap, and the changes in the general government debt-to-GDP ratio. We use two methods of estimation: the GMM and Markov-switching methods, as we allow for monetary policy regime switches. Our results suggest that the central banks in the Czech Republic and Poland responded to growing debt by lowering interest rates, while the Hungarian central bank acted in the opposite way.

The remainder of this paper is organized as follows. The next section presents the possible explanations of the direct impact of public debt on interest rates set by the central banks. Section 3 describes data, methodology and estimation results, and the final section offers some conclusions.

2. Monetary policy rates and public debt

In this section we present arguments for the possible relationship between interest rates set by the central banks and the public debt stock. According to the standard view, monetary policy should tighten when fiscal policy loosens, *ceteris paribus*. Changes in fiscal policy affect output and the medium-term inflation prospects, to which monetary policymakers respond. In this sense the impact is indirect. It seems, however, that two other possible explanations of this relationship, more direct, may be derived from the literature: a debt management issue and a financial stability issue.

We have already alluded to the fiscal theory of the price level, according to which high public debt may result in higher price levels. According to this theory, such a situation may occur if the public debt is unsustainable, i.e. the intertemporal government budget constraint is not fulfilled. For public debt

sustainability the relativity between interest rates and growth is important. If there are not many possibilities for the public finances to generate surplus – which can be a problem in times of economic slowdown – interest rates higher than growth will lead to a continuous increase in debt in relation to GDP. This brings us to the relationship between interest rates and the public debt. Goodhart (2012) concluded that in the face of low economic growth the only way to prevent the public debt from exploding, in particular in peripheral countries, is to set low interest rates, lowering the interest payments on outstanding debt.

Goodhart (2012) explains that high deficits and public debt levels make fiscal sustainability a concern for central banks, which may take into account the possible effect of interest rate changes on the burden of the interest payments on the public sector. He predicts that in the coming years monetary policy and debt management will become closely interrelated, and that the times when monetary and fiscal policy were independent and separated were only temporary in central banking.

Debt management issues may, however, be further complicated when a significant part of public debt is denominated in foreign currency. In this case decreasing interest rates will lead to currency depreciation, increasing the value of the foreign debt expressed in domestic currency.

Taking into account these considerations, we may conclude that monetary policymakers may be concerned about fiscal stability issues and take public debt into consideration when deciding about the level of interest rates, however the direction of the relationship between interest rates and the public debt is ambiguous when a high share of the debt is denominated in foreign currency.

Some authors postulate that monetary policy should respond to asset prices, or more generally, to financial stability. There are numerous studies discussing this issue on theoretical as well as empirical grounds. Baxa et al. (2013) provide an excellent survey of the existing literature in the field. They also estimate monetary policy rules for several central banks using the financial stress indicator as one of variables to which monetary policy responds. Moreover, they use a time-varying framework to capture changes in the strength of the reaction. They find that the interest rate setting behaviour of the central banks is affected by high financial stress. For the Czech Republic, Hungary and Poland, Vašíček (2012) conducted a similar study using the threshold model with the financial stress indicator as one of the threshold variables. His results suggest that in the Czech Republic and Poland the central banks respond to financial stress by decreasing interest rates, while in Hungary the central bank increases interest rates in the face of financial stress.

While there is empirical evidence that monetary policy responds to financial stress and tries to ensure financial stability, fiscal sustainability and financial stability are strictly related. For example, Shirakawa (2012) describes the potential impact of an increase in government debt on financial stability and price stability, and Hellebrandt et al. (2012) state that "there is no question that price and financial stability depend upon the maintenance of fiscal stability." We may, therefore, conclude that central banks may directly respond to the changes in the public debt level for financial stability reasons.

3. Monetary policy rules with public debt

In this study we estimate the monetary policy rule, originally proposed by Taylor (1993), and we expand the set of standard variables measuring the economic imbalances to which the central banks may possibly respond, by adding the public debt. For the reasons explained above we do not form expectations about the sign of the relationship.

As the relationship between interest rates and public debt may run in both directions (negative and positive), the impact of public debt on interest rates may change over time, depending on the monetary policy regime. For this reason, we estimate the monetary policy rules using the GMM, which allows for corrections of possible endogeneity, as well as the Markov-switching model, which allows for changes of monetary policy regimes.

3.1. Data

The time span of the analysis ranges from 1998:q1 to 2014:q2 (in the case of the Czech Republic the sample period is 1999:q1 to 2013:q1[1]). We use quarterly data, as Vašíček (2012) suggests, in order to avoid problems with the high persistency of some variables, such as inflation and interest rates, and noise in the data at monthly frequency. The dependent variable is the quarterly average of the main policy interest rate set by the three analyzed central banks. As Arlt and Mangel (2014) argue, in many empirical studies on monetary policy rules the interest rates set by the central banks are approximated by the interbank money

[1] In the case of the Czech Republic the sample used for the estimation is shorter than for the two remaining countries and ends in first quarter of 2013. We decided to shorten the sample because since 2 November 2012 the Czech National Bank has maintained its two-week repo rate at a level that is considered to be the binding lower band on short-term nominal interest rates.

market interest rates; yet, in such a case the behaviour of the money market is tested rather than the interest rate setting behaviour of the central banks.

Arlt and Mangel (2014) also criticize the use of the future inflation rate as the explanatory variable in forward-looking Taylor rule estimations, which is common in empirical studies. They point out that the currently set interest rate influences the future inflation rate, which may actually be different than forecasted at time of making the interest rate decision. On the other hand, the estimation of forward-looking, rather than backward-looking, Taylor rules seems to be justified in the case of inflation-targeting countries. The best solution would be the choice of conditional inflation projections, but such data are not available for all the three central banks for the whole period. Therefore, we try to avoid the problem by using the inflation expectations of commercial banks' analysts formed for the period 12 months ahead (in the case of Hungary – for the end of the next year).[2] For Hungary and Poland the source of the data is Reuters, for the Czech Republic we rely on the data from the Czech National Bank survey of financial analysts. As the frequency of the data is monthly, we use quarterly averages.

As the measure of the output gap we use the difference between the logarithm of real GDP and its trend obtained by the HP filter. For the foreign interest rate we use the interest rate set by the European Central Bank as the main central bank in the region. The exchange rate is measured as the deviation of the logarithm of the real effective exchange rate from the trend obtained by the HP filter (quarterly data obtained from Eurostat).

Finally, we use seasonally adjusted quarterly data on the general government debt-to-GDP ratio. The unit root tests indicated the existence of a unit root in the time-series in the case of all three countries, and therefore the government debt is incorporated in the Taylor rule equation as the first difference. The source of the data is Eurostat. Below the descriptive statistics of the data are presented.

[2] Mackiewicz-Łyziak (2016) estimates Taylor rules for the Czech Republic, Hungary and Poland using past inflation, future inflation, and inflation expectations and finds that in the case of these countries forward-looking Taylor rules describe monetary policy in a better way.

Table 1. Descriptive statistics for variables used for the Taylor rule estimation

	Mean	Median	Maximum	Minimum	Std. dev.
Czech Republic					
Interest rate	0.0247	0.0217	0.0549	0.005	0.0158
Inflation exp.	0.0297	0.0276	0.0477	0.0163	0.0081
Output gap	-0.0010	-0.0030	0.0440	-0.0271	0.0190
Debt (diff.)	0.0226	0.0200	0.0710	-0.0270	0.0249
Exchange rate	0.0025	-0.0024	0.0957	-0.0568	0.0353
Hungary					
Interest rate	0.090	0.0813	0.2017	0.0249	0.0390
Inflation exp.	0.0465	0.0415	0.1175	0.0200	0.0209
Output gap	-0.0003	-0.0022	0.0361	-0.0406	0.0165
Debt (diff.)	0.0124	0.0090	0.1540	-0.0620	0.0428
Exchange rate	3.57E-13	0.0018	0.0996	-0.1087	0.0376
Poland					
Interest rate	0.0774	0.0525	0.2383	0.0250	0.0562
Inflation exp.	0.0372	0.0277	0.1072	0.0184	0.0221
Output gap	-0.0001	-0.0011	0.0252	-0.0207	0.0119
Debt (diff.)	0.0081	0.0125	0.0690	-0.0820	0.0315
Exchange rate	2.36E-13	0.0033	0.1692	-0.1573	0.0659
Common					
ECB int. Rate	0.0234	0.0234	0.0475	0.0023	0.0125

Source: Own calculations.

3.1. Results of the GMM estimation

This section presents the estimated monetary policy reaction functions. The estimated rules are forward-looking, in the sense that they include forecasted inflation rates. Other variables – the output gap and the public debt – enter the equation either lagged by one period or as a value in the current period. Moreover, we assume the interest rate smoothing behaviour of the central banks (as suggested by Judd and Rudebusch (1998)), so the interest rate equation includes its past value.

The way in which inflation should enter the Taylor rule in the case of the three examined countries is not obvious. All three countries are inflation targeters, with explicitly set inflation targets. In such a case it seems reasonable to include the inflation gap in the monetary policy rule, that is, the difference between the

inflation rate and the inflation target, rather than inflation alone. However, the countries adopted the inflation targeting framework amidst high inflation, with a view to stabilizing inflation expectations and bringing inflation down. Initially, the inflation targets were set for the end of the year and were gradually lowered. As the primary aim of the new monetary policy strategy at the early stages of inflation targeting was to reduce inflation, the downward deviations of inflation from the inflation target were frequently not corrected. Therefore, we would observe no interest rate reduction in response to the negative inflation gap, because the true and ultimate inflation target of the central bank was lower. For this reason we decided to estimate the Taylor rules with the inflation rate rather than the inflation gap.

At the first stage of the study, the Generalized Method of Moments (GMM) is used to deal with the possible endogeneity introduced by the forward-looking variable. Following Sznajderska (2014), we add the ECB's interest rate and the real effective exchange rate (the deviation from the trend), to the set of instruments consisting of lagged explanatory variables (we use two lags of each variable).[3] As explained above, in the case of small open economies these two variables may influence the interest rate setting behaviour of the central banks. The estimations were obtained with the Newey-West covariance estimator, allowing for heteroscedasticity and autocorrelation (HAC weighting matrix). Table 2 presents the results of the estimation.

Table 2. GMM estimates of the monetary policy rules

	Czech Republic	**Hungary**	**Poland**
Const.	-0.01*** (0.001)	-0.01* (0.004)	-0.01*** (0.003)
Interest rate(-1)	0.83*** (0.03)	0.77*** (0.10)	0.71*** (0.06)
Inflation	0.35*** (0.08)	0.58** (0.23)	0.96*** (0.21)
Output gap	0.01 (0.02)	0.26*** (0.04)	-0.11 (0.10)
Debt (first diff.)	-0.04*** (0.01)	0.07* (0.03)	-0.07** (0.03)
R^2	0.99	0.92	0.99
Prob(J-stat)	0.28	0.76	0.10

Note: Standard errors in parenthesis; *, **, and *** denote statistical significances at the 10%, 5% and 1% level, respectively; Prob(J-stat) denotes the p-value of the Sargan test for over-identification.

Source: own calculations.

[3] Foreign interest rates enter the Taylor rule for CEE countries, for example in Vašíček (2010) and Arlt and Mangel (2014).

The results show that in all the analyzed countries the estimated smoothing parameter (the coefficient on the lagged interest rate) is rather high, with the highest value for the Czech Republic and the lowest for Poland. All the central banks actively respond to the inflation forecast, yet the strength of the response is also different for different countries: the weight of the inflation forecast in the monetary policy rule is the highest in the case of Narodowy Bank Polski (the National Bank of Poland) and lowest in the case of the Czech National Bank.[4] The only central bank that seems to also actively respond to output fluctuations during the analyzed period is the Magyar Nemzeti Bank (the National Bank of Hungary).

What is interesting from the point of view of this study is the response of the central banks to the growth of debt stock. It seems that all three central banks react to the changes in government debt. However, the central banks differ in the direction of their reactions: in the case of the CNB and NBP the reaction is negative, while in the case of the MNB the reaction is positive. This may reflect the fact that although all the countries witnessed a growing debt ratio, the situation in Hungary was the most difficult. The positive reaction of the central bank to growing debt may reflect the intention of the central bank to demonstrate that it is concerned about economic stabilization and its will to counteract the outflow of capital. Among the three analyzed countries, Hungary has the highest share of public debt denominated in foreign currency. In 2014 it constituted 39.7% of total debt, whereas in Poland and in the Czech Republic it was 35.2% and 14.3%, respectively.[5] Only a year earlier, however, in 2013, the share of debt denominated in foreign currency in total debt was 42.1% in Hungary, 29.7% in Poland, and 19.6% in the Czech Republic, so the differences between Hungary and the two remaining countries were significantly higher.

On the other hand, the negative response of two other central banks may indicate the willingness of the central banks to engage in debt management.

3.2. Results of Markov-switching estimation

In the above estimation of the Taylor rule it is assumed that the Taylor rule is linear and the coefficients are constant. This assumption may be not satisfied in reality. Nonlinearities in Taylor rules may be the result of switches

[4] As a robustness check, we also estimated the Taylor rules with future inflation (two quarters ahead) as the explanatory variable. The qualitative results were very similar, with somewhat lower coefficients on inflation.

[5] The source of data on the share of debt denominated in foreign currency in total debt is Eurostat.

between different regimes of monetary policy, i.e. the central banks' preferences may not be stable over time and may change. In the context of regime switches in monetary policy, the estimation of the threshold models has become common in the literature. This approach was adopted, for example, by Vašíček (2012) in his aforementioned study for the three CEE countries, using the inflation gap, the output gap, and the financial stress index as threshold variables. Bunzel and Enders (2010) find evidence of the threshold effect in the Fed's interest rate setting. Another approach to estimating the regime-switching Taylor rule is the use of the Markov switching model (Hamilton, 1989), which does not require determining the threshold variable and its threshold value. In this model the transition between states occurs according to some unobserved state variable with certain transition probabilities. Hutchison et al. (2013) use the Markov switching Taylor rule to distinguish between "Dove" and "Hawk" regimes in India, which they define as periods when the output gap is the primary concern of monetary policy and periods when inflation is of primary concern. Zheng et al. (2012) estimate the regime switching forward-looking monetary policy rule for China, distinguishing between two regimes: an inflation targeting regime and a regime with the central bank focusing mainly on the output gap. Mackiewicz-Łyziak (2016) estimates the regime switching Taylor rule for the Czech Republic, Hungary and Poland and finds evidence for two monetary policy regimes: passive and active, with the passive regime characterized by a high degree of interest rate smoothing and low responsiveness to inflation and output, while in the active regime the smoothing parameter is lower and the importance of inflation and/or output gap is higher.

In this section we take a similar approach to Hutchison et al. (2013), Zheng et al. (2012) and Mackiewicz-Łyziak (2016) and estimate the Markov-switching Taylor rules for monetary policy in the Czech Republic, Hungary, and Poland. We allow all the coefficients to change between regimes, as we want to assess the overall change in the central banks' reactions to economic conditions. The estimation of the Markov switching model does not require any *a priori* knowledge about the regimes, such as choosing a threshold variable according to which regime changes occur, as in the threshold model. The regimes are estimated directly from the data. The change of regimes occurs according to some unobservable state variable, which may be interpreted as the state of the economy. The results of the estimations are presented in Table 3.

Table 3. Markov-switching estimates of the monetary policy rules

	Czech Republic		Hungary		Poland	
	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2
Const.	-0.003**	-0.01***	-0.002***	-0.006	0.02***	-0.01***
	(0.002)	(0.002)	(0.0002)	(0.004)	(0.006)	(0.003)
Interest rate(-1)	0.86***	0.76***	0.72***	0.76***	0.49***	0.81***
	(0.07)	(0.03)	(0.004)	(0.08)	(0.06)	(0.05)
Inflation	0.24***	0.45***	0.57***	0.54***	0.72***	0.76***
	(0.04)	(0.08)	(0.008)	(0.19)	(0.13)	(0.18)
Output gap	0.01	0.12***	0.19***	0.10	1.12***	-0.05
	(0.02)	(0.03)	(0.002)	(0.07)	(0.14)	(0.07)
Debt (first diff.)	-0.04***	0.02	0.02***	0.05	-0.05	-0.04**
	(0.01)	(0.02)	(0.0006)	(0.04)	(0.07)	(0.02)
Log(sigma)	-6.88***	-6.54***	-8.95***	-4.78***	-5.45***	-6.02
	(0.18)	(0.21)	(0.33)	(0.15)	(0.19)	(0.13)
$\mathbf{P_{11}}$	0.73		0.21		0.85	
$\mathbf{P_{22}}$	0.61		0.83		0.94	
Exp. dur.	3.8	2.6	1.3	5.8	6.6	16.6
AIC	-9.51		-6.98		-8.06	
Schwarz c.	-9.01		-6.50		-7.58	

Note: Standard errors in parenthesis; *, **, and *** denote statistical significances at the 10%, 5% and 1% level, respectively; exp. dur. denotes expected duration of a given regime.

Source: Own calculations.

Following Mackiewicz-Łyziak (2016) we interpret the results as indicating the existence of active and passive monetary policy regimes. Generally, the active regime is characterized by stronger reactions of the central banks to inflation and/or the output gap and a lower smoothing parameter.[6] In the Czech Republic, in the active regime the central bank responds stronger to inflation and starts paying attention to the output gap, although the weight attached to the output gap is lower than the weight of inflation. In the passive regime output gap developments are not statistically significant. In Hungary a similar behaviour may be observed: in the passive regime the central bank reacts only to inflation developments and in the active regime the reaction to inflation is slightly stronger and the central bank starts responding also to the output gap developments. The weight of inflation is also higher than the weight of the output gap. In Poland the change of the smoothing parameter between the regimes is the largest among all the analyzed countries. The change in the central bank's behaviour between regimes is also a little different than in the other countries, namely in the active regime the output gap developments become statistically significant, similarly as in the Czech Republic and Hungary, but the weight put by the NBP to the output gap is very

[6] It should be noted, however, that in the case of Hungary, the difference in the smoothing parameter between the regimes is not statistically significant, as indicated by the Wald test.

high and exceeds the weight of inflation, which, in turn, is slightly lower than in the passive regime (although the difference between the coefficients on inflation in the two regimes is not statistically significant).

It should be noted that in all three countries inflation is always a significant variable in the monetary policy rule, regardless of the regime, and the output gap is significant in the active regime, and insignificant in the passive regime. In all these countries the passive regime seems to be the dominant one, as suggested by the estimated probabilities and the expected durations (see the Appendix for figures of the estimated regime probabilities). In the Czech Republic and Hungary they followed one another during the entire sample period, with the active regime lasting longer in the Czech Republic than in Hungary. In Poland the active regime dominated in the first half of the sample period, while in the second half only the passive regime occurred.

The main difference between the countries is in the central banks' responses to government debt. The estimation of the Markov-switching rules confirm our previous findings based on the GMM estimation in this respect. In Hungary the central bank responded to growing public debt by increasing the interest rate, while in the Czech Republic and Poland the opposite reaction was observed. These results are consistent with the findings of Vašíček (2012). This is not surprising, since fiscal sustainability and financial stability – expressed in Vašíček (2012) as the financial stress index – are strictly related. Moreover, in the Czech Republic and Poland the reaction to the changes in the government debt was statistically significant only in the passive regime, and in Hungary in the active regime. Therefore we may conclude that the CNB and the NBP react to government debt in the standard situation (passive regime), trying to lower the debt burden by cutting interest rates.

4. Conclusions

Goodhart (2012) presumes that an era of independent and separately conducted monetary and fiscal policy is coming to an end. Such arrangements in economic policy were only possible when public finances were under control. Since government deficits and debts have become a problem, central banks will have to engage in debt management to ensure fiscal and financial stability.

In this study we added the fiscal variable – change in the government debt – to the standard set of variables explaining the interest rate setting behaviour of the central banks. The are several reasons why the central banks may want to react to the government debt. On one hand, the central bank may want to counteract the

loose fiscal policy and its consequences for the economy and tighten monetary conditions. It may also try to prevent instability in the financial markets in the face of growing fiscal imbalances. On the other hand, debt service costs increase along with rising interest rates, so a tight monetary policy would increase the burden of the debt. The central bank may be inclined to cooperate with the government and to ease its monetary policy when the public debt is high. The picture is further complicated when a large share of debt is denominated in foreign currency. In such a case the impact of the public debt on interest rate setting is ambiguous.

Indeed, our results suggest that the relationship between central banks' interest rates and the growth of government debt may be both positive as well as negative. All the three analyzed central banks: the CNB, the NBP and the MNB, responded to growing debt, but in the case of the Hungarian central bank the response was positive, while in the case of the other two central banks it was negative. The same conclusions were obtained using the GMM method as well as the Markov-switching estimation. These results are consistent with the findings of Vašíček (2012), who showed similar reactions of these central banks to the financial stress indicator. It seems that in the face of growing imbalances, the MNB reacts by tightening the monetary conditions, while the CNB and the NBP do the opposite.

The rest of our findings are as follows. The central banks seem to switch between two monetary policy regimes – an active and a passive one – with the passive regime being dominant. The passive regime is characterized by higher degree of interest rate smoothing, weaker response to the expected inflation and no statistically significant reaction to the output gap. The higher relative weight of expected inflation than that of the output gap is confirmed by the GMM estimation of the linear Taylor rule. In the active regime, the weight of the expected inflation increases (with the exception of Poland) and the output gap becomes statistically significant.

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Appendix

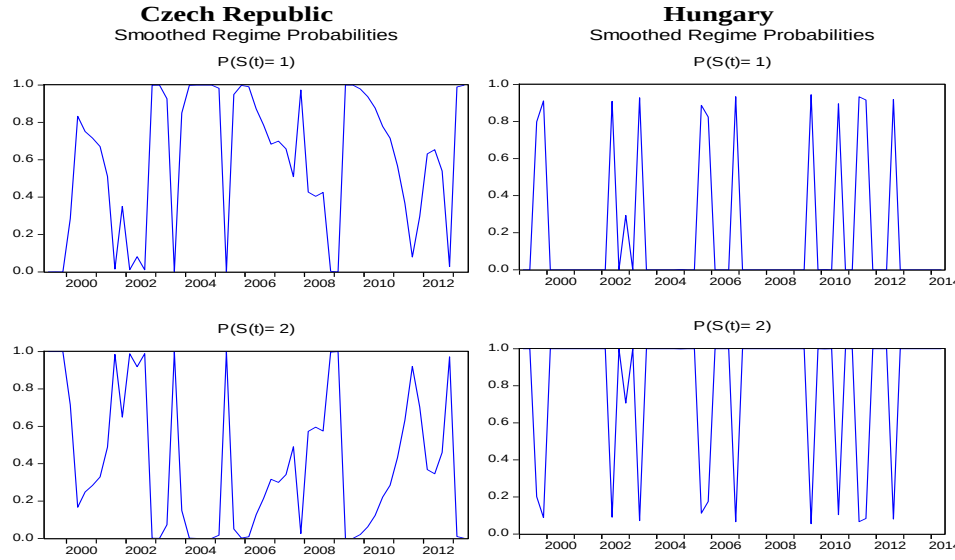
Table A.1. Augmented Dickey-Fuller and Phillips-Perron unit root tests for the government debt-to-GDP ratio and the first difference of the debt-to-GDP ratio

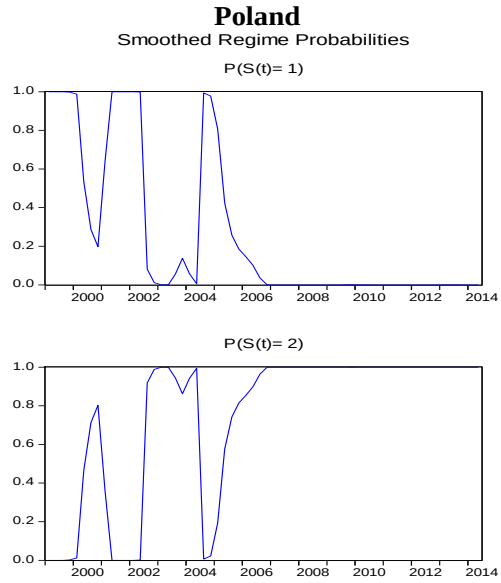
	Czech Republic	Hungary	Poland
		Debt-to-GDP ratio	
ADF	-1.10	-0.45	-1.18
PP	-0.84	-0.31	-1.23
		First difference of debt-to-GDP ratio	
ADF	-3.58***	-8.73***	-7.01***
PP	-8.54***	-8.77***	-7.02***

Note: Test equations with intercept. *** denotes rejection of the null of a unit root on 1% level.

Source: Own calculations.

Figure A.1. Smoothed probabilities of the regimes





Source: Own calculations.

Streszczenie

CZY BANKI CENTRALNE W KRAJACH EUROPY ŚRODKOWEJ REAGUJĄ NA DŁUG PUBLICZNY?

Celem badania jest analiza reguł polityki pieniężnej w Czechach, Polsce i na Węgrzech, z długiem jako dodatkową zmienną objaśniającą. Estymowana jest liniowa reguła przy użyciu Uogólnionej Metody Momentów oraz reguła nieliniowa przy użyciu modelu przełącznikowego Markova. Wyniki badania sugerują, że w Czechach i Polsce władze monetarne reagowały na rosnący dług obniżaniem stóp procentowych, podczas gdy na Węgrzech reakcja była odwrotna. Ponadto, wyróżniamy pasywny i aktywny reżim polityki pieniężnej, przy czym reżim aktywny charakteryzuje się niższym stopniem wygładzania stóp procentowych i silniejszą reakcją banku centralnego na inflację i/lub lukę produktową. W reżimie pasywnym luka produktowa okazuje się być statystycznie nieistotna.

***Słowa kluczowe**: polityka pieniężna, dług publiczny, reguła Taylora, zmiana reżimu*