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Sirucek, Martin

Faculty of business and economics, Mendel University in Brno

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Impact of money supply on stock bubbles

Martin Širůček

Abstract

MARTIN ŠIRŮČEK: Impact of money supply on stock bubbles

This article is focus on the effect and implications of changes in money supply in US on stock bubble rise on the US capital market, which is represented by the Dow Jones Industrial Average index. This market was chosen according to the market capitalization. The attention of paper is focused on problems, if according to the results of empirical analysis is the money supply significant factor which cause the bubbles and if during the time growth the significancy and impact of this macroeconomic factor on stock index.

Key words: money supply, stock market, stock bubbles, granger causality, Dickey-Fuller test

Introduction

Shares and stock markets are extremely sensitive to any price-shaping information, relevant for future trends and market development. The price-shaping factors generally include macroeconomic and microeconomic factors, but also the psychological and subjective influence of investors who can affect the behaviour of the entire market and its volatility (which grows alongside the growing number of market participants, who haven't relevant knowledge and experiences), the development of new technologies and the impacts of globalisation. So growth the impact of psychological and behavioural factors which influence the market

behaviour. So growth the market volatility and investors can be more often take a part by the buy or sell mania when rising the stock bubbles. That the volatility is growing confirm e.g. **Ambrosio, Kinniry** (2009), in their study form US market is significant growth standard deviation of stock index from 90th or **Eichengreen, Tong** (2003). So, thanks the growing of market capitalization are the implications of bubble bursting still more significancy. Volatile stock market represent not only risks for investors or listed companies, but also for the whole economy, which during the evolution of stock bubble embody overheat activity and also after the burst rapidly sink (measured by GDP). According to representatives of Austria economic school, was the cause of “welfare” or felling of wealth growing, which slowly goes into bubble, cheap credit policy. Right these credits cause, that new liquidity can be used as investment on capital markets, which will be at standard conditions (without cheap credit) off (closely **Kohout** (2007)). **Novotný** (2012) mention, that vacant monetary policy create environment in which investors prefer more risky investment as consequences of bull mood (euphoria, future expectations). From the investor view are safely and more conservatively investment not so attractive, because they would not pay a “hidden tax” in shape an inflation, they are press enter on the “euphoria wave” and blow the bubble. According to low real profit, the investors inflate the bubble too, because if they want to make a real profit, they have to search and invest into more risky assets (stocks), with them they have not enough experience and knowledge. After than they can make his investment decisions according to other market members (crowd effect, what is meaning that they only follow others market member and his decisions).

From the investors view (no matter if retail or institutional investor) is very important notify, by which fundamentals the investor enter in his position, and if these

fundamentals really changed so much that is time to close his positions or if is not a right time for example to expand in his position, so that they buy new assets and so decline the average buy price. This decisions are the basic decisions which should every investor make and not only in high volatility period when other market members make massive sell or buy order. Period of massive selling or buying orders is characteristic thereby, that in this period play the main role the psychology and other behavioural factors. This period should every investor evaluate and awake if these period is not only a situation which as first named Alan Greenspan as irrational exuberance (speculative madness). Fundamentals and his impact on stock prices are the most important factors in long investment period, which influence the price evolution. Investor who make decision if enter or not in long position, should these decisions make not only according to other market members (crowd effect) or according to subjective factors (intuition), but first of all according to macroeconomic and/or microeconomic fundamentals. Just accepting the fundamentals and their projection into investment decisions can lead to bubble elimination and elimination of his consequences.

Stock markets are influent by many factors and is practically impossible that the retail investor project all these factors into his investment decisions. The basic instrument, which help investors make their buying or selling decisions for concrete stock title is fundamental analysis. Just the fundamental analysis study the impact of macroeconomic and microeconomic factors on stock price evolution. The main objective of this analysis is answer the question, which stock is over-, under- and right evaluate and so set the right title for buying or selling.

King (1966), which made his analysis of 64 listed companies from 6 industries branch, mention that stock prices are significantly influenced (in average from 40 - 50 %, author note) by macroeconomic factors. A similar view is shared by **Musilek** (1997) who, unlike King, stays on the general level and claims that if an investor wants to be successful, he must focus mostly on price-shaping macroeconomic factors. In regard of that the spot price of stock present future income, which are discounted, **Flannery, Protopapadakis** (2002) mean that macroeconomic variables are the most important indicators, which influence the stock returns, because right these factors has impact on future company's cash flow and influence the high of discount rate.

From these options can we recognise, that macroeconomic factors are the most important factors which explain the stock prices movement and that these factors has the biggest impact on these assets. That is the reason why should the investor always project these factors in his decisions by portfolio management and so can everybody recognize if he is a real (long) investor and not only a speculator. So the investor have to make his decisions just on macroeconomic factors (but not only) and don't act as other market members (irrational exuberance).

The first studies in modern history, which focus on the affect of macroeconomic variables on stock prices can we post e.g. **Lintner** (1973), **Oudet** (1973), **Nelson** (1976), **Jaffe, Mandelker** (1977) or **Fama, Schwert** (1977). The impact of national macroeconomic factors on the performance of national stock market in the modern period was addressed by authors such as **Bilson, Brailsford and Hooper** (2000), who maintain that these factors determine the stock prices more than the global macroeconomic factors. According to **Veselá** (2010) the macroeconomic factors that

influence the development of stock prices include interest rate, inflation, GDP, money supply, the movement of international capital changes, exchange rates, political and economic shocks. **Chen, Roll, Ross** (1986) or **Benaković, Posedel** (2010) as other important macroeconomic factor name the oil price or industrial production. According to **Kohout** (2010), the most important factor which influence the development of stock prices in the long term is the amount of money in the economy (i.e. money supply). Also **Flannery, Protopapadakis** (2002) include among the major macroeconomic factors the money supply as well as unemployment, trade balance, the number of new residential buildings and the Producer Price Index.

So macroeconomic factors are very important determinants of stock markets in long investment horizon. Important factor, which influence stock prices and according to e.g. **Gupta** (1974), **Musílek** (1997), **Poiré** (2000), **Borkovec** (2001), **Kohout** (2010) či **Shostack** (2003), the most important factor is money supply and his evolution and changes. In case of expansive monetary policy flow more and more money into economy which are the consumer not able rational use and these money don't end only in consumption, but on capital markets too, where can be invest in high risky assets (closely e.g. **Kohout** (2010)). So the price growth over his intrinsic (fundamental) value and the bubble created. The simply question is, if we can the money supply set as the starter of stock bubbles. According to theoretically background growing with the money supply growth also the prices in economy (inflation). So is here a strong premise that should growth the stock prices too and they can growth over his fundamental value and create the bubble. Positive relationship between money supply and stock prices found in his study e.g. **Keran** (1971), **Rogalski, Vinso** (1977), **Shostack** (2003), **Yuanyuan, Donghui** (2004). But can we consider the impact of money supply on stock prices during the time for

constant or not? Some authors, e.g. **Kulhánek, Matuzsek** (2006) or **Veselá** (2007), mention that during the time sink the intensity of positive relationship between money supply and selected European stock markets. Other question is, if there exist a positive relationship, if these nexus express immediately or with lag. That the markets should react on money supply changes with lag explain e.g. **Veselá** (2007), **Rejnuš** (2009) with the liquidity effect, transmission and not direct transmission mechanism.

Just the positive relation between money supply and stock prices is frequently mention topic of scientific studies and financial analysis. **Alatqi, Fazel** (2008) mention, that these basic relation come from negative relationship between money supply changes and interest rates and that from negative relationship between interest rates and stock prices.

Stock bubbles creation is according **Kohout** (2010) signalisation for investors that the stock market is not effective and as mention **Polanský** (2010) financial bubbles verify that the market does not function perfectly. **Zamrazilová** (2010) mention that central banks should by setting the monetary policy setting consider just the stock prices evolution and changes on capital markets.

Dillén, Sellin (2003) define three basic reasons why should central banks by setting monetary policy consider stock bubbles, which can be created as consequences of money supply growth: (a) bubbles represent financial instability, (b) bubbles can lead to fluctuation in real activity, (c) bubbles cause price instability.

If the investor is a stickler of market efficiency theory or not, one think is clear. Price bubbles existed, existing and (probably) will be exist (same position mention **Posen** (2003)). For example on the market evolution in 20. and 21. century can be identified

bubbles such as USA 1929, Japan, Austria late 80th, Asia 1997, USA 2000, Sweden 2000, Finland 2000, China 2007, USA 2007/2008. **Tregler** (2005) define stock bubble as price growing over his intrinsic value. His statement confirm **Baker** (2000), who mention that the market overvaluation during the IT bubble from year 2000 was 7,79 to 13,64 bil. US dollars. The problematic of price bubbles in new era (financial crisis) pursue in his works e.g. **Deev, Kajurová, Stavárek** (2012), **Alatiqi, Fazel** (2008), **Jiang et al.** (2009) , **Hanousek, Novotný** (2012). As causes of stock bubbles mention **Cecchetti** (2001) growth of bank reserves (monetary base M2, vide infra).

According to **Kubicová, Komárek, Plašil** (2012) or **Greenspan** (2004) is very complicated identify the bubble rise ex post but also ex ante. This statement confirm **Kohout** (2010) and mention, that factors which signalise bubble rise are: (a) very high P/E ratio (see **Shiller** (2010) or **England** (2003)), (b) inadequate growth of market capitalisation during 5 or 10 years before bubble burst.

Methods and Resources

Market which enter into empirical analysis was set according to his market capitalisation and his share in the global market capitalisation, because as mention **Veselá** (2007), market capitalization and trade volumes are factors by which can we explore the sense, size and position of stock exchanges on world market. As mention **WFE** (2011) the US market was the biggest market on the world according to market cap with capitalisation 19 789 bil. US dollars (42 % global market cap), following by Asia capital markets with capitalization of 14 670 bil. US dollars (31 % global market cap).

The US capital market is represented by the Dow Jones Industrial Average (DJIA) stock index. For empirical analysis are using moment time series of selected variables. Regarding to the focus of this paper the input variables are monthly closing price of DJIA adjusted of dividends and splits. The money supply is represented with the monetary base M2 and MZM (money with zero maturity), all in nominal value.

In the empirical analysis are using only stationary time series, so as recommend e.g. **Tomšík, Viktorová** (2005). The original data (in levels) was not stationary so was make first differences what recommended e.g. **Artl** (1997) and which were set as stationary time series. According to **Artl** (1997), there are several ways to determine the time line type, that is, to determine the time line cointegration order: (a) to examine the time line chart and evaluate subjectively whether the line is stationary or not, (b) to assess the shape of autocorrelation function, (c) to apply the unit root test. The test of unit root will be provide by the augmented Dickey-Fuller test (ADF test). According to **Dickey, Fuller** (1979), this test can be recorded in the general form:

$$\Delta Y_t = \beta_0 + (\rho - 1)Y_{t-1} + \beta_2 \Delta Y_{t-1} + \beta_3 \Delta Y_{t-n} + \varepsilon_t$$

where:

ΔY tested variable,

β constant,

ρ level of cointegration.

Regarding to the character of input data is ADF test do in this forms:

(a) random walk with constant (model stationary in constant) $\Delta Y_t = b_0 + \beta Y_{t-1} + \varepsilon$

(b) random walk with constant and trend (model stationary in constant and trend)

$$\Delta Y_t = b_0 + \beta Y_{t-1} + b_2 t + \varepsilon.$$

After the ADF test the Granger causality test will be performed and demonstrating the correlation or non-correlation (if there is a relation or not) between DJIA and the money supply. **Korda** (2007) classified Granger causality test as explicit causality which says that the causal affect of a variable X on a variable Y such situations can be regarded in which the explanation of Y by using past Y values and X is better than a pure explanation of Y under its own history. The point is that as **Jochech** (2010) notes, the Granger test assumes that all information for predicting selected variables are contained in the very past values of these variables. Due to the focus of this paper, the Granger causality test will therefore examine e.g. the hypothesis that variable M2 unafect variable DJIA if adding the delayed variable M2 improves the prediction model stated, explained only by its delayed values.

The Granger causality test can be described through the following equations, verifying the causal relationship between a change in the money supply measured by the M2 aggregate and the DJIA index:

$$y_t = \alpha_0 + \sum_{i=1}^m \alpha_i y_{t-i} + \sum_{i=1}^m \beta_0 x_{t-i} + u_t,$$

where:

y_t dependent variable (in this case stock index),

x_t independent variable (in this case nominal money supply),

α and β regression coefficients,

t number of observation,

U_t random error,

m number of lag.

In empirical analysis, where will be tested the causal relationship between money supply and stock market are tested two regressions:

$$I_t = \alpha_0 + \alpha_1 I_{t-1} + \dots + \alpha_m I_{t-m} + \beta_1 MS_{t-1} + \dots + \beta_m MS_{t-m} + u_t$$

$$MS_t = \alpha_0 + \alpha_1 MS_{t-1} + \dots + \alpha_m MS_{t-m} + \beta_1 I_{t-1} + \dots + \beta_m I_{t-m} + u_t$$

where:

I stock index (DJIA),

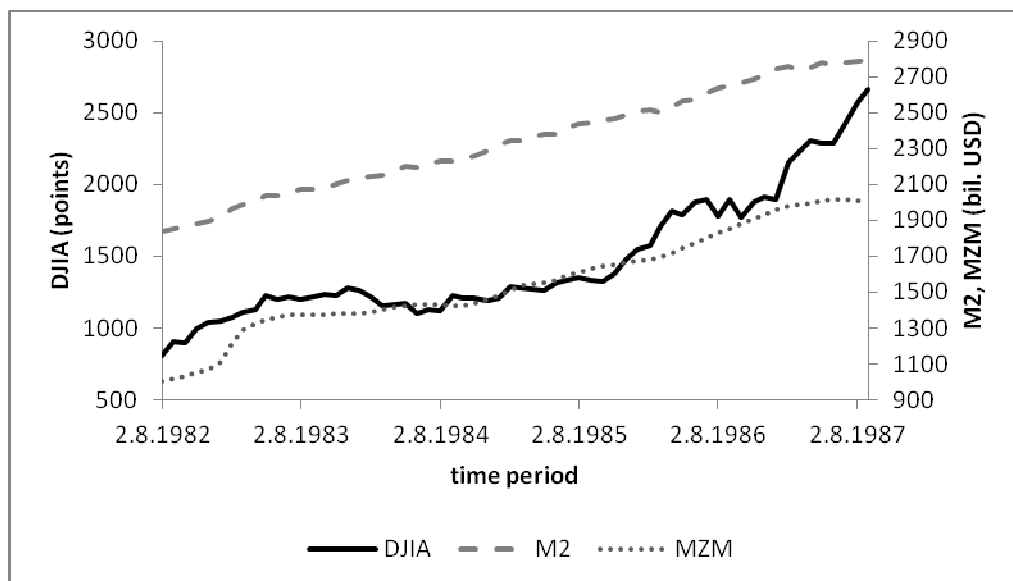
MS nominal money supply represented by monetary base M2 or MZM

For empirical analysis are using stock bubbles which fulfil the conditions of high P/E ratio before burst and inadequate growth in period from 5 to 10 years in face of the peak. In addition these bubble are in broad awareness of all investors and by these bubbles is no doubt that these bubble are really bubbles: (a) market crash in year 1987 („*Black Monday*“), (b) period before burst the technological bubble *Dot.com* in year 2000, (c) period before burst of real estate bubble in year 2007 (*Subprime bubble*)

Results

Fig. 1 show evolution of US capital market represented by DJIA index from half of 1982 to the bubble burst in year 1987, when till half of 1982 was the volatility of the

stock index constant and since the year 1982 started growing. So the market cap and the bubble was risen. This correspond with **Kohout** (2009), which set the inadequate growth of market (measured by market cap) as warning signal of bubble rise. In the chart was the development illustrated in levels, but in the empirical analysis enter the stationary first differences. In period 1667 - 1982 was the monthly growth rate of DJIA 0,0653 %, while in period 1982 - 1987 was it 1,9873 %, that is 30 times higher then in previous period. In same time period was the monthly growth rate of monetary base M2 0,7189 % for years 1967 - 1982, let us say 0,4646 % in period 1982 - 1987. For the monetary base MZM was the monthly growth rate for period 1967 - 1982 0,6817 % and in next period (1982 - 1987) it was 1,1433 %. Higher growth rate by monetary base MZM was caused by the growth of this aggregate in year 1983. So the question is, if the money supply is significant factor which cause this bubble or not.



1: DJIA and money supply, 1982 - 1987

Tab. I show the results of Granger causality test (provided on stationary first differences) which measure the impact of money supply on US stock market DJIA by 5 % significance level and different length of lags.

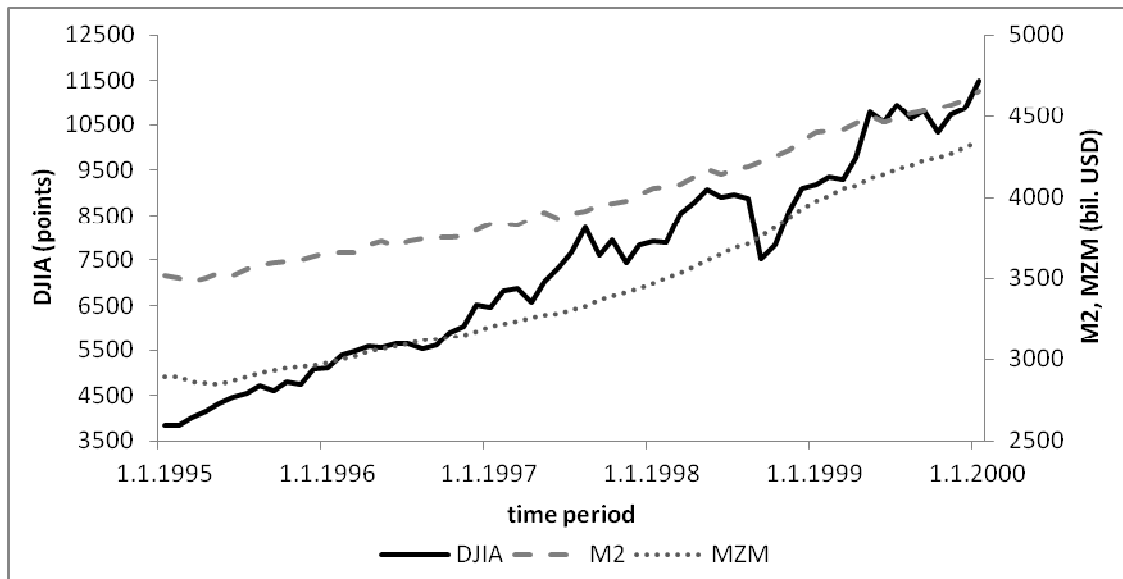
I: Granger causality test, period 1982 - 1987

Hypothesis $\alpha = 5 \%$	lag							
	1	2	3	4	5	6	12	18
	F-st.	F-st.	F-st.	F-st.	F-st.	F-st.	F-st.	F-st.
M2 unaffect DJIA	0,2231	0,3258	0,3513	0,4238	0,6253	0,5293	0,6461	1,0160
MZM unaffect DJIA	0,0434	0,0871	0,3398	0,4999	0,5683	0,5293	0,4224	0,5847

On the basis of the results can I set that in the period from 1982 to 1987 hasn't money supply represented by monetary base M2 or MZM significant impact on DJIA development. That's meaning that this macroeconomic determinant wasn't according to Granger test significant factor which cause this bubble.

Other bubble which was analyze was bubble of IT companies Dot.com, which wasn't connected only with the NASDAQ market, but consequences of his burst feel the investor on "industrial" DJIA index too. This bubble is suitable example of irrational bubble, where thanks oversize expectations, growth the prices of IT companies inadequate in years 1995 - 2000 and so growth the whole market. That this bubble is an example of irrational bubble confirm **Komárek, Kubicová** (2011) in their study.

Fig. 2 show the situation before the market hit the peak in year 2000.



2: DJIA and money supply, 1995 - 2000

Implemented ADF test identify all variable stationary and this first differences enter into Granger causality test with the goal disclose if the money supply influence the DJIA index in period of Dot. com bubble rise. Tab. II contain results of this test made also by 5 % significancy level with several lags.

II: Granger causality test, period 1995 - 2000

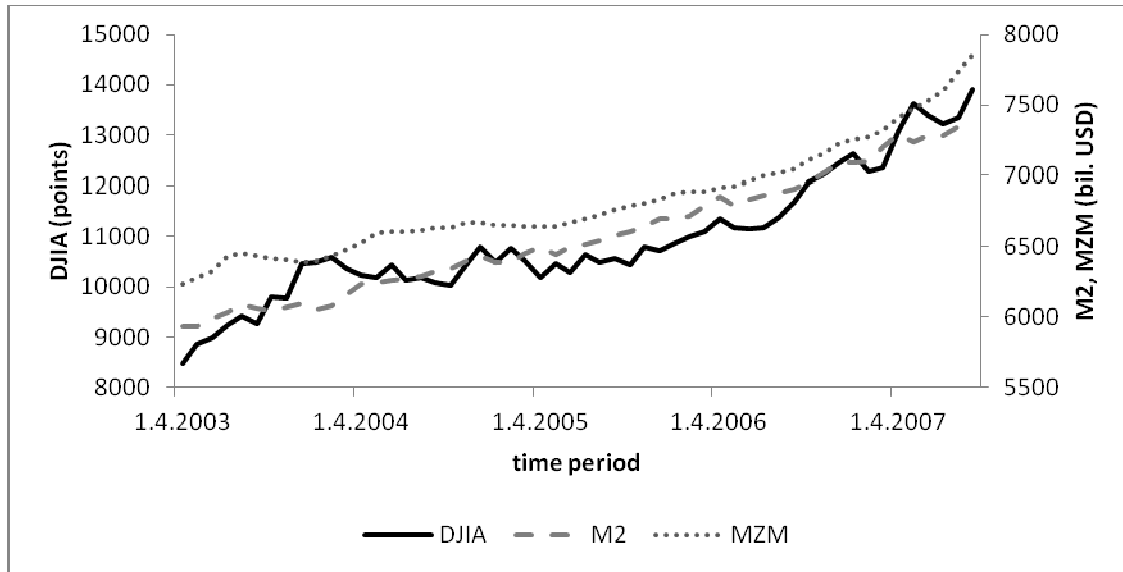
Hypothesis $\alpha = 5 \%$	lag							
	1	2	3	4	5	6	12	18
	F-st.	F-st.	F-st.	F-st.	F-st.	F-st.	F-st.	F-st.
M2 unaffact DJIA	0,1941	0,1816	1,9657	1,4016	1,0487	0,8300	0,8524	1,5250
MZM unaffact DJIA	0,1058	0,0716	0,8867	1,3306	1,0737	1,3074	1,2239	1,2702

Granger test don't found that in this period, when rise the IT bubble, the impact of money supply measured by monetary base M2 or MZM on DJIA index. So in this period is strong premise that money supply wasn't a significant factor which cause this bubble too. This result correspond with **Komárek, Kubicová** (2011), who as the

starter r of this bubble assign oversize future expectations, that's meaning first of all psychological and subjective factors.

The last analyzed bubble was the Subprime bubble, which is connected with the real estate bubble and the financial crisis which started in year 2007/2008. As the main factor which cause the real estate (mortgage) bubble were low interest rates, which allow that the clients with low bonity or credibility reach these mortgage. These clients were not able to repay the mortgage in period when the interest rates began to rise and the bubble was created. But the bubble don't rose only on real estate market, but also on capital market which over three years of stagnation after the IT bubble and attacks from 11. September till second half of 2007 rapidly growth. The monthly growth rate of DJIA index was 0,9650 %, what is approximately only half value then growth in year 1987. Average monthly growth rate in this period of money supply was 0,41 % by monetary base M2 or 0,44 % by monetary base MZM. This values are comparable with monthly growth of money supply in period before burst in year 1987.

Fig. 3 show the development of money supply (both monetary base) and DJIA index since started the growth trend in year 2003 till the collapse in second half of 2007.



3: DJIA and money supply, 2003 - 2007

Results of ADF test for first differences by the variable MZM demonstrated that on 5 % significancy level this first differences are not stationary. Although this variable was set as non-stationary, was in next empirical analysis use these first differences by reason of losing information value of this variable. In addition, **Artl** (2003) warn against “over-differencing”, when we can reach stationary data, but the additional difference can cause a trouble with interpretation (else we have a stationary series, but the curve is very plain, so we lose the information value of this variable).

Tab. III show the results of Granger causality test of the impact of money supply changing on DJIA index on 5 % sificancy level during years 2003 - 2007 when rise the Subprime bubble.

III: Granger causality test, 2003 - 2007

Hypothesis $\alpha = 5\%$	lag						
	1	2	3	4	5	6	12
	F-st.	F-st.	F-st.	F-st.	F-st.	F-st.	F-st.
M2 unaffect DJIA	2,9545	1,4031	0,8290	0,5693	0,3847	0,8235	3,0152
MZM unaffect DJIA	2,7531	3,4553	3,5947	2,7345	3,5827	3,1458	1,9681

Upon to results of Granger causality test can I say, that during the period when rise the new age financial crisis had the nominal money supply measured by the monetary base MZM impact on evolution of DJIA index. Effect of this monetary base was found already from lag 1 month, but only on 10 % significancy level, and on 5 % significancy level from lag 2 month. Only with one year lag was confirm the hypothesis that money supply don't affect stock prices. Other site, the effect of monetary base M2 was confirmed only with the lag of one year. In this period can we recognise higher liquidity of this monetary base and so not so long reaction on changes in money supply. These results confirm results of **Croushore** (2006) study, which mention narrower relation between monetary base MZM and economic evolution.

Pursuant to these results can I say, that nominal money supply measured by monetary base MZM is significant factor, which effect DJIA evolution, first of all in last 10 - 15 years, when growth the market volatility and market volume. That is meaning, that in last two decade growth the impact of central bank activities on capital markets, first of all action as Quantitative easing.

Discussion

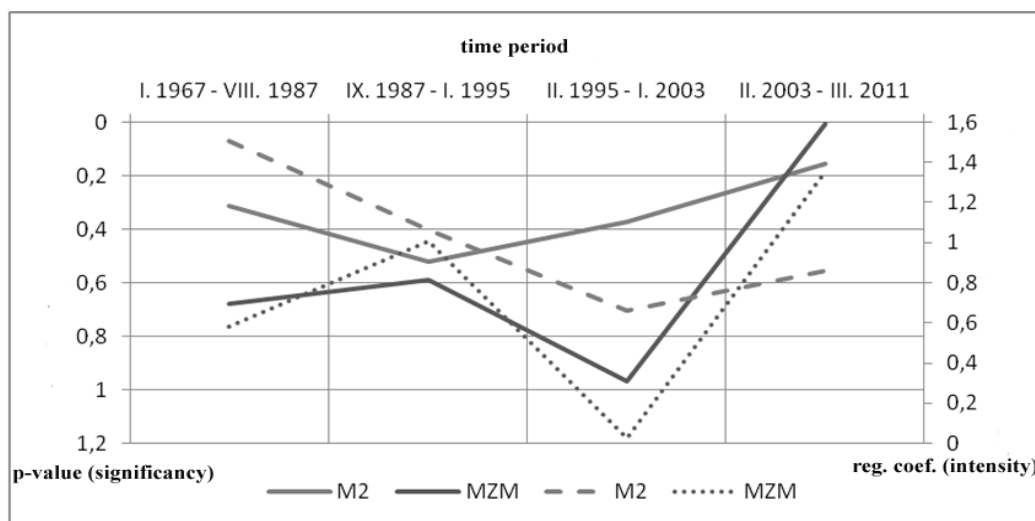
This paper was focus on the topic, if the money supply is significant factor, which cause a stock bubbles or not. As was written, **Kohout** (2009) define a stock bubble as a period in which growth the stock prices with oversize rate during 5 - 10 years in face of the peak. **England** (2003) mention, that investors has only one way how to recognise the bubble and that is the according to P/E ratio and his growth. Following these information, were as analysed bubbles selected the period before crash in year

1987 (Black Monday), period when rise the IT bubble till year 2000 and period before burst of the last financial crisis - Subprime bubble, which started on the real estate market. Upon to Granger causality test wasn't money supply represented by monetary base M2 and MZM marked as macroeconomic factor, who effect the bubble rise in period 1982 - 1987.

Next analysed bubble was the IT Dot.com bubble from year 2000, their consequences don't affect only the NASDAQ market but also the "industrial" Dow Jones index, and other capital markets too. Before the burst of this bubble in year 2000 growth the stock prices first of all of the IT and other companies from technology and innovative branch. The growth was supported with excessively future expectations, so the Granger causality test don't reject the hypothesis, that money supply unafect the stock index. Other words, money supply wasn't set as factor which effect the stock prices in period 1995 - 2000 and which caused the IT bubble. Similarly **Bordo, Wheelock** (2007) mention, that in this period rapidly growth the productivity by lower inflation rate. The productivity growth was connected with the IT boom and future expectations. So it can be the productivity growth which can effect the bubble rise, eventually important role can be played by other non-quantifiable factors, such as just the investors expectations. **Ofek, Richardson** (2001) mention other reasons for the bubble rise, such as limited possibilities of short sell by new listed IT companies. **Němec** (2012) mention that since 2000 can FED and his low interest rate policy during economy growth helped with blow out this bubble. The same mistake can we found several year later by the collapse of real estate market.

Last analysed bubble was the Subprime bubble, which started on the real estate market and bursted in year 2007. The period of the bubble rise were set years from

2003, when the market stopped the stagnation from year 2001, till third quarter 2007. During this period Granger causality test identified causality relationship between monetary base MZM and DJIA index since 2 month lag. That is meaning by this monetary base was rejected the hypothesis that money supply unaffect the stock prices. Also this test confirm, that in last 10 - 15 years growth the effect and sense by this monetary base, what showing Fig. 4.



4: Money supply significany and intensity during the time

Results which were achieved correspond with **Humayum** (2012), who evaluate monetary base MZM as significant factor of stock markets evolution and first of all as factor which cause the new financial crisis and Subprime bubble. Growing sense of money supply by explanation of stock market development confirm **Lucca, Moench** (2012), who mention that under the stock profits in last 15 years stay FED and his policy of lower interest rates.

Summary

This paper analyzed the effect of money supply on stock bubbles rise. Stock market was represented by the US capital market, which was selected according his market

capitalization, concrete by the Dow Jones Industrial Average stock index in monthly close price adjusted of dividends and split. Money supply was represented by nominal monetary base M2 and MZM. On US capital market was found effect of money supply (first of all of monetary base MZM) on bubble rise from year 2007. Other way in the period when rise the Dot.com bubble and the bubble which was ended at the Black Monday crash wasn't money supply set as significant factor, which influence the bubbles rise. In period of the Subprime bubble rising react the stock market on the money changes practically immediately, because it was found that the MZM monetary base effect the stock market with 1 month lag (on 10 % significancy level) or from the lag 2 month on 5 % significancy level. Pursuant to the results can I say that with the growing of market volume and market volatility, for investors growth the significancy and effect of money supply (first of all monetary base MZM). So should investors implement this macroeconomic factor into their investment decisions, just in the period of high market fluctuations. Similar viewpoint hold also **Lucca, Moench** (2012).

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Contact address

Ing. Martin Širůček, Department of finance, Mendel University in Brno, 613 00 Brno, Czech Republic, e-mail: sirucek@gmail.com