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THE NEXUS BETWEEN INFLATION RATE AND ECONOMIC GROWTH OF POLISH PROVINCES AFTER EU ACCESSION

Summary: This paper is one of the first contributions which examine the nexus between inflation rate and economic growth of Poland after EU accession based on the regional data. The results prove that in the period 2004-2010 the causal link between inflation rate and economic growth among Polish regions was of a nonlinear nature. The empirical analysis confirmed the existence of two statistically significant inflation threshold levels related to contemporaneous as well as one-year-lagged causal effects.

Keywords: Inflation rate, economic growth, threshold point, structural break, Polish regional data.

Introduction

The effect of inflation on the rate of economic development and growth has become one of the central points of research in both theoretical and empirical aspects. This complex problem is still an issue that needs to be resolved, especially in case of transition economies which have gained less attention from the researchers so far. The link between output growth and inflation has not yet been well defined, although there are many contributions which are concerned with this relationship.

A common assumption in macroeconomic theory holds that low inflation is a necessary condition for economic growth. However, the discussion about the relationship between inflation and economic growth is still not finished. Different schools of economic thought supplied different results of research on this

relationship. The representatives of so-called *structuralists,* who trace the origins of their approach to Kalecki's "Problems of Financing Economic Development in a Mixed Economy", claim that inflation is essential for economic growth [Kalecki, 1970]. Some theoretical studies suggest that inflation supports long-run growth by raising capital accumulation [Mundell, 1963]. Tobin [1965] introduced money into the Solow-Swan model as an asset alternative to capital. He stressed that inflation increases the opportunity cost of holding money. Therefore, it favours capital accumulation and in consequence supports economic growth. Some authors indicate that money expansion speeds up inflation and accelerates growth in the long run by lowering the marginal product of capital, tax credits or the saving rate [Stockman, 1981; Cooley and Hansen, 1989; Haslag, 1995; Jones and Manuelli, 1995]. In contrast, the *monetarists* see inflation as a harmful factor for economic growth [Mallik and Chowdhury, 2001].

In endogenous growth models, the effects of inflation are derived in the works of Gomme [1993] and Jones and Manuelli [1995] among others. The contributors noticed that when money is introduced in the budget constraint in a model of human capital accumulation, a rise in the rate of inflation negatively affects both consumption and supply of labour. De Gregorio [1993] argued that inflation may have essential effects also on the accumulation of physical capital[1]. Besides theoretical deliberations, also most of previous empirical contributions supported the view that there exists a negative relationship between inflation and economic growth [Barro, 1991; Fischer and Modigliani, 1978; Bullard and Keating, 1995].

If the view that inflation has negative impact on economic activity and growth holds true, then policy-makers should try to hold a low rate of inflation. At this place an important question arises: What is the desired level of inflation rate in the context of maximizing economic growth? The answer to this question is not straightforward as it depends on the time period considered but also on the nature and structure of a specific economy. The nonlinearity in the relationship between inflation and economic growth is a subject of research conducted in more recent contributions. It can be concluded that at lower rates of inflation, the relationship is insignificant or positive. However, at higher levels, inflation has an essential negative impact on economic growth. Under the assumption that a nonlinear relationship between inflation and economic growth is given, the key issue is to determine the *threshold level*, i.e. the structural break point at which the sign of the relationship between the two variables switches. In order to estab-

[1] He assumed that money is one of the means of reducing transaction costs both for households and firms. Thus, a higher inflation rate forces agents to reduce their money holdings. The result causes a rise in the transaction costs and a negative impact on investment and growth.

lish the threshold level one may either define *a priori* the thresholds for different levels of inflation rate in *ad hoc* manners [Fischer, 1993; Barro, 1996; Bruno and Easterly, 1998] or apply a spline regression in order to estimate the threshold rate of inflation directly from the available data [Ghosh and Phillips, 1998; Sarel, 1996]. According to Friedman [1997], one of the most famous monetarists, an increase in inflation may imply inflation uncertainty. The latter is a possible source of the ineffective price mechanisms which in turn lead to many economic problems and lower the rate of economic growth[2]. Cukierman and Meltzer [1986] stressed that more inflation uncertainty results in rise of inflation due to the policy of monetary authorities. In contrast, Holland [1995] argues that when inflation rises and leads to uncertainty, the rate of money supply growth will soon be reduced by the central bank. This would cut down inflation rate and diminish the negative growth effects of inflation uncertainty.

To summarize, the impact of inflation on economic growth is still one of the most important topics in economics. However, the scientific discussion has not led to consistent results so far. In addition, to the best of our knowledge the inflation-growth link among Polish provinces has never been examined so far. Both these facts are the main sources of the motivation to conduct this empirical study.

1. Literature overview

The content of this section is mostly concerned with the recent empirical results on the link between inflation and economic growth. In general, most of previous empirical contributions showed that economic growth is essentially affected by inflation and the sign of this impact is negative. The channels through which inflation could have an impact on growth are those of savings [Gylfason, 1999; Fry, 1994], the structure of the tax system, such as depreciation allowances [Feldstein, 1983], the effect of the tax system on investments [De Long and Summers, 1991], the distortions the tax system infers on the allocation of capital [Auerbach, 1989; Cohen, Hassett and Hubbard, 1997], the effect of inflation on the activity of financial markets [Boyd, Levine and Smith, 1995; Huybens and Smith, 1999], the impact of inflation on macroeconomic volatility (expressed through the volatility in interest and exchange rates [Ferderer, 1993; Cukierman et al., 1993; Gylfason, 1999] and the indirect impact imposed through the distribution of human capital [De Gregorio, 1993; Heymann and Leijonhufvud, 1995]).

[2] The allocation of resources depends on the inflation uncertainty due to its impact on interest rates. Thus, in order to examine the real effects of inflation one should take into account the link between inflation uncertainty and output. A positive causal effect of inflation uncertainty on inflation may give a rise to the positive correlation between inflation and inflation uncertainty.

Wang [1996] used annual data from the period 1978-1993 to examine the relation between inflation and economic growth in China. He demonstrated that inflation in year t had an insignificant contemporaneous impact on economic growth, however, it had a significant negative impact on growth in year t+1.

In contrast, Liu and Xie [2003] and Liu and Zhang [2004] examined short-run inflation-growth relations and found that inflation supported economic growth in China. Similarly, Chen [2007] applied the generalized autoregressive conditional heteroskedasticity in mean model and showed that inflation supported economic growth in China in the period 1952-2004.

One can easily see that previous empirical research has not formulated sharp conclusions on inflation-growth links. From a historical perspective, one can notice that before the two oil shocks in 1973 and 1979, many researchers believed that the inflation-growth relationship was either positive or insignificant. However after the stagflation of the 1970s, this idea was challenged by new macroeconomic data. Economists have found that inflation harms growth [Barro, 1991; Kim and Willett, 2000; Apergis, 2005]. On the basis of some developments in the field of theoretical economics which took place in the 1990s, some contributors have found empirical evidence supporting the point of view that low inflation might enhance employment and economic growth [Fischer, 1993; Sarel, 1996; Khan and Senhadji, 2001; Pollin and Zhu, 2006]. Furthermore, since the inflation-growth relationship is one of the most important links for the central bank in every country, some economists have estimated the inflation turning points for single countries [Singh and Kalirajan, 2003; Sweidan, 2004; Mubarik, 2005].

Fischer [1993] argued that growth is mainly affected through the uncertainty channel. This impact is a result of uncertainty associated either with inflation or instability of the budget and the current account. Both of them distort the price mechanism or influence the effects of an uncertain macroeconomic framework on investment. Friedman [1997] stressed the importance of the assumption that a higher variability of inflation is usually accompanied by higher average rates of inflation[3]. He also argued that firms and workers waste productive resources in order to deal with inflation [Fischer and Modigliani, 1978]. Therefore, inflation uncertainty is likely to reduce the allocative efficiency of the price system. This, in turn, can contribute again to relative price variability (this effect is known in economic literature as so-called *Lucas's signal extraction hypothesis*). This leads to a lower ability of an economy to grow [Smyth, 1994]. The uncertainty linked with high inflation reduces the level of productivity and consequently harms economic growth [Fisher, 1993].

[3] In addition, Friedman stressed that increased inflation uncertainty seems to negatively affect real economic activity and, thus, economic growth (this relationship is well known in the literature as *the Friedman hypothesis*).

By the means of the exponential general autoregressive conditional heteroskedastic model, Narayan, Narayan and Smyth [2009] established empirically that rise in inflation uncertainty lowers average inflation. Moreover, they proved that inflation volatility harms economic growth.

Some recent results on the link between uncertainty, inflation and economic growth are presented in Ozdemir's paper [Ozdemir, 2010]. The author stressed the importance of research on causal relationships between inflation, output growth, and real and nominal uncertainty. Kong [2007] found evidence supporting the impact of inflation threshold on growth using bootstrap approach in two different scenarios. He claimed that the effects of inflation on growth are uniformly negative (or uniformly positive) when using the 3.9 per cent (or 6.5 per cent) inflation threshold level. He could not confirm that high inflation lowered China's economic growth and moderate inflation enhanced it.

Mubarik [2005] estimated the threshold level of inflation for Pakistan. He applied a dataset covering the period 1973-2000. He found that the inflation rate beyond 9 per cent is harmful for the economic growth of Pakistan. However, Hussain [2005] could not detect any threshold level of inflation for Pakistan in the period 1973-2005.

Lee and Wong [2005] calculated the threshold levels of inflation for Taiwan and Japan using quarterly data from the period 1965-2002 for Taiwan and the period 1970-2001 for Japan. The contributors stressed that the inflation rate beyond 7.25 per cent is harmful for the economic growth of Taiwan. They also managed to establish two threshold levels for Japan (equal to 2.52 per cent and 9.66 per cent). An extensive discussion on the relationship between inflation and growth is given in other recent contributions [Apergis, 2005; Munir, Mansur and Furuoka, 2009; Hwang and Wu, 2011].

2. The dataset and methodology

In this paper we used a dataset consisting of a panel of annual observations for all sixteen Polish provinces in the period 2003-2010[4]. Table 1 provides details on all the variables.

[4] Although we start our deliberations focusing on the period 2003-2010, in further steps we consider first-order differenced data, i.e. we focus solely on the post-EU-accession period.

Table 1. Brief description of the data used in this paper

Full name of the variable	Abbreviation used	Definition	Unit
Real gross domestic product in province *i* in year *t*	$Y_{i,t}$	Gross domestic product at constant 2003 prices	PLN
Real gross fixed capital formation in province *i* in year *t*	$K_{i,t}$	Gross fixed capital formation at constant 2003 prices	PLN
Total labour force in province *i* in year *t*	$L_{i,t}$	Number of employed	-
Human capital in province *i* in year *t*	$H_{i,t}$	The level of human capital was approximated by a sum of real (at constant 2003 prices) expenditures on R&D, healthcare and education	PLN
Inflation rate in province *i* in year *t*	$\pi_{i,t}$	Price index of consumer goods and services in province *i* in year *t* (price index of previous year = 100)	-

Source: The Central Statistical Office of Poland (Local Data Bank and Statistical Yearbooks of the Regions).

In order to examine the possible threshold effect of inflation on economic growth we refer to Fischer [1993] and use a growth accounting equation as the basis of our model. In the first step we examine standard Cobb-Douglas production function:

$$Y_{i,t} = F(A_{i,t}, K_{i,t}, L_{i,t}) = A_{i,t} K_{i,t}^{\alpha} L_{i,t}^{\beta}, \tag{1}$$

where $A_{i,t}$ is the level of technology in *i*-th province in year *t* and remaining symbols were described in Table 1. After differentiating (1) with respect to time, we get the conventional growth accounting equation:

$$\dot{Y}_{i,t} / Y_{i,t} = \dot{A}_{i,t} / A_{i,t} + \alpha\left(\dot{K}_{i,t} / K_{i,t}\right) + \beta\left(\dot{L}_{i,t} / L_{i,t}\right), \tag{2}$$

which can be rewritten in the following linear-approximated form:

$$\Delta \ln Y_{i,t} = \Delta \ln A_{i,t} + \alpha \Delta \ln K_{i,t} + \beta \Delta \ln L_{i,t}. \tag{3}$$

Fig. 1 contains the plots of measures of economic growth ($\Delta Y_{i,t}$) and inflation rate ($\pi_{i,t}$), i.e. the pair of variables for which the analysis of causal links will be conducted in this study.

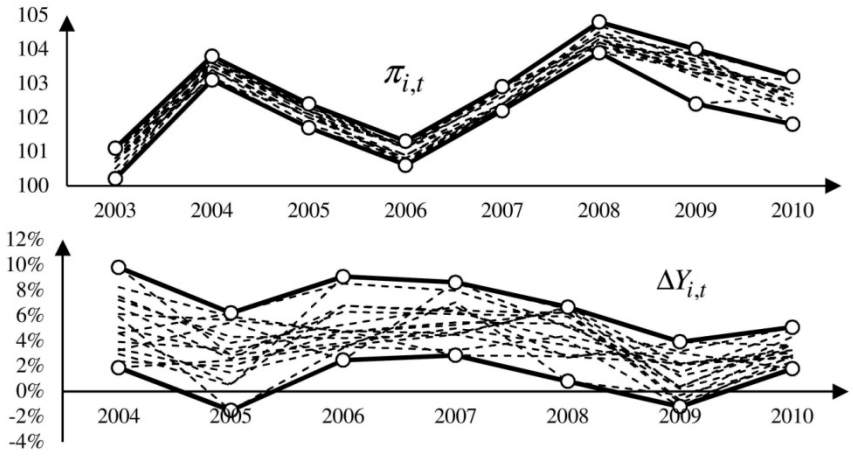

Fig. 1. Inflation rate (previous year =100) and economic growth in Polish provinces in period 2004-2010 (growth) and 2003-2010 (inflation)[a)]

[a)] In order to keep the plots as readable as possible we did not name the plots of $\Delta Y_{i,t}$ and $\pi_{i,t}$ for all possible choices of *i*. The solid lines, which correspond to maximal and minimal values of both variables among Polish provinces, provide useful information about the rate of inflation and economic growth in the whole group of the voivodeships. However, in order to provide general information on the dynamics of the examined variables, the dotted lines were also used to mark the values of $\Delta Y_{i,t}$ and $\pi_{i,t}$ for $i = 1, \ldots, 16$.

Source: The Central Statistical Office of Poland (Local Data Bank and Statistical Yearbooks of the Regions).

Plots presented in Fig. 1 provide some important suggestions. First, inflation rate could have caused not only the contemporaneous but also the one-period-lagged impact on economic growth. Second, it seems likely that in the period 2004-2010 the inflation threshold effect could take place. The latter may be taken into account in the growth model via the dummy variable which equals one when the inflation rate is greater or equal to the threshold level, and zero otherwise. If one additionally takes the level of human capital into account the final form of the equation describing the rate of technological progress could be as follows [Edwards, 1998; Dollar and Kraay, 2004; Rao and Vadlamannati, 2011]:

$$\Delta \ln A_{i,t} = \alpha_i + \gamma t + \lambda \Delta \ln H_{i,t} + \sum_{j=0}^{1} D_{\pi}^{j} \pi_{i,t-j} + \sum_{j=0}^{1} \tilde{D}_{\pi}^{j} \left(\pi_{i,t-j} - \pi^{*} \right), \tag{4}$$

where π^{*} denotes the inflation threshold level, $\tilde{D}_{\pi}^{j}$ stands for a dummy variable which is equal to one if $\pi_{i,t-j} - \pi^{*}$ is positive and zero otherwise.

3. Empirical results

In the first step we performed unit root test to verify whether all continuous variables considered in models (3) and (4) are stationary. The results confirmed that the variables are I(0), thus no panel-cointegration methods are required during the estimation[5]. In the next step we run a stepwise procedure to find the threshold level. We examined a set of trial points defined as $\pi_p^* = 100 + p \cdot 0.05$ for $0 \le p \le 100$. For each choice of π_p^* we estimated (via fixed effects) model (3) using equation (4). After each estimation we calculated three different model choice criteria: AIC and HQ information criteria as well as sum of squared errors (ESS). Fig. 2 summarizes the outcomes.

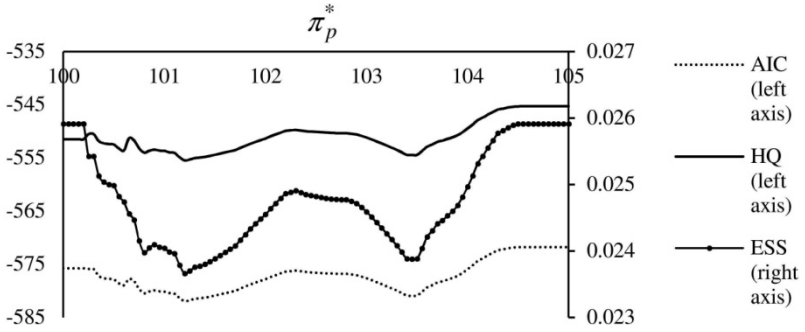

Fig. 2. Plots of the selected model choice criteria against trial inflation threshold levels

Source: Ibid.

As one can see plots presented in Fig. 2 suggest the existence of two threshold levels. Thus, in the next step we focused on models (3) in which the technological progress was described by the following expression:

$$\Delta \ln A_{i,t} = \alpha_i + \gamma t + \lambda \Delta \ln H_{i,t} + \sum_{j=0}^{1} D_\pi^j \pi_{i,t-j} + \sum_{j=0}^{1} \tilde{D}_\pi^j \left(\pi_{i,t-j} - \pi_p^* \right) + \sum_{j=0}^{1} \tilde{\tilde{D}}_\pi^j \left(\pi_{i,t-j} - \pi_r^{**} \right), \quad (5)$$

where π_p^* and π_r^{**} denote two inflation threshold levels, $\tilde{D}_\pi^j$ ($\tilde{\tilde{D}}_\pi^j$) stands for a dummy variable which is equal to one if the expression $\pi_{i,t-j} - \pi_p^*$ ($\pi_{i,t-j} - \pi_r^{**}$)

[5] All tests were performed at 5% significance level. We tested both common (Levin, Lin and Chu, Breitung tests) as well as individual unit root processes (Im-Pesaran-Shin and Fisher tests). For each test we examined solely individual effects as well as individual effects and linear time trends. In case of Levin, Lin and Chu, Breitung and Im-Pesaran-Shin tests autocorrelation was corrected via application of additional lags (SIC criterion was used to choose the optimal lag from the set {1, …,4}), while in case of Fisher test autocorrelation was corrected via application of variance estimators based on Bartlett kernel and bandwidth chosen according to the Newey and West method.

is positive and zero otherwise. Next, for each pair of $\pi_p^* = 100 + p \cdot 0.05$ and $\pi_r^{**} = 100 + r \cdot 0.05$, where $0 \le p < r \le 100$, we estimated (via fixed effects)[6] and analysed models (3) using equation (5). Following table presents the results of establishing π_p^* and π_r^{**} according to AIC, HQ and ESS criteria in the group of $101 \cdot 100 / 2 = 5050$ different variants of model (3).

Table 2. The results of estimating inflation threshold rates in Poland after EU accession

Criteria	π_p^*	π_r^{**}
AIC	101.4	103.4
HQ	101.4	103.4
ESS	101.35	103.45

Despite slight differences, we may assume that $\pi_p^* = 101.4$ and $\pi_r^{**} = 103.4$ as these values were clearly pointed out by two out of the three measures applied. After finding the threshold levels we estimated model (3) assuming that progress of technology may be described by the formula (5) in which $\pi_p^* = 101.4$ and $\pi_r^{**} = 103.4$. Table 3 contains the results[7]. In order to control for heteroscedasticity we used the robust Huber/White/sand-wich VCE estimator [Wooldridge, 2009; Stock and Watson, 2008; Arellano, 2003].

Table 3. The results of estimation of model (3) with two threshold levels assumed

	Fixed effects		Random effects	
Coefficient	Value	*p*-value	Value	*p*-value
D_π^0	0.4	0.602 [0.593]	0.6	0.663 [0.651]
D_π^1	1.8	0.089 [0.093]	1.6	0.101 [0.095]
$\tilde{D}_\pi^0$	-0.7	0.531 [0.592]	-0.9	0.473 [0.452]
$\tilde{D}_\pi^1$	-2.9	0.041 [0.022]	-2.9	0.028 [0.011]
$\tilde{\tilde{D}}_\pi^0$	-0.9	0.093 [0.073]	-0.8	0.122 [0.092]
$\tilde{\tilde{D}}_\pi^1$	1.2	0.192 [0.143]	1.1	0.353 [0.249]

[6] For the sake of comprehensivity we re-estimated all 5050 variants of model (3) using random effects. Since the results turned out to be similar to those obtained via fixed effects we did not decide to present them in a separate table.

[7] In tables 3 and 4 we present the results devoted solely to the inflation-related coefficients as remaining outcomes are less important from the perspective of the main goals of this paper. Moreover, to control for possible impact of heteroscedasticity we also applied robust standard errors (*p*-values in square brackets).

As one can see not all inflation-related coefficients turned out to be statistically significant even at the 10% level. Thus, in the next step we performed the backward stepwise regression procedure described in detail in Gurgul and Lach [2010]. After dropping variables insignificant at 10% level we obtained the final form of the model[8].

Table 4. The results of backward stepwise regression of the model (3) with the two threshold levels

	Fixed effects		Random effects	
Coefficient	Value	*p*-value	Value	*p*-value
D_{π}^{1}	1.65	0.091 [0.093]	1.63	0.094 [0.093]
$\tilde{D}_{\pi}^{1}$	-2.80	0.023 [0.027]	-3.11	0.009 [0.027]
$\tilde{\tilde{D}}_{\pi}^{0}$	-0.8	0.097 [0.087]	-0.7	0.082 [0.095]

As one can see after dropping statistically insignificant variables only three inflation-related coefficients were left in the growth model. The results allow to claim that the strongest effect of inflation on economic growth was observed with one year lag. If the inflation in year t was smaller (greater) than π_p^* its impact on economic growth in year t+1 was positive (negative). When inflation remained low, the lagged impact of inflation on economic growth was positive: every 1-percentage-point increase in the inflation rate stimulated economic growth in next period by around 1.6 per cent. When inflation remained high, the impact on growth was negative: every 1-percentage-point increase lowered growth in next period by around 1.2-1.5 per cent. In addition, the results prove that if inflation exceeded π_r^{**} it caused contemporaneous negative impact on economic growth: every 1-percentage-point increase in the inflation rate lowered economic growth in the same period by around 0.7-0.8%.

Concluding remarks

To the best of our knowledge this paper is one of the first contributions which examine the nexus between inflation rate and economic growth in Polish provinces after EU accession. The results allow to claim that in the period 2004-2010 inflation rate was statistically significant factor which has been imposing contemporaneous as well as one-period-lagged nonlinear causal effects on economic growth.

[8] In each case the order of dropping insignificant variables was the same for the asymptotic and robust variants of calculating the standard errors.

The threshold levels (i.e. the levels above which inflation becomes inimical to growth) were equal to 1.4% and 3.4% for one-year-lagged and contemporaneous effects, respectively. It is important to note, that much stronger effect of inflation on economic growth was observed with one year lag. These findings seem to have a wide range of important policy implications, especially in terms of the inflation targeting. One cannot forget, however, that the post-accession period was a specific time in the history of Polish regions as it was a period of rapid economic growth (2006-2007) but also a period in which the global financial crisis outbroke and started to affect Polish economy. Therefore, further research seems to be required to re-examine and verify the robustness of the empirical outcomes presented in this study.

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References

Apergis N. (2005), *Inflation uncertainty and growth: Evidence from panel data*, "*Australian Economic Papers*", Vol. 44, No. 2, pp. 186-197.

Arellano M. (2003), *Panel Data Econometrics*, Oxford University Press, Oxford.

Auerbach A.J. (1989), *The Deadweight Loss from 'Non-Neutral' Capital Income Taxation*, "Journal of Public Economics", Vol. 40, pp. 1-36.

Barro R.J. (1991), *Economic Growth in a Cross Section of Countries*, "Quarterly Journal of Economics", Vol. 106, pp. 407-444.

Barro R.J. (1996), *Inflation and Growth*, "Federal Reserve Bank of St. Louis Review", Vol. 78, pp. 153-169.

Boyd J.H., Levine R., Smith B.D. (1995), *Inflation and Financial Market Performance*, Federal Reserve Bank of Minneapolis, Minneapolis.

Bruno M., Easterly W. (1998), *Inflation Crises and Long-Run Growth*, "Journal of Monetary Economics", Vol. 41, pp. 3-26.

Bullard J., Keating J.W. (1995), *The long-run relationship between inflation and output in postwar economies*, "Journal of Monetary Economics", Vol. 36(3), pp. 477-496.

Chen T. (2007), *Uncertainty, inflation and output growth in China*, "Economic Theory and Business Management", Vol. 27, No. 12, pp. 23-29.

Cohen D., Hassett K.A., Hubbard R.G. (1997), *Inflation and the User Cost of Capital: Does Inflation Still Matter?*, "NBER Working Papers", No. 6046.

Cooley T.F., Hansen G.D. (1989), *The inflation tax in a real business cycle model*, "American Economic Review", Vol. 79, No. 4, pp. 733-748.

Cukierman A., Meltzer A.H. (1986), *A Theory of Ambiguity, Credibility, and Inflation under Discretion and Asymmetric Information*, "Econometrica", Vol. 54(5), pp. 1099-1128.

Cukierman A., Kalaitzidakis P., Summers L.H., Webb S.B. (1993), *Central bank independence, growth, investment, and real rates*, "Carnegie-Rochester Conference Series on Public Policy", Vol. 39(1), pp. 95-140.

De Gregorio J. (1993), *Inflation Taxation and Long-Run Growth*, "Journal of Monetary Economics", Vol. 31, pp. 271-298.

De Long B.J., Summers L.H. (1991), *Equipment Investment and Economic Growth*, "Quarterly Journal of Economics", Vol. 106, pp. 445-502.

Dollar D., Kraay A. (2004), *Trade, growth and poverty*, "Economic Journal", Vol. 114, F22-F49.

Edwards S. (1998), *Openness, productivity and growth: what do we really know?* "Economic Journal", Vol. 108, pp. 383-398.

Feldstein M. (1983), *Inflation, Tax Rules and Capital Formation*, University of Chicago, Chicago.

Ferderer P. (1993), *The Impact of Uncertainty on Aggregate Investment Spending: An Empirical Analysis*, "Journal of Money Credit and Banking", Vol. 25, pp. 30-48.

Fischer S., Modigliani F. (1978), *Towards and Understanding of the Real Effects and Costs of Inflation*, "Weltwirtschaftliches Archiv", pp. 810-832.

Fischer S. (1993), *The Role of Macroeconomic Factors in Growth*, "Journal of Monetary Economics", Vol. 32, pp. 485-512.

Friedman M. (1977), *Nobel Lecture: Inflation and Unemployment*, "Journal of Political Economy", Vol. 85, pp. 451-472.

Fry M. (1994), *Money, Interest and Banking in Economic Development*, second edition, John Hopkins University Press. Baltimore.

Ghosh A., Phillips S. (1998), *Warning: Inflation may be harmful to your growth*, "IMF Staff Papers", Vol. 45, No. 4, pp. 672-710.

Gomme P. (1993), *Money and growth revisited: Measuring the costs of inflation in an endogenous growth model*, "Journal of Monetary Economics", Vol. 32(1), pp. 51-77.

Gurgul H., Lach Ł. (2010), *The causal link between Polish stock market and key macroeconomic aggregates*, "Betriebswirtschaftliche Forschung und Praxis", Vol. 4, pp. 367-383.

Gylfason T. (1999), *Output Gains from Economic Stabilization*, "Journal of Development Economics", Vol. 56, pp. 81-96.

Haslag J.H. (1995), *Monetary policy, banking, and growth*, "Economic Inquiry", Vol. 36, No. 3, pp. 489-500.

Heymann D., Leijonhufvud A. (1995), *High Inflation*, Clarendon Press, Oxford.

Holland S. (1995), *Inflation and uncertainty: tests for temporal ordering*, "Journal of Money, Credit, and Banking", Vol. 27(3), pp. 827-837.

Hussain M. (2005), *Inflation and Growth: Estimation of Threshold Point for Pakistan*, "Pakistan Business Review", Vol. 17(3), pp. 1-15.

Huybens E., Smith B.D. (1999), *Inflation, Financial Markets and Long-Run Real Activity*, "Journal of Monetary Economics", Vol. 43, pp. 283-315.

Hwang T., Wu J. (2011), *Inflation and Economic Growth in China: An Empirical Analysis*, "China and World Economy", Vol. 19, No. 5, pp. 67-84.

Jones L.E., Manuelli R.E. (1995), *Growth and the effects of inflation*, "Journal of Economic Dynamics and Control", Vol. 19, No. 8, pp. 1405-28.

Kalecki M. (1970), *Problems of Financing Economic Development in a Mixed Economy* [in:] W.A. Eltis, M.F.G. Scottand J.N. Wolfe (eds.) *Induction, Growth and Trade: Essays in Honour of Sir Roy Harrod*, Oxford University Press, Oxford.

Khan M.S., Senhadji A.S. (2001), *Threshold effects in the relationship between inflation and growth*, "IMF Staff Papers", Vol. 48, No. 1, pp. 1-21.

Kim S., Willett T.D. (2000), *Is the Negative Correlation between Inflation and Growth Real? An Analysis of the Effects of the Oil Supply Shocks*, "Applied Economics Letters", Vol. 7, Iss. 3, pp. 141-147.

Kong D. (2007), *Does inflation restrain the financial development and economic growth?* "IMF Staff Papers", Vol. 48, No. 1, pp. 1-21.

Lee C., Wong S.Y. (2005), *Inflationary threshold effects in the relationship between financial development and economic growth: evidence from Taiwan and Japan*, "Journal of Economic Development", Vol. 30(1), pp. 49-68.

Liu J., Xie W.D. (2003), *Dynamic relationship between economic growth and inflation*, "The Journal of World Economy", Vol. 26, No. 6, pp. 48-57.

Liu J., Zhang H. (2004), *Positive testing for the Tobin effect or anti Tobin effect in China's economy*, "Management World", Vol. 20, No. 5, pp. 18-24.

Mallik G., Chowdhury A. (2001), *Inflation and Economic Growth: Evidence from Four South Asian Countries*, "Asia-Pacific Development Journal", Vol. 8(1), pp. 123-135.

Mubarik Y.A. (2005), *Inflation and growth: An estimate of the threshold level of inflation in Pakistan*, "State Bank of Pakistan Research Bulletin", Vol. 1, No. 1, pp. 35-44.

Mundell R. (1963), *Inflation and real interest*, "Journal of Political Economy", Vol. 71, No. 3, pp. 280-283.

Munir Q., Mansur K., Furuoka F. (2009), *Inflation and Economic Growth in Malaysia: A Threshold Regression Approach*, "ASEAN Economic Bulletin", Vol. 26(2), pp. 180-193.

Narayan P.K., Narayan S., Smyth, R. (2009), *Understanding the inflation-output nexus for China*, "China Economic Review", Vol. 20, No. 1, pp. 82-90.

Ozdemir Z.A. (2010), *Dynamics Of Inflation, Output Growth And Their Uncertainty In The UK: An Empirical Analysis*, "Manchester School", Vol. 78(6), pp. 511-537.

Pollin R., Zhu A. (2006), *Inflation and economic growth: A cross-country nonlinear analysis*, "Journal of Post Keynesian Economics", Vol. 28, No. 4, pp. 593-614.

Rao B.B., Vadlamannati K.C. (2011), *Globalization and growth in the low income African countries with the extreme bounds analysis*, "Economic Modelling", Vol. 28(3), pp. 795-805.

Sarel M. (1996), *Nonlinear effects of inflation on economic growth*, "IMF Staff Papers", Vol. 43, No. 1, pp. 199-215.

Singh K., Kalirajan K. (2003), *The inflation-growth nexus in India: An empirical analysis*, "Journal of Policy Modeling", Vol. 25, No. 4, pp. 377-396.

Smyth D.J. (1994), *Inflation and Growth*, "Journal of Macroeconomics", Vol. 16, pp. 261-270.

Stock J.H., Watson M.W. (2008), *Heteroskedasticity-robust standard errors for fixed effects panel data regression*, "Econometrica", Vol. 76, pp. 155-174.

Stockman A.C. (1981), *Anticipated inflation and the capital stock in a cash-in-advance economy*, "Journal of Monetary Economics", Vol. 8, No. 3, pp. 387-393.

Sweidan O.D. (2004), *Does inflation harm economic growth in Jordan? An empirical analysis for the period 1970-2000*, "International Journal of Econometrics and Quantitative Studies", Vol. 1, No. 2, pp. 41-66.

Tobin J. (1965), *Money and Economic Growth*, "Econometrica", Vol. 33, pp. 671-684.

Wang T. (1996), *Economic Analysis of Price Inflation in Mainland China*, Chung-Hua, Taipei.

Wooldridge J.M. (2009), *Introductory Econometrics: A Modern Approach. 4th ed.*, South-Western College Pub, Cincinnati.

ZWIĄZKI POMIĘDZY STOPĄ INFLACJI A WZROSTEM GOSPODARCZYM W POLSKICH WOJEWÓDZTWACH W OKRESIE POAKCESYJNYM

Streszczenie: Artykuł jest jednym z pierwszych opracowań analizujących na poziomie regionalnym związki pomiędzy stopą inflacji a wzrostem gospodarczym w Polsce po wejściu do UE. Wyniki potwierdziły, że w okresie 2004-2010 występował nieliniowy związek przyczynowy pomiędzy stopą inflacji a tempem wzrostu gospodarczego w polskich województwach. Badania potwierdziły występowanie dwóch statystycznie istotnych progowych poziomów inflacji związanych z równoczesnymi i opóźnionymi efektami czasowymi.

Słowa kluczowe: stopa inflacji, wzrost gospodarczy, poziomy progowe, zmiana strukturalna, polskie dane regionalne.