Polityki Europejskie,
Finanse i Marketing
12 (61) 2014

Sylwester Kozak
Szkoła Główna Gospodarstwa Wiejskiego w Warszawie

THE IMPACT OF THE ADDITIONAL CREDIT ON THE ECONOMIC GROWTH AND PERSONAL INCOME. IS IT ALWAYS POSITIVE?

Wpływ dodatkowego kredytu na rozwój gospodarczy i dochody ludności. Czy zawsze jest pozytywny?

Before the financial crisis, most studies indicated a positive impact of the credit growth on economic development. The experience of recent years significantly changed this view. The paper presents results of the analysis on relationship between credit growth and the GDP growth and growth of personal income (GDP per capita) in 2004-2011. The test was based on a panel regression model using data from the World Bank. It shows that the credit growth accelerates economic growth and personal income in countries with a moderate level of income. In case of high income euro countries, especially highly indebted economies credit growth is not favorable for the growth of GDP or GDP per capita, what could be explained by creation of the asset bubble and saturation of the economy with credit. In addition, dynamic of economic growth is mitigated by increasing inflation.
***Keywords**: credit, economic growth, individual incomes.*

Introduction

The bank loan is one of the main instruments for financing the economy. Up to the early 2000s in the literature prevailed the view that loans raise capacity of the economy to develop. According to such rules in periods of economic downturn monetary authorities generally stimulate economic growth through monetary easing and reduction of funding costs, and in the consequence increasing the amount of credit granted. So supply of additional loans usually contributes to the improvement of economic situation[1].

This mechanism, however, began to change in the late 1990s. In an environment of low interest rates, the volume of lending increased sharply. Additionally the structure of loans changed, as banks granted a large portion of them to households, including mortgage loans financing purchase of real estate. Experienced loan growth in the medium term did not always bring an economic growth. On the contrary, in some cases it became the cause of the crisis, including the recent global financial crisis.

At this time it began to be noticed that the mechanism of stimulating the economy with credit no longer have a unitary character throughout the global economy. Greater benefits from the credit recorded in the less developed economies, while highly developed economies felt the saturation of credit and did not use it effectively. The

[1] T. Beck, R. Levine, N. Loayza, Finance and the sources of growth. Journal of Financial Economics, vol. 58, Issues 1-2, 2000, p. 261-300.

impact of credit on the economy became irregular in nature and varied not only in terms of the country`s economic development, but also the type of the sector to which it was delivered.

The purpose of this paper is to analyze the relationship between the growth of bank credit granted to the private sector and the growth of GDP and GDP per capita. Data from the World Bank were used. The analysis was carried out for groups of countries divided by the value of personal income. Additionally two groups of high income countries were introduced: the euro area and the highly indebted euro countries. The study cavers the period 2004-2011 and is based on a panel regression with fixed effects. Estimations were conducted with the statistical program STATA version 11

The results indicate that increase in the growth of bank credit had a positive impact on the growth of GDP and GDP per capita in low and middle income countries (up to 12 746 USD). In the euro area, especially in most indebted (Greece, Spain, Ireland and Portugal) countries the credit growth weakened economic development. This means that the credit in these countries created asset bubble or was spent inefficiently due to over lending. In addition, in all countries the economic growth was weakened by rising inflation.

The remaining part of the paper is structured as follow. The first part presents the literature review, the second the changes in GDP and volume of credit granted in selected regions of the global economy, and the third the results of the research on the relationship between credit growth and economic growth. The whole analysis is summarized in the conclusions.

1. Literature review

Empirical studies on the impact of the banking sector on the economy indicate that the increase of its size could be a source of long-term economic growth[2]. Larger scale of financial intermediation enables more efficient and profitable investment of funds and stimulation technological development of enterprises. However these interactions are not uniform and linear. Additional loans accelerate mainly processing industries that use external financing to improve the technological level of production[3]. In addition, the simulative function of credit is most effectively realized in economies characterized by moderate inflation[4], or possessing rather developed financial sector[5].

[2] V. Bencivenga, B. Smith, Financial intermediation and endogenous growth. The Review of Economic Studies, vol. 58(2), 1991, p. 195-209; J. Grenwood, B. Jovanovich, Financial Development, growth and the distribution of income. Journal of Political Economy, vol. 98(5), 1990, p. 1076-1108.; R.G. King, R. Levine, Finance and growth: Schumpeter might be right. The Quarterly Journal of Economics, vol. 108(3), 1993, p. 717–37.

[3] P. Arestis, P. Demetriades, Financial Development and Economic Growth: Assessing the Evidence. Economic Journal, vol. 107, 1997, p. 83-99; R. Rajan, L. Zingales, Financial dependence and growth. American Economic Review, vol. 88(3), 1998, p. 559–86.

[4] P. Rousseau, P. Wachtel, Inflation thresholds and the finance-growth nexus. Journal of International Money and Finance, vol. 21(6), 2002, p. 777-793.

[5] P. Demetriades, S. Law, Finance, institutions and economic development. International Journal of Finance and Economics, vol. 11(3), 2006, p. 245-260.

The impact of additional funding weakens with the saturation of the economy with credit, when additional funds do not have opportunity to generate higher production[6]. Analyses indicate that the over-developed banking sector may even adversely affect the state of the economy by raising the probability of banking and currency crises, increasing the volatility of asset prices or reducing the effectiveness of the allocation of funds and human capital[7]. In periods of growth in the capital markets financial institutions become weaker monitor credit risk deriving from funded companies and excessively engage in their lending. This action leads to an inefficient allocation of funds and high financial losses what aggravate the development of the whole economy[8].

Research on the optimal size of the banking sector which allows efficiently supply the economy in credit leads to the conclusion that the banking size should depend on, inter alia, the economic potential of the state and conditions of its public finances. It is believed that the value of the credit to the private sector should not exceed 100% of the country GDP. In such conditions, the economy of the country has sufficient potential to absorb losses incurred by banks and designate public funds for the restructuring[9].

It is recognized that the range of 80 to 100% of GDP is the most optimal size of the banks' lending to private sector, although the fastest economic growth can be achieved by lending at the level of 90% of GDP. Too low level of lending does not provide capacity to generate in enterprises improvement of efficiency and economies of scale. In banking system small savings accumulated in banks are not able to finance large economic projects, which provide high profits, reduction of fixed costs and economy of scale[10]. On the other hand the excessively developed banking sector comparing to the size of the economy prevents from the effective use of all loans and thus reduces the overall efficiency of the stimulating function of credit on the economy[11].

Positive evaluation of the size of credit at the level lower than 100% of GDP comes from the need to maintain a balance between banking and real sectors, which mutually compete for resources and human capital. The existing relationship between productivity growth, represented by a value of GDP per 1 employee, and the amount of the loan has the shape of an inverted U, and its maximum falls in the value of the loan equal to 90% of GDP. This means that the reduction of credit by banks weakens the chances of raising the technological level of the economy, while the excess takes away investment capital and human resources from the real sector and weakens their effectiveness[12]. A similar relationship exists between the value of the credit to the private sector and annual GDP

---

[6] J. De Gregorio, P. Guidotti, Financial development and economic growth. World Development, vol. 23(3), 1995, p. 433–448.

[7] P. Rousseau, P. Wachtel, What is Happening to The Impact of Financial Deepening on Economic Growth?. Economic Inquiry, vol. 49, 2011, p. 276–288.

[8] N. Gennaioli, A. Shleifer, R. Vishny, Neglected Risks, Financial Innovation, and Financial Fragility. NBER Working Papers, no. 16068, 2010.

[9] F. Rioja, N. Valev, Does one size fit all? A reexamination of the finance and growth relationship. Journal of Development Economics, vol. 74(2), 2004, p. 429–447; J.L. Arcand, E. Berkes, U. Panizza, Too Much Finance?. International Monetary Fund, IMF Working Papers, nr 161, 2012.

[10] D. Acemoglu, F. Zilibotti, Was Prometheus unbound by chance? Risk, diversification, and growth. Journal of Political Economy, vol. 105 (4), 1997, p. 709 – 751.

[11] J. Grenwood, B. Jovanovich, Financial Development …, op. cit.

[12] S. Cecchetti, E. Kharroubi, Reassessing the Impact of Finance on Growth, Bank for International Settlements. BIS Working Papers, no. 381, 2012.

growth. In this case, it is noted that the economy is most efficiently absorbing bank credit when its total volume is in the range of 80 to 100% of GDP[13].

2. Changes in the volume of credit and the level of economic growth

For most of the twentieth century in developed countries the value of the credit granted to the private sector remained at around 60% of GDP. In the United States larger changes in this relationship resulted mainly from strong increases or decreases in prices in the real estate market. Along with changes in prices also the value of loans changed to finance large transactions in this market in the 1980s, the 1990s and 2000s (Figure 1). A similar situation occurred in Japan, where since the early 1950s the value of the bank loan strongly increased. These changes resulted largely from an increase in prices of residential and commercial property, with a maximum value occurred in the early 1990s, i.e. just before the outbreak of the crisis in the Japanese economy. As a result of the crisis the private sector lost its capacity for timely servicing loans and the ratio of bank credit to GDP suddenly collapsed.
In the European Union the dynamic growth of loans, much more exceeding economic growth began in the early 1980s. This trend experienced a particular acceleration in the second half of the 1990s and in the early 2000s. It happened due to the emergence of the boom in the capital market and real estate market. Important components of the total loans granted by the banks were loans to households. It led to a strong indebtedness significantly exceeding the size of households' disposable income[14].

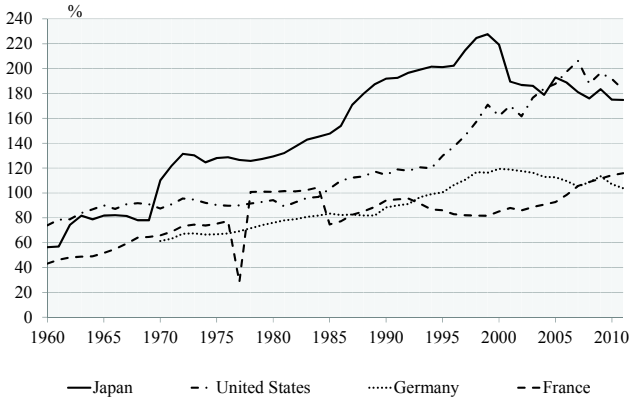

Figure 1.Value of credit as % of GDP in the some countries in 1960-2011
Source: own elaboration based on the data from the World Bank.

However in recent years in different regions changes of the size of lending to non-financial sector do not occur in a uniform manner. The scale of these changes depends on the country economic development and the average size of GDP per capita. In

[13] J.L. Arcand, E. Berkes, U. Panizza, Too Much Finance?, …, op. cit.
[14] S. Kozak, Household debt in the EU-15 and the new EU Member States in 2001-2010. Polityki Europejskie, Finanse i Marketing, Zeszyty Naukowe SGGW w Warszawie, no. 6 (55), 2011, p. 44-56 [in Polish].

countries with high income the ratio of bank credit to GDP was generally much higher than in the other groups of countries (Figure 2)[15]. The highest level of this relationship occurred in the euro zone countries, where GDP per capita is among the highest. Such increase in lending was caused by the relaxation of monetary policy just after starting the Economic and Monetary Union (EMU).

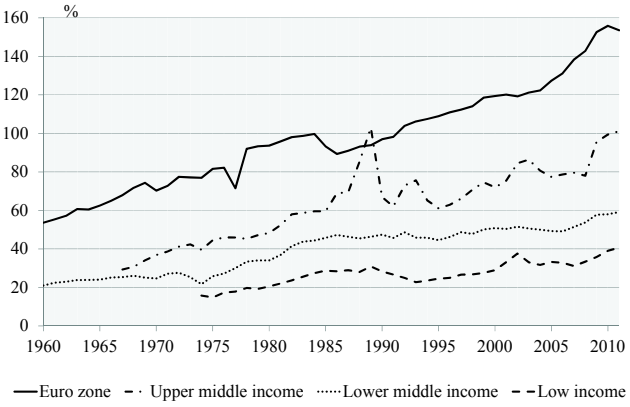

Figure 2. Value of bank credit as % of GDP for regions divided by GDP per capita in 1960-2011
Source: own elaboration based on the data from the World Bank.

In addition, as a result of the extension of high ratings of its largest states, including Germany and France on the entire euro zone, in the peripheral euro countries interest rates on loans fell far below the level that reflects the actual credit risk. In 1999-2007, the ratio of credit to private sector to GDP has increased by tens of percentage points, among others, in Greece from 84% to 114%, in Spain from 112% to 200%, in Portugal, from 94% to 166%, in Ireland from 103% to 195%. To a large extent the monetary policy easing contributed to a sharp increase in the value of loans and then to the economic collapse and financial crisis (Figure 3). The crisis revealed as early as mid-2007, and its consequences led governments of these countries to the solvency limit.
These cases are consistent with the results of Kaminsky and Reinhart[16], who suggest that the rapid growth of short-term lending, particularly to finance real estate market, inevitably leads to a strong decline in GDP.

[15] International Monetary Fund divides countries according to the value of their GDP per capita: high-income economies: more than 12,746 USD (e.g. Australia, Canada, Norway, United States); upper-middle-income economies: more than 4,125 USD but less than 12,746 USD (e.g. Albania, Argentina, Malaysia, Peru); lower-middle-income economies: more than 1,045 USD but less than 4,125 USD (e.g. Armenia, Bolivia, Pakistan, Ukraine), low-income-economies: less than 1,045 USD (e.g. Ethiopia, Kenya, Madagascar, Tajikistan), ; http://data.worldbank.org/about/country-and-lending-groups.
[16] G. Kaminsky, C. Reinhart, The Twin Crises: The Causes of Banking and Balance-of-Payments Problems. American Economic Review, vol. 89, no. 3, 1999, p. 473-500.

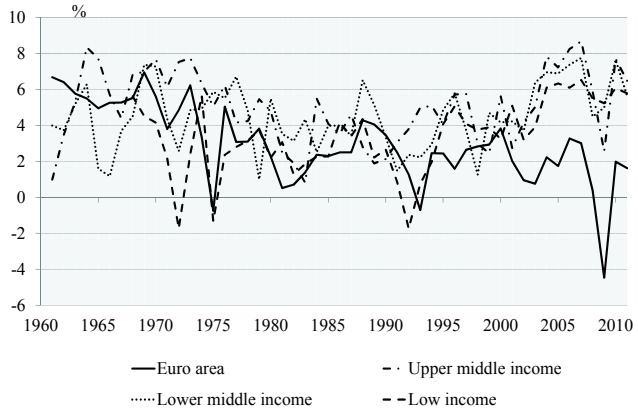

Figure 3. Annual GDP growth in regions divided by GDP per capita in 1960-2011
Source: own elaboration based on the data from the World Bank.

In countries with lower GDP per capita the value of loans remained relatively constant and stable over a longer period. The first increases in loans emerged in the late 1990s in countries with medium-high income, including some countries of Latin America and Central and Eastern Europe. It was related, among others, with the improvement of the economic situation in these regions. In all groups of countries significant improvement of loan growth emerged in the mid-2000s during the period of rising economic prospects in the entire global economy (Figure 3).

Directions of changes in GDP growth were dependent on the economic situation in the most developed countries (Figure 3). However, the magnitude of these changes was, to some extent, dependent on the value of the GDP per capita. GDP growth in countries with medium-high income was the most correlated with changes in the euro zone. Countries with lower personal income since 1960 recorded a generally positive GDP growth, and the changes were much milder than those of the euro area (Figure 3). The crises of the 1980s, the 1990s, and the 2000s characterized not so deep economic slowdown in these countries. This suggests that the less economically developed countries bear much smoothly economic collapses and the financial crises.

Changes in the value of GDP per capita had much milder course. The value of this variable increased steadily since the 1980s, and a noticeable increase in the rate of its growth came in the mid-2000s. In this case, the strongest changes took place in countries with the highest values of GDP per capita. The negative growth appears only in the years 2007-2010 in the euro area. Other economies, in various degrees, followed developments of the euro zone economy. A significant increase of GDP per capita in countries with the highest and middle-income countries appeared after 2005. This increase resulted, among others, from the increase in asset prices which were recorded during this period in the largest global economies.

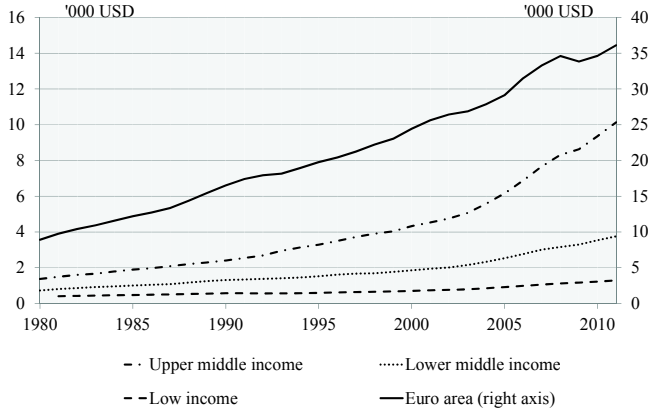

Figure 4. GDP per capita in regions divided by GDP per capita in 1980-2011
Source: own elaboration based on the data from the World Bank.

3. Relationship between bank credit growth and GDP growth

The analysis of the relationship between growth of bank credit and ,both, growth in GDP and growth in GDP per capita was conducted on the basis of data from the World Bank for the years 2004-2011. Annual data for individual countries were used. Due to the shortness of the time series and to enhance the estimation accuracy the test was carried out using a panel regression model:

$$Y = \alpha + \beta * X + \gamma * D + \varepsilon$$

where Y stands for GDP growth, and GDP per capita growth, X stands for lagged bank credit growth, and inflation, D stands for dummy variables, ε is random component, and α, β, γ – coefficients to be estimated. For characterization of the economic growth, annual GDP growth and growth of GDP per capita were used as explained variables. The following explanatory variables were used in the model: the annual growth of bank credit[17], the annual rate of inflation, and dummy variables of: "Low income", "Low-mid income", "Up-mid income", "Euro", "Euro-high-debt", respectively, corresponding to the set of countries: low, medium-low and medium-high GDP per capita and the members of the euro zone and the highly indebted members of the euro zone. Due to the delay between the time of granting a loan and its expected economic effect the variable describing the dynamics of the credit growth was delayed by one year. Descriptive statistics of the variables used in the regression model are contained in Table 1. Ratios of correlations between variables used in the model are presented in (Table 2). The ratios of correlation between explanatory variables are at the low level.

Table 1. Descriptive statistics

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
GDP growth (%)	1350	3,87	5,82	-51,03	106,28
GDP pc growth (%)	1350	2,07	5,64	-50,24	91,67

[17] For the calculation of the growth values of credit denominated in local currencies were used.

Bank credit growth (%)	1350	49,12	83,31	-100,03	5 606,06
Inflation (%)	1350	25,95	345,32	-17,64	2 377,13
Low income	1350	0,14	0,35	0,00	1,00
Low-mid income	1350	0,19	0,39	0,00	1,00
Up-mid income	1350	0,22	0,41	0,00	1,00
Euro	1350	0,07	0,26	0,00	1,00
Euro-high-debt	1350	0,02	0,12	0,00	1,00

Source: own elaboration.

Table 2. Correlation of variables

	GDP growth	GDP pc growth	Bank credit growth (-1)	Inflation	Low income	Low-mid income	Up-mid income	Euro	Euro-high-debt
GDP growth	1								
GDP pc growth	0,97	1							
Bank credit growth (-1)	-0,04	-0,07	1						
Inflation	-0,08	-0,08	0,08	1					
Low income	-0,03	-0,09	0,01	0,02	1				
Low-mid income	0,00	-0,03	0,01	0,00	-0,20	1			
Up-mid income	0,03	0,05	-0,00	0,03	-0,22	-0,26	1		
Euro	-0,03	0,04	-0,02	-0,02	-0,11	-0,13	-0,14	1	
Euro-high-debt	-0,01	0,02	-0,01	-0,01	-0,05	-0,06	-0,07	0,46	1

Source: own elaboration.

The results confirm the hypothesis raised about the diverse impact the bank credit growth on the economic growth and growth of personal income. To capture the economic effects of high and relatively short-term increase in bank loans the study was conducted in two versions. In the first one the group of highly developed countries of euro area countries were included, and in the second the group of most indebted euro area countries.

In case of the GDP growth the regression analysis indicates that although, in general, bank credit growth accelerates the GDP growth, this impact differs between groups of countries divided by the GDP per capita (Table 3). Additional credit most positively impacts the economy in countries with the lowest level of personal income. With raising the level of personal income the positive impact of the additional credit weakens. In case of euro area countries in the period 2004-2011 additional credit had a negative impact on

the GDP growth, and in the group of most indebted countries the impact was the largest. These results harmonized with the results of Kaminsky and Reinhart[18], who proved that in the most developed economies banks heavily compete for profitable opportunities to lend funds and they even supply credit to borrowers with insufficient creditworthiness. Excessive lending leads to creation of asset bubbles and, in some cases, to financial crises.

Additionally, similarly to Rousseau and Wachtel[19] the results indicate that growing inflation has a negative impact on the economic development. An increase of inflation by 10 pp. may reduce GDP growth by 1 pp.

Table 3. Impact of the credit growth on GDP growth in 2004-2011

Explanatory variables	Coefficient	z-statistic	Coefficient	z-statistic
Bank credit growth (-1)	3,376	5,88***	3,376	5,87***
Inflation	-0,011	-1,98**	-0,011	-1,96**
Low income	1,683	2,95***	2,116	3,94***
Low-mid income	1,226	2,40**	1,659	3,50***
Up-mid income	0,877	1,76*	1,310	2,84***
Euro	-1,906	-2,93***		
Euro-high-debt			-2,718	-2,32**
Constant	2,968	7,74***	2,534	7,71***
Observations	1350		1350	
Groups	180		180	
Overall R^2	0,3221		0,3153	
Wald chi^2	81,95***		77,93***	***

Note: ***, **, * - estimations at the statistical significance of 1%, 5% and 10%.
Source: own elaboration.

The next model with the growth of GDP per capita provides similar results (Table 4). In general, additional credit helps to raise personal income; however this impact is not equal. Countries with moderate level of GDP per capita provide the most favorable conditions for credit to raise personal income. Such positive impact weakens with lowering the level of personal income. Such trend could be explained by the lower level of banking system development and lack of opportunities for efficient redistribution of collected savings. The conclusion is similar to the opinion of Demetriades and Law[20] who indicate that undeveloped financial system worsens opportunity of bank lending to generate additional GDP growth. In highly indebted euro countries over-lending leads to the drop in personal income. Banks in these countries shift lending activity to the households, particularly to finance transactions on the real estate market[21].

[18] G. Kaminsky, C. Reinhart, The Twin Crises…, op.cit.
[19] P. Rousseau, P. Wachtel, Inflation thresholds …, op.cit.
[20] P. Demetriades, S. Law, Finance, institutions …, op.cit.
[21] Financial System Development in Poland 2010, Narodowy Bank Polski, Warszawa 2012, p. 83-87.

The impact of inflation on personal income is negative, similarly to the case of GDP growth. The results are in accordance to results of Barro[22] who finds that inflation is one of negative factors of the personal income growth.

Table 4. Impact of credit growth on the growth of GDP per capita in 2004-2011

Explanatory variables	Coefficient	z-statistic	Coefficient	z-statistic
Bank credit growth (-1)	2,783	4,95***	2,793	4,97***
Inflation	-0,009	-1,70*	-0,009	-1,70*
Low income	0,981	1,76*	1,010	1,96**
Low-mid income	1,474	2,95***	1,504	3,29***
Up-mid income	1,755	3,59***	1,786	4,01***
Euro	-0,531	-0,83		
Euro-high-debt			-1,941	-1,71*
Constant	1,172	3,12***	1,140	3,58***
Observations	1350		1350	
Groups	180		180	
R2	0,2519		0,2607	
Wald chi2	55,85***		58,71***	***

Note: ***, **, * - estimations at the statistical significance of 1%, 5% and 10%.
Source: own elaboration.

Conclusions

Before the financial crisis, most studies indicated a positive impact of credit growth on economic development. The experience of recent years significantly changed this view. The results of the conducted research indicate that in the period of 2004-2011 the impact of the credit growth on the growth of GDP and GDP per capita differs depending on the level of personal income in a country.

The growth of credit positively impacted economic development in countries with moderate personal income. Within this group the accelerating capacity of additional credit weakened with the rise of personal income. Furthermore in case of high developed economies additional credit negatively impacted growth of GDP. The highest negative impact occurred in the most indebted euro area countries.

High personal income and probable saturation of the economy with credit negatively impacted the relationship between credit growth and GDP per capita growth in euro zone, and particularly in the most indebted euro countries. Oppositely, in case of moderate income countries the impact of credit growth was positive; however the ability of additional credit to raise personal income weakens with lowering the level of personal income. Such behavior could be also connected with weaker developed financial sectors in these countries. Additionally, raising inflation unfavorably influenced the growth of GDP and GDP per capita.

[22] R. Barro, Determinants of Economic Growth in a Panel of Countries. Annals of Economics and Finance, vol. 4, 2003, p. 231-274.

Literatura

Acemoglu, D., Zilibotti, F., 1997. Was Prometheus unbound by chance? Risk, diversification, and growth. Journal of Political Economy, vol. 105 (4), p. 709 – 751.
Arcand J.L., Berkes E., Panizza U., Too Much Finance?, International Monetary Fund, IMF Working Papers, no. 161, 2012.
Arestis P., Demetriades P., Financial Development and Economic Growth: Assessing the Evidence, Economic Journal, vol. 107, 1997, p. 83-99.
Barro R., Determinants of Economic Growth in a Panel of Countries. Annals of Economics and Finance, vol. 4, 2003, p. 231-274.
Beck T., Levine R., Loayza N., 2000: Finance and the sources of growth, Journal of Financial Economics, vol. 58, Issues 1-2, 2000, p. 261-300.
Bencivenga V., Smith B., 1991: Financial intermediation and endogenous growth, The Review of Economic Studies, vol. 58(2), 1991, p. 195-209;
Cecchetti S., Kharroubi E., Reassessing the Impact of Finance on Growth, Bank for International Settlements, BIS Working Papers, no. 381, 2012.
De Gregorio J., Guidotti P., Financial development and economic growth, World Development, vol. 23(3), 1995, p. 433–448.
Demetriades P., Law S., Finance, institutions and economic development, International Journal of Finance and Economics, vol. 11(3), 2006, p. 245-260.
Financial System Development in Poland 2010, Narodowy Bank Polski, Warszawa 2012.
Gennaioli N., Shleifer A., Vishny R., Neglected Risks, Financial Innovation, and Financial Fragility, NBER Working Papers, no. 16068, 2010.
Grenwood J., Jovanovich B., 1990: Financial Development, growth and the distribution of income, Journal of Political Economy, vol. 98(5), 1990, p. 1076-1108.
Kaminsky G., Reinhart C., The Twin Crises: The Causes of Banking and Balance-of-Payments Problems. American Economic Review, vol. 89, no. 3, 1999, p. 473-500.
King R., Levine R., 1993: Finance and growth: Schumpeter might be right, The Quarterly Journal of Economics, vol. 108(3), 1993, p. 717–37;
Kozak S., Household debt in the EU-15 and the new EU Member States in 2001-2010. Polityki Europejskie, Finanse i Marketing, Zeszyty Naukowe SGGW w Warszawie, no. 6 (55), 2011, p. 44-56 [in Polish].
Rajan R., L. Zingales, Financial dependence and growth, American Economic Review, vol. 88(3), 1998, p. 559–86.
Rioja F., Valev N., Does one size fit all? A reexamination of the finance and growth relationship, Journal of Development Economics, vol. 74(2), 2004, p. 429–447.
Rousseau P., Wachtel P., Inflation thresholds and the finance-growth nexus, Journal of International Money and Finance, vol. 21(6), 2002, p. 777-793.
Rousseau P., Wachtel P., What is Happening to The Impact of Financial Deepening on Economic Growth?, Economic Inquiry, vol. 49, 2011, p. 276–288.

Informacje o autorze:

dr hab. Sylwester Kozak,
Warsaw University of Life Sciences – SGGW,
Department of European Policy,
Public Finances and Marketing,
161 Nowoursynowska Str., 02-787 Warsaw
e-mail: sylwester_kozak@sggw.pl.