THE EFFECT OF M3 MONETARY AGGREGATES AND BANK LOANS ON THE ECONOMIC GROWTH OF COUNTRIES IN THE EUROZONE, THE USA AND JAPAN

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Abstract: *This paper examines the influence of selected indicators of the banking sector (M3 monetary aggregates and bank loans provided to the non-financial private sector) on economic growth (GDP) in the Eurozone, the USA and Japan. Cointegration of these selected indicators of the banking sector has been demonstrated in relation to the development of GDP using the Engle - Granger cointegration test. These tests were applied to selected statistical data from the years 2000 to 2015. The first was to determine the optimum delay using Akaike criteria for all-time series analysed. Then the presence of a unit root was analysed using the Dickey - Fuller test. Based on the test results, time series were excluded which appear to be stationary. If the conditions were met, testing then continued with the Engle - Granger test to detect cointegration relations, which would determine a relationship between selected variables. Based on these tests, it was found that at a significance level of 0.05, no cointegration relationship exists between any of the time series in the countries surveyed.*

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JEL Classification: *E51, E47, C32.*

Introduction

It is a well-known fact that there is a strong relationship between banking credit and economic activity. Hence, it is a reasonable question whether credit data can be used in nowcasting GDP growth. It is important for policymakers to make ontime decisions with the most available data and nowcasting is an important tool when policies in question are needed to be made based on current figures. (Akcelik et al., 2013). An increased interest in the impact of bank lending on the development of an economy has been particularly evident in recent years as a result of the global financial crisis. The original cause of this crisis was the situation in the USA which itself was caused by an inability of different economic entities, particularly households, to repay excessively large loans. Therefore various authors have begun to pay attention to the influence of the size of loans on GDP development. The development of an economy is influenced by the banking sector stability and development level, especially given the fact that the economy financing greatly depends on the crediting activity. The financial turbulence surfaced in 2007, generated by the crediting activity, with an excessive risk, towards the applicants with a precarious credit history, that could not have fulfilled the terms for the granting of a standard mortgage credit, and by the complex financial products, have convinced many economists to study the manner by which the economy may be put back on track. However, the trust of investors and banks within the economy did not return and we entered an actual crediting and economy growth vicious circle. The amplitude of this vicious circle depends on both the causality relation established between the crediting activity and the economic growth, which may be unidirectional or mutual, as well as its intensity. (Armeanu et al., 2015)

Defining the monetary (currency) units, their structure and the dynamics of development provides valuable information necessary for implementing monetary policy. The central banks therefore monitor the links between monetary aggregates and inflation, monetary aggregates and interest rates, and monetary aggregates and GDP (Polouček, 2009). Central banks work with monetary aggregates and at the same time, define them as well. Using these aggregates, they influence the amount of money in the national economies. Monetary aggregates are funds which differ in their degree of liquidity. Monetary aggregates are generally indicated with a capital letter M and the numbers 1 to 3. The lower the number, the greater the liquidity of the monetary aggregate. A monetary aggregate of a higher level encompasses the entire previous monetary aggregate plus another asset which is less liquid. The European Central Bank (ECB) defines monetary aggregates as "narrow" (M1), "intermediate" (M2) and "broad" (M3). "Narrow" aggregates, M1, consist of the most liquid assets; i.e., including currency in circulation (banknotes and coins), as well as balances that can immediately be converted into cash or used for cashless payments (such as overnight deposits). "Intermediate" aggregates, M2, include "narrow" money (M1) plus deposits with an agreed maturity of up to 2 years, and deposits redeemable at notice of up to three months. "Broad" money, M3, comprises M2 along with marketable instruments issued by the Monetary Financial Institution sector. (European Central Bank, 2009). Due to exhaustion of the interest rate channel by central banks, attention of central banks shifted from the conventional monetary policy to unconventional monetary policy. Loose monetary policy, quantitative easing and other programs for purchase of assets were adopted by central banks under exceptional conditions. Central banks stimulated the economic growth, decreased unemployment, supported bank systems by adopting unconventional monetary loosening and increased investments of economic subjects by pumping money into the economy. (Černohorský and Kněžáčková, 2013)

The aim of this paper is to examines the influence of selected indicators of the banking sector (M3 and bank loans provided to the non-financial private sector) on economic growth (GDP) in the Eurozone, the USA and Japan. Among the selected indicators of the banking sector, a time series of bank loans provided to the non-financial private sector and the time series of the M3 monetary aggregate were chosen. Any cointegration of these economic variables has been demonstrated in relation to the development of GDP using the Engle - Granger cointegration test. These tests were applied to selected statistical data from the years 2000 to 2015. The input data are quarterly in nature and are adjusted for seasonal influences. The relationship sought with macroeconomic variables can be defined on the basis of the output of the test.

This paper consists of the following sections: In Section 1, the authors present a review of the literature related to economic growth and the impact of the banking sector on economic growth. Section 2 presents a theoretical basis for the implementation of the Engle - Granger cointegration test. Section 3 contains an analysis of selected indicators of the banking sector on economic growth in the Eurozone, the USA and Japan, using the Engle - Granger cointegration test. In Section 4, the authors present their findings.

1 Statement of a problem

Many authors have devoted themselves to understanding how the banking sector (banks) can affect the economic growth of individual countries in their international research work.

Based on this research, it can be said that for the economic growth of individual countries (development of GDP), an important indicator from the banking sector appears to be the size of the loans provided. Based on research by Levine (1999) and Beck et al. (2000), or Levine et al. (2000), it may be further noted that only loans to the private sector will better explain economic growth.

Takats and Upper (2013) observed the effect of bank loans on economic growth in the period following the financial crisis. The analysis included data from 39 financial crises which preceded credit booms. During these crises, the progress of bank loans (either in real terms or in relation to GDP) did not correlate to economic growth over the period of several years after economic recovery.

Even in the past, models were analysed focusing on the relationship between monetary aggregates and GDP. At the beginning of the 1980s, the US Federal Reserve relied on the M1 aggregate in their estimates of GDP growth and inflation. However, the Federal Reserve later gravitated in their analyses towards the broader monetary aggregates M2 and M3 in predicting GDP and inflation. However, since the 1990s, these aggregates have also become less reliable, which has been associated with the deregulation of the financial system in the USA. Through the use of the VAR models, they estimated well the relationship of monetary aggregates and GDP, but also failed to predict inflation. (Jílek, 2013).

The study by Feldstein and Stock (1994) explored the possibility of using M2 in influencing the nominal GDP in the USA. A simple VAR optimisation model reduces the average standard ten-year deviation of annual GDP growth by more than 20 percent. These statistical tests show that the regulating the growth of M2 aggregates can result in a significant reduction in the volatility of GDP growth. Liang (2011) analysed the relationship between money supply (represented by the monetary aggregate M2) and economic growth (GDP) in the USA. He concluded that the time lag in the changes in GDP is caused by changes in the M2 aggregate and via simultaneous equations can predict the future change in GDP through corresponding changes in the M2 aggregate.

Among the first authors whose results did not confirm a positive relationship between money supply and real GDP include Fisher and Seater (1993). These authors used new econometric methods and concluded that the positive relation between the observed values in the case of the US fails. Over time, studies were formed where analyses were conducted for several countries simultaneously, attempting to generalise the results and thus confirm the relationship of the amount of money in the economy and GDP. Among the first to confirm a positive relationship was Weber (1994), who conducted an analysis of the G7 countries, while using various definitions of monetary aggregates for testing the robustness of the results. Conclusions in agreement with Weber (1994) were also provided by McCandless and Weber (1995), who of course did not find a statistically significant relationship between the rate of growth of the money supply and real output, even for any one of the three accepted definitions of money in 110 countries. Positive relationships can be found only for some of the 21 countries belonging to the OECD.

Based on this research, we can say that the volume of loans appears to be a significant indicator of the economic growth of individual countries (GDP development) from the banking sector. Based on research by Levine (1999) and Beck et al. (2000), or Levine et al. (2000), it may be further noted that economic growth can better be explained only through loans provided to the private sector. Based on a literature search, an appropriate relationship then appears to be that of M3 values (i.e., the main indicators of the volume of money in the economy) and GDP. This relationship has also been previously analysed by such authors as Weber (1994) and King and Levine (1993). These authors have confirmed that using this indicator can explain economic growth in more than 80 countries.

2 Methods

The analysis of experimental data that have been observed at different points in time leads to new and unique problems in statistical modelling and inference. The impact of time series analysis on scientific applications can be partially documented by producing an abbreviated listing of the diverse fields in which important time series problems may arise (e.g. economics, stock markets, environmental sciences or medicine). (Shumway and Stoffer, 2010)

Granger and Engle (1991) recent developments in the field of cointegration, which links long run components of a pair or of a group of series. It can then be used to discuss some types of equilibrium and to introduce them into time-series models in a fairly uncontroversial way. The idea was introduced in the early 1980s and has generated much interest since then amongst econometricians and macroeconomists. In light of the paper's objective, the concept of cointegration – dealt with primarily by the authors Granger and Engle (1987) – is used to investigate the how the indicators of loans provided by banks to the private non-financial sector and M3 affect GDP in the eurozone countries.

In an attempt to achieve up-to-date output, individual tests are conducted on quarterly data from the years 2000-2015 that have been seasonally adjusted. The data are derived from the Research Division of the Federal Reserve Bank of St. Louis (FRED) – data on gross domestic product at constant prices and the M3 monetary aggregate – and from the Bank for International Settlements (BIS) – data on the amount of bank loans provided to the private non-financial sector.

First, the time series that have been presented here are always tested for optimal lag length. This is done using the Akaike information criterion (AIC), when the best lag (used later in the subsequent tests) is always taken to be the lowest AIC value. The time lag between when a macroeconomic shock or other adverse condition is recognized by central banks and the government, and when a corrective action is put into place. The response lag may be short or long, depending on whether policy makers have a definite course of action or must deliberate on the right action to take. (Mankiw, 2014)

$$(M) = ln\sigma a\ 2 + 2M/T \quad (1)$$

The tests are conducted on the basis of the relationship of the values in (1), where M expresses the number of parameters, $ln\sigma a2$ denotes residual variance, and T is the number of observations (Arlt and Arltová, 2007).

Distinguishing between types of time series as stationary and non-stationary is very important when examining their relations, as the use of non-stationary time series could result in a situation which is referred to as apparent or senseless regression.

There are several statistical tests to determine the order of integration, known as unit root tests. Here we have employed the probably most widely used of them, which is known by the name of its creators, the Dickey-Fuller test (hereinafter referred to as the ADF test). This test then is used to analyse whether the time series is of type I (0) - stationary or I (1) - non-stationary.

The analysis was conducted in the Gretl 1.9.4 program for econometric analysis; this program makes it possible to conduct an augmented Dickey-Fuller test (ADF test) for this case. For more details, see Dickey and Fuller (1979).

Three versions of the ADF test are commonly used for verifying hypotheses – one with a constant, one without a constant, and one with both a constant and a trend. When testing, we used the assumption that the process listed below (2), where we test that Ø=0 (the variable contains a unit root), takes the following form (Arlt and Arltová, 2007):

$$\Delta Xt = (\emptyset 1 - 1)Xt - 1 + \sum_{i=1}^{p} \alpha i\, Xt - 1 + et \qquad (2)$$

X_t expresses the dependent variable, p lag, and et the residual term. Deciding on the stationarity – or the non-stationary – of a time series will be conducted by evaluating the p values (the level of significance is in this paper always set at 0.05), which thus establishes whether the null hypothesis is rejected or accepted with 95% probability. For this test, this is formulated as follows:

H_0: the tested series are non-stationary (a unit root exists)

H_1: the tested series are stationary (a unit root does not exist)

Since non-stationarity can be assumed for the series analysed, and the said apparent regression cannot arise when using a stationary time series (the type I (0) series), the option is offered here to remove it by differencing (stationing) individual analysed series. However, research carried out by authors such as Banerjee et al. (1993) have demonstrated that this path cannot proceed, because it will result in the loss of important information on long-term relationships between the properties of time series. For the analysis of unsteady relationships between series, the EG test (Engle and Granger, 1987), was therefore used, which is able to analyse cointegration of non-stationary time series according to the following hypotheses:

H_0: Test series are not cointegrated

H_1: Test series are cointegrated

Decisions on the relationship between time series are based on p values defined by the EG test. If the null hypothesis ($p > 0.05$) is not rejected, the time series will be identified as non-cointegrated – thus, for series between which there is no long-term relationship, or for series which contain no common element and examining them as a system is irrelevant since they have developed over the long term independently. Otherwise (in cases where $p < 0.05$) the time series will be identified as cointegrated; i.e., for series between which a long-term relationship can be demonstrated at a level of significance.

3 Influence of selected indicators of the banking sector on the economic growth of countries in the Eurozone, Japan

The Engle-Granger cointegration test is used to test the causal relationship between the overall amount of loans provided by banks to the private non-financial sector and GDP and between the M3 monetary aggregate and GDP. Both the absolute values and year -to-year changes are tested for these values. If the deviation of the time series trends is only short-term (and disappear over time), then there is a limit beyond which the deviation cannot continue - it can then be stated that the time series are in equilibrium. The statistical expression of this condition is called a “cointegrated time series”. If there is no such limit, then it cannot be said that they are in equilibrium; thus statistically speaking, such a time series cannot be said to be cointegrated. It is natural that when examining relationships between economic time series, mainly cointegrated series are of any interest, as only for these series can the nature of their relation be analysed. If the time series are not cointegrated, then for a long time they will not contain any common element and their investigation as a system can be regarded as irrelevant, as they have developed over the long term independently (Artl, 1997).

The time series used are listed for the period of all four quarters of the year 2000 up to all four quarters of the year 2015. The absolute values of GDP, seasonally adjusted, are listed in constant prices either for the year 2009 or 2010. Table 1 shows a description of the variables used.

Tab. 1: Description of the variables used for bank loans and M3 in the selected banking sectors

Variable abbreviation	Description of variable
GDPUSA	Time series of seasonally adjusted gross domestic product in the USA
ΔGDPUSA	Annual change in the time series of seasonally adjusted gross domestic product of the USA
BCUSA	Time series of total bank loans to the private non-financial sector of the USA
ΔBCUSA	Annual change in the time series of total bank loans to the private non-financial sector of the USA
GDPJAP	Time series of seasonally adjusted gross domestic product in Japan
ΔGDPJAP	The annual change in the time series of seasonally adjusted gross domestic product of Japan
BCJAP	Time series of total bank loans to the private non-financial sector of Japan
ΔBCJAP	Annual change in the time series of total bank loans to the private non-financial sector of Japan
GDPEUR	Time series seasonally adjusted gross domestic product of the Eurozone
ΔGDPEUR	The annual change in the time series of seasonally adjusted gross domestic product of the Eurozone
BCEUR	Time series of total bank loans to the private non-financial sector of the Eurozone
ΔBCEUR	Annual change in the time series of seasonally adjusted gross domestic product of the Eurozone
MUSA	Time series for M3 for the USA
ΔMUSA	Annual change in M3 for the USA
MJAP	Time series for M3 for Japan
ΔMJAP	Annual change in M3 for Japan
MEUR	Time series for M3 for the Eurozone
ΔMEUR	Annual change in M3 for the Eurozone

Source: (Author's own work)

3.1 Test for the Optimum Delay Series Using Akaike Criteria

Before using the EG test, it is necessary to test the time series for optimal lag, where the dependent variable is the value of GDP, i.e., ΔGDP. Tables 2 and 3 list the values of the AIC criterion for 4 lag lengths (the lowest value is always shown in bold type). The optimal lag results determined that, according to the Akaike criterion's lowest values, a lag length of 2 always appears to be optimal for the absolute values of the dependent variable of GDP. The lag length is also 2 for the year-to-year changes of the listed values. This optimum delay correspondents to the economic theory. (Mankiw, 2014)

Furthermore, it is possible to state that the lowest AIC was achieved for absolute values in the Eurozone countries while including the constant. In the case of year-to-year changes, the lowest AIC value was likewise achieved when including the constant. Nonetheless, the length of the optimal lag is always the same in each test, even when the constants or trends of various AIC values are included.

In absolute values, the lowest were AIC were found in the USA with the inclusion of the trend; in Japan with the inclusion of a constant with the trend; and in the Eurozone with the inclusion of a constant (Table 2). In the event of annual changes, the lowest AIC values achieved were consistent for all countries with the inclusion of constants. However, although each test achieved the possible inclusion of constants or trends of different values of AIC, the optimum level of series delays has always been the same. Those results will be reflected in subsequent tests.

Tab. 2: Results of optimum delay in the USA, Japan and the Eurozone for bank loans

Order of delay	**AIC for GDPUSA**	**AIC for ΔGDPUSA**	**AIC for GDPJAP**	**AIC for ΔGDPJAP**	**AIC for GDPEUR**	**AIC for ΔGDPEUR**
-	Test with trend	Test with constant	Test with constant and trend	Test with constant	Test with constant	Test with constant
1	53.329719	2.592379	59.015445	4.003271	49.984407	2.822197
2	**53.291988**	**2.271509**	**58.897321**	3.713388	**49.688352**	**2.057152**
3	53.319015	2.293977	58.933717	**3.711705**	49.723992	2.086916
4	53.346715	2.324482	58.971440	3.732284	49.731454	2.114469

Source: (Author's own work based on the results of Gretl 1.9.4.)

The first test will be for the optimum delay of the time series. For absolute values of the selected variables, a second order delay again seems to be optimum. The same delay, except for Japan, seems best for variables in terms of annual changes. For Japan, the optimum delay seems to be a delay of the third series. In these tests, the lowest values were always achieved in tests involving a constant (Table 3). The results of this analysis will be reflected in further calculations.

Tab. 3: Results of optimum delay the USA, Japan and the Eurozone for M3

Order of delay	**AIC for GDPUSA**	**AIC for ΔGDPUSA**	**AIC for GDPJAP**	**AIC for ΔGDPJAP**	**AIC for GDPEUR**	**AIC for ΔGDPEUR**
-	Test with constant	Test with constant	Test with constant	Test with constant	Test with constant	Test with constant
1	53.474906	2.536159	58.987111	3.990218	49.862320	2.721023
2	**53.338622**	**2.268613**	**58.896527**	3.713008	**49.329968**	**2.132477**
3	53.339520	2.297858	58.934843	**3.711844**	49.369137	2.168949
4	53.376893	2.323283	58.967915	3.732458	49.403809	2.203680

Source: (Author's own work based on the results of Gretl 1.9.4.)

3.2 Verifying the Stationarity of the Time Series

Possible non-stationarity of data can lead to apparent regression; the difficulty with this lies mainly in the fact that using the least squares method would make it possible to obtain statistically significant parameter estimates of the regression function – even though the time series analysed do not relate to each other. For this reason, it is necessary to test the time series used here with the help of an augmented Dickey-Fuller test. The results of the ADF test for a unit root, in this case in the model with the constant, are shown in Table 4. The results of the ADF unit root test, in this case using a model with a constant and a trend are shown in Table 4 (where all p values for each parameter of the variables analysed are displayed successively).

Tab. 4: ADF test results for total loans provided by banks

Variable abbreviation	Value of *p* parameter	Evaluation of ADF test results	H_0:
GDPUSA	0.928	Time series non-stationary	Not refused
BCUSA	0.504	Time series non-stationary	Not refused
GDPJAP	0.208	Time series non-stationary	Not refused
BCJAP	0.385	Time series non-stationary	Not refused
GDPEUR	0.451	Time series non-stationary	Not refused
BCEUR	0.333	Time series non-stationary	Not refused
ΔGDPUSA	**0.004**	**Time series stationary**	**Refused**
ΔBCUSA	0,630	Time series non-stationary	Not refused
ΔGDPJAP	0,142	Time series non-stationary	Not refused
ΔBCJAP	0,733	Time series non-stationary	Not refused
ΔGDPEUR	**0,002**	**Time series stationary**	**Refused**
ΔBCEUR	0,799	Time series non-stationary	Not refused

Source: (Author's own work based on the results of Gretl 1.9.4.)

As can be seen here, for time series with absolute values, all time series at a significance level of 0.05 were marked as non-stationary. For time series based on annual changes, only data coming from Japan were identified as non-stationarity. Time series of annual changes of GDP from the USA and the Eurozone indicate a significance level of stationarity.

In the subsequent ADF test (Table 5) including testing with a constant, again some series seem stationary. This is the time series of ΔGDPUSA and ΔGDPEUR. These series will again be excluded from the following cointegration analyses. Other series showed existence of a unit root at a significance level of 0.05.

Tab. 5: Results of the ADF test for M3

Variable abbreviation	Value of *p* parameter	Evaluation of ADF test results	H_0:
GDPUSA	0.904	Time series is non-stationary	Not refused
MUSA	0.999	Time series is non-stationary	Not refused
GDPJAP	0.430	Time series is non-stationary	Not refused
MJAP	0.999	Time series is non-stationary	Not refused
GDPEUR	0.451	Time series is non-stationary	Not refused
MEUR	0.364	Time series is non-stationary	Not refused
ΔGDPUSA	**0.004**	**Time series is stationary**	**Refused**
ΔMUSA	0.116	Time series is non-stationary	Not refused
ΔGDPJAP	0.142	Time series is non-stationary	Not refused
ΔMJAP	0.929	Time series is non-stationary	Not refused
ΔGDPEUR	**0.002**	**Time series is stationary**	**Refused**
ΔMEUR	0.734	Time series is non-stationary	Not refused

Source: (Author's own work based on the results of Gretl 1.9.4.)

3.3 Cointegration Analysis

The results of the cointegration analysis for the remaining time series of bank loans are shown in Tables 6 and 7. As can be seen, the *p* value of the parameter identified all pairs of time series as non-integrated at a significance level of 0.05, thus for the series which have no relationship between them.

Tab. 6: Results of the Engel - Granger cointegration test and ADF test for bank loans

Variable abbreviation	P value	Length of delay	H_0:	Conclusion
GDPUSA-BCUSA	0.512	2	Not refused	No cointegration
GDPJAP-BCJAP	0.352	2	Not refused	No cointegration
GDPEUR-BCEUR	0.274	2	Not refused	No cointegration
ΔGDPUSA-ΔBCUSA	Basic requirements for cointegration not met			
ΔGDPJAP-ΔBCJAP	0.3185	3	Not refused	No cointegration
ΔGDPEUR-ΔBCEUR	Basic requirements for cointegration not met			

Source: (Author's own work based on the results of the data processed by Gretl 1.9.4.)

On the basis of the Engel - Granger cointegration analysis, the same conclusions can be drawn for M3 as for the previous analysis, as testing all relationships showed non-cointegration at a significance level of 0.05 among the remaining pairs of time series.

Tab. 7: Results of the Engel – Granger cointegration test and ADF test for M3

Variable abbreviation	P value	Length of delay	H_0:	Conclusion
GDPUSA-MUSA	0.724	2	Not refused	No cointegration
GDPJAP-MJAP	0.341	2	Not refused	No cointegration
GDPEUR-MEUR	0.382	2	Not refused	No cointegration
ΔGDPUSA-ΔMUSA	Basic requirements for cointegration not met			
ΔGDPJAP-ΔMJAP	0.3192	3	Not refused	No cointegration
ΔGDPEUR-ΔMEUR	Basic requirements for cointegration not met			

Source: (Author's own work based on the results of the data processed by Gretl 1.9.4.)

The time series monitored covers the period from 2000 to 2015. In this period, the global financial crisis gradated and unconventional monetary and fiscal policy tools were applied, in the Eurozone countries as well as others. The unconventional set of monetary policies was inspired from the experience of Japan's deflationary period. (Albu et al., 2014) ECB, Bank of Japan and the US Federal Reserve have applied quantitative easing as an unconventional tool of the central banks. The main essence of quantitative easing is the purchase of financial assets by the central bank from commercial banks or other private institutions. This step seeks to expand the monetary base. It can be noted that in this period no mutual long term relationship of these variables has been demonstrated. The reasons for the rejection of the hypothesis are specific conditions in selected banking systems – financial crisis and unconventional monetary policy, which is applied in case of non-standard development of economies.

4 Discussion

The results of the analyses show that all tested time series are, according to the ADF test, non-stationary and it was necessary to adjust the time series by differentiation. Based on the Engle-Granger cointegration test, it may be noted that the time series are not cointegrated and there was no positive dependence of GDP development on the basis of developments in M3 and bank loans to the non-financial private sector. These findings are consistent with economic theory and the conclusions of Fisher and Seater (1993) and McCandless and Weber (1995). The Engle-Granger cointegration test does not confirm a statistically significant relationship between GDP and M3, or GDP and bank loans to the non-financial private sector. Yet the relationship between the volume of bank loans to the non-financial private sector and GDP corresponds with the conclusions of the authors Takats and Upper (2013), who concluded that the development of bank loans has no effect on economic growth over several years after economic recovery.

In further research, it would be possible to focus on models that allow for the endogeneity of a variable. Such studies already exist, but they mostly deal with data from the USA (e.g., Liang, 2011 and Feldstein and Stock, 1994). It would be interesting to apply the same model to the Eurozone. Using these methods however requires a greater amount of observation and longer time series. This is difficult for the European Union, as the Eurozone was only established in 1999. As well, during this time, fundamental changes occurred, which the Eurozone was forced to confront. In the period under review, a global financial crisis occurred and in reaction to it, the European Central Bank had to accede to an unconventional monetary policy. This monetary policy included quantitative easing of money and setting negative interest rates. Both of these factors affected the M3 aggregate as well as the development of bank loans to the private non-financial sector.

Conclusion

The relationship between the amount of bank loans to the non-financial private sector and GDP and the M3 aggregates to GDP should be emphasised that in the time period analysed, between 2000 and 2015. The course of the global financial crisis occupies fully one third of the time period in question. This may be the reason why a positive impact of the banking sector on the economic development of countries in the Eurozone, Japan and the USA could not be statistically confirmed. Data input into the analysis show strong growth in bank loans to the non-financial private sector and the M3 aggregates. Although there is obvious strong growth in the monitored data, GDP is almost unresponsive. After the global financial crisis the European Central Bank, the Bank of Japan and the US Federal Reserve were forced to cut their interest rates very close to zero; the financial systems did not stabilise and the economic situation in the Eurozone countries began to deteriorate sharply. Therefore, the ECB, the Bank of Japan and the Federal Reserve were forced to adopt this unconventional monetary policy in the form of quantitative easing of money for the purpose of monetary expansion (and thus growth of the M3 aggregates). The growth of loans in this period was aided by the low interest rates in the financial market set by the ECB, Bank of Japan and the Federal Reserve.

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References

Akcelik, Y., Ermişoğlu, E., Oduncu, A. (2013). GDP Growth and Credit Data. *Central Bank of the Republic of Turkey Working Paper* 13/27. [online]. Available at: https://core.ac.uk/download/pdf/ 12036388.pdf [27.2.2017].

Albu, L. L., Lupu, R., Călin, A. C., Popovici, O. C. (2014). The Effect of ECB's Quantitative Easing on Credit Default Swap Instruments in Central and Eastern Europe. *Procedia Economics and Finance*, 8, pp. 122-128.

Arlt, J. (1997). Kointegrace v jednorovnicových modelech. *Politická ekonomie*, 45 (5), pp. 733-746.

Arlt, J., Arltová, M. (2007). *Ekonomické časové řady: [vlastnosti, metody modelování, příklady a aplikace].* Praha: Grada.

Armeanu, D., Pascal, C., Poanta, D., Doia, C. A. (2015). The credit impact on the economic growth. *Theoretical and Applied Economics*, 22 (1), pp. 5-14.

Banerjee, A., Newbold, P. (1993). *Co-integration, error correction, and the econometric analysis of non-stationary data*. Oxford: Oxford University Press.

Bank for International Settlements. (2016). Credit to the non-financial sector. [online]. Available at: http://www.bis.org/statistics/tot credit.htm [20.5.2016].

Beck, T., Levine, R., Loayza, N. (2000). Finance and the Sources of Growth. *Journal of Financial Economics,* 58, (1-2), pp. 261-300.

Černohorský, J., Knězáčková, R. (2013). Does higher rate of central bank independence mean lower inflation rate? *6th International Scientific Conference on Finance and the Performance of Firms in Science, Education, and Practice*, pp. 209-220.

Datamarket. (2016). M3 for Euro Area. [online]. Available at: https: //datamarket. com/data/set/1uya/m3-for-euro-area-quarterly-data#!ds=1uya&display=line [8.11.2016].

Dickey, D. A., Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*, 74(366a), pp. 427-431. DOI 10.1080/01621459.1979.10482531

Engle, R. F., Granger, C. W. J. (1987). *Co-Integration and Error Correction: Representation, Estimation, and Testing.* Econometrica*, 55(2), pp. 251-276. DOI 10.2307/1913236*

Engle, R., Granger, C. (1991). *Long-run economic relationships: Readings in cointegration*. Oxford: Oxford University Press.

European Central Bank. (2009). The ECB's definition of euro area monetary aggregates. [online]. Available at*:* http://www.ecb.int/stats/money/aggregates/aggr/ html/hist.en.html [8.3.2016].

European Central Bank. (2016). ECB Annual Report 2015. [online]. Available at*:* https://www.ecb.europa.eu/pub/pdf/annrep/ar2015en.pdf?776f8e3f5ee4da49e0f8e7ad5316b547 [18.9.2016].

Feldstein, M., Stock, J. H. (1994). *The use of a monetary aggregate to target nominal GDP. Monetary policy*. Chicago: The University of Chicago Press.

Fisher, M. E., Seater, J. (1993). *Long-run Neutrality and Superneutrality in an ARIMA Framework.* American Economic Review*, 83(3), pp. 402–415.*

FRED Economic Data (2016). Real Gross Domestic Product for Euro area (19 countries). [online]. Available at*:* https://fred. stlouisfed. org/series/CLVMNACSCAB1GQEA1913 [20.5.2016].

Jílek, J. (2013). *Finance v globální ekonomice II. Měnová a kurzová politika*. Praha: Grada Publishing.

King, R. G., Levine, R. (1993). Finance and Growth: Schumpeter Might Be Right. *The Quarterly Journal of Economics*, 108(3), pp. 717-737. DOI 10.2307/2118406

Liang, F. (2011). The Relationship Between Money Supply and The GDP of United States. Diss. Hong Kong Baptist University Hong Kong. [online]. Available at*:* http://lib-sca.hkbu .edu.hk/trsimage/hp/08050597.pdf [20.5.2016].

Mankiw, N. G. (2014). *Principles of macroeconomics*. Stamford: Cengage Learning.

McCandless, G. T., Weber, W. E., (1995). Some Monetary Facts. *Federal Reserve Bank of Minneapolis Quarterly Review*, 19(3), pp. 2–11.

Polouček, S. (2009). *Peníze, banky, finanční trhy*. Praha: C. H. Beck.

Shumway, R. H., Stoffer, D. S. (2010). *Time series analysis and its applications: with R examples.* Springer Science & Business Media.

Takats, E., Upper, Ch. (2013). Credit and Growth after Financial Crises. *BIS Working Paper No. 416*. [online]. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2375674 [19.4.2016].

Weber, A. (1994). Testing Long-Run Neutrality: Empirical Evidence for G7 Countries with Special Emphasis on Germany. *Carnegie-Rochester Conference Series on Public Policy*, 41, pp. 67–117. DOI 10.1016/0167-2231(94)00014-X

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