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THE EFFECTIVENESS OF THE FEDERAL RESERVE SYSTEM'S MONETARY POLICY IN THE YEARS 1962–2018

Abstract

Background: The monetary policy of the Federal Reserve System affects the term structure of nominal interest rates as well as other asset prices, and thus influences aggregate demand and price levels through these effects. This complex process is known as the monetary transmission mechanism and the transmission process of monetary impulses changes over time. The strength of this impact is a staple subject of economic research.
Research purpose: The aim of the article is to assess the effectiveness of the Federal Reserve System's monetary policy transmission mechanism over the period 1962–2018. In particular, the scale and timing of the interest rate pass-through to economic activity have been examined.
Methods: Econometric methods (the vector autoregression model) have been used. The empirical analysis was carried out based on U.S. economic statistics for the years 1962–2018, which were taken from the FRED and BEA Databases.
Conclusions: Empirical findings reveal that the way in which the Federal Reserve System's monetary policy influenced the U.S. economy was diversified at particular time intervals. The results imply that the effectiveness of the U.S. central bank's interest rate policy has been decreasing since the mid-1980s. Firstly, in the period 1962–1983, the real GDP growth rate and the inflation rate were more sensitive to changes in the federal funds rate than in the period 1984–2018. Secondly, in the period 1962–1983, the effective federal funds rate had an almost threefold greater impact on economic activity and price processes. Thirdly, until the mid-1980s, the effects of monetary impulses were felt longer in the American economy than in the later period. What is more, there is no evidence to suggest that the period of historically low interest rates caused a decline in the effectiveness of the transmission of monetary policy impulses.

Keywords: monetary policy, interest rates, Federal Reserve System.

JEL classification: E44, E52, E58

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1. Introduction

The monetary policy of the Federal Reserve System (Fed), like the monetary policy of any other central bank, affects the term structure of nominal interest rates as well as other asset prices, and thus influences aggregate demand and price levels through these effects[1]. This complex process is known as the monetary transmission mechanism (MTM) and the transmission process of monetary impulses changes over time. The strength of this impact is a staple subject of economic research, from the works of Boivin and Giannoni[2], through the work of Walsh[3], to the article by Endut et al.[4]

There is considerable evidence suggesting that the U.S. economy has fundamentally changed over the past five decades. In particular, there has been a significant decline in the volatility of inflation and in the volatility of economic activity since the early 1980s[5]. The way in which the U.S. central bank conducts its monetary policy has also changed. In the 1970s and the 1990s, significant modifications took place in the way the Fed's monetary policy strategy was formulated and implemented[6]. Therefore, the question remains whether these events were accompanied by changes in the transmission process of monetary impulses to the real economy.

The aim of the article is to assess the effectiveness of the Fed's monetary policy transmission mechanism over the past 50 years. In particular, the scale and timing of the interest rate pass-through to economic activity have been ex- amined. Econometric methods (the vector autoregression model) have been used. The empirical analysis was carried out on the basis of U.S. economic statistics for the years 1962–2018, which were taken from the FRED and BEA Databases.

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1 **M.A. Akhtar**, *Understanding Open Market Operations. Public Information Department*, Federal Reserve Bank of New York 1997, p. 10.

2 **J. Boivin**, **M.P. Giannoni**, *Assessing Changes in the Monetary Transmission Mechanism: A VAR Approach*, Federal Reserve Bank of New York Economic Policy Review 2002/8 (1), pp. 97–111.

3 **C.E. Walsh**, *Monetary policy transmission channels and policy instruments*, Working Paper, University of California, Santa Cruz 2014, pp. 1–60.

4 **N. Endut**, **J. Morley**, **P. Tien**, *The changing transmission mechanism of US monetary policy*, Empirical Economics 2018/54 (3), pp. 959–987.

5 **F. Canova**, **L. Gambetti**, *Structural changes in the US economy: Is there a role for monetary policy?*, Journal of Economic Dynamics and Control 2009/33 (2), pp. 477–490.

6 **D. Brózda-Wilamek**, *Ewolucja strategii polityki pieniężnej FED w latach 1977–2017*, Studia Ekonomiczne. Zeszyty Naukowe 2018/352, p. 30.

2. The monetary policy transmission mechanism

The main task of a central bank is to influence the economy through monetary policy tools. Generally, we may conclude that by causing changes in market interest rates, financial market conditions, and the exchange rate, monetary policy actions have significant effects on output, employment, and prices. Mishkin distinguishes four basic channels of the monetary policy transmission mechanism, i.e.[7]:
1) the interest rate channel,
2) the exchange rate channel,
3) the credit channel,
4) the asset price channel.

Central banks use these monetary policy transmission channels to achieve their main goals, which, in the case of the Federal Reserve System, means promoting maximum employment, maintaining stable prices, and moderating long-term interest rates.

The general scheme of the monetary policy transmission mechanism is presented in Figure 1. When analyzing the system of dependencies[8], it can be observed that monetary policy measures (both current and expected) are directly transferred to the money market and the asset market. These changes then affect the commodity market and the labor market, and, ultimately, aggregate production and prices. Finally, the changes in current and forecast production and inflation rates are included in the latest decisions made by the monetary authorities.

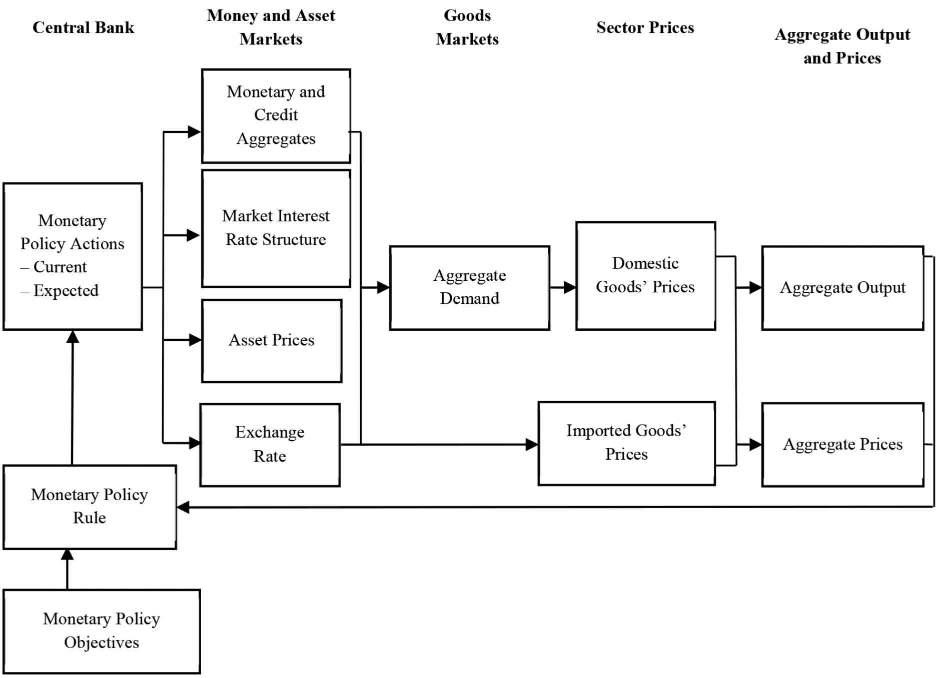
In the study of the monetary policy transmission mechanism, it is important to assess its effectiveness, which is determined by both the speed of this process as well as the scale of economic variables' sensitivity to strength of the monetary impulse. The effectiveness of the monetary policy transmission mechanism depends on its credibility, but also on the structural characteristics of the given economy. It may change over time and tends to be influenced by both structural shocks and the cyclical behavior of the economy. The first type of shocks can permanently affect the strength of a specific channel, while the latter induces temporary fluctuations[9].

[7] **F.S. Mishkin**, *The channel of monetary transmission: lessons for monetary policy*, National Bureau of Economic Research Cambridge (MA) Working Paper 1996/5464, pp. 1–15.

[8] The arrows in Figure 1 depict causality as running from monetary policy to the money and asset market, the labor and goods market as well as aggregate price and output. For simplicity, feedback effects from output and prices to the goods and services markets and, ultimately, to the asset and money markets, are not depicted. The sequence of causality does not suggest precedence in time.

[9] **T. Łyziak**, **J. Przystupa**, **E. Stanisławska**, **E. Wróbel**, *Monetary policy transmission disturbances during the financial crisis. A case of an emerging market economy*, Eastern European Economics 2011/49 (5), p. 89.

FIGURE 1: *The general scheme of the monetary policy transmission mechanism*



Source: **N. Loayza**, **K. Schmidt-Hebbel**, *Monetary Policy Functions and Transmission Mechanisms: An Overview*, in: **N. Loayza**, **K. Schmidt-Hebbel** (eds.), *Monetary Policy: Rules and Transmission Mechanisms*, Central Bank of Chile, 2002, p. 2.

3. The effectiveness of the Federal Reserve System's monetary policy transmission mechanism – literature review

Empirical studies have been conducted on the transmission mechanism of the Federal Reserve System's monetary policy in the United States since the early 1990s. They have appeared quite frequently in the American literature, from the works of Bernanke and Blinder[10], through the work of Brunner[11], to the article by Walsh[12].

10 **B.S. Bernanke**, **A.S. Blinder**, *The Federal Funds Rate and the Channels of Monetary Transmission*, The American Economic Review 1992/82 (4), pp. 901–921.

11 **A.D. Brunner**, *The Federal Funds Rate and the Implementation of Monetary Policy: Estimating the Federal Reserve's Reaction Function*, International Finance Discussion Papers 1994/(466), pp. 1–46.

12 **C.E. Walsh**, *Monetary policy transmission channels…*, pp. 1–60.

At this point, particularly noteworthy is the study of Endut et al.[13], who compared the importance of specific monetary transmission channels in influencing real economic processes. Their paper reveals the changes that have taken place in the Fed's monetary transmission mechanism over the past 50 years. The econometric model estimated by Endut et al.[14] indicates that between 1960 and 1970, the credit channel and the interest rate channel played an equally important role in the monetary policy transmission mechanism. In turn, since 1980, the interest rate channel has been much more important in the transmission of monetary shocks to the real economy in comparison with the credit channel.

The results of a study by Willis and Cao[15] are also particularly interesting. The economists investigated the sensitivity of the American economy to changes in monetary policy, analyzing the interest rate channel and, more specifically, the response of employment to changes in the federal funds rate between 1960 and 2007. Their results suggest that the interest rate sensitivity of employment has declined in recent decades for nearly all industries as well as for the whole economy. Willis and Cao[16] are convinced that the decline in interest rate sensitivity of the American economy is not due to changes in the conduct of monetary policy but due to structural changes in industries and the financial markets.

Other economists have attempted to more generally assess the effectiveness of the Fed's monetary policy transmission mechanism, without precisely distinguishing the monetary transmission channels they are considering. For instance, Romer and Romer[17] showed that between 1969 and 1996, the Fed's monetary policy exerted a large, relatively quick, and statistically significant impact on both production and inflation. Using a VAR model, they noticed that the restrictive monetary policy impulse caused the maximum drop in industrial production about two years after the occurrence of the shock, and in the inflation rate after about four years.

On the other hand, Belviso and Milani[18] used the factor-augmented vector autoregressive model (FAVAR) to evaluate the monetary transmission mechanism.

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13 **N. Endut**, **J. Morley**, **P. Tien**, *The changing transmission mechanism…*, p. 985.

14 *Ibidem*, pp. 959–987.

15 **J. Willis**, **G. Cao**, *Has the U.S. economy become less interest rate sensitive?*, Economic Review 2015/100 (2), pp. 5–36.

16 *Ibidem*, p. 25.

17 **C.D. Romer**, **D.H. Romer**, *A New Measure of Monetary Shocks: Derivation and Implications*, American Economic Review 2004/94 (4), p. 1081.

18 **F. Belviso**, **F. Milani**, *Structural Factor-Augmented VARs (SFAVARs) and the Effects of Monetary Policy*, B.E. Journal of Macroeconomics: Topics in Macroeconomics 2006/6 (3), pp. 1–44.

The period of their research covered the years 1960–1998. The model estimation analysis demonstrates a statistically significant effect of the restrictive monetary policy impulse on real economic activity about a year after the occurrence of the interest rate shock, and on the inflation rate after about three years.

The study conducted by Boivin and Giannoni[19] is also noteworthy. Using a VAR model, they noticed that the influence of the Federal Reserve System's monetary policy on the American economy has decreased since the early 1980s. Between 1980 and 2002, the reaction of production and inflation rate to the monetary policy impulse was much less pronounced and durable. What is more, in this period, the Fed's monetary policy affected economic activity with almost one fourth the strength than in the previous period (i.e., between 1959 and 1979). This regularity is confirmed by the results of research conducted by Bernanke and Mihov[20] and Kuttner and Mosser[21], among others.

Höppner et al.[22], similarly to Boivin and Giannoni[23], confirmed the declining influence of the Fed's monetary policy on the U.S. economy between 1962 and 2002. In addition, they observed that the beginning of the 1980s was a special period for the American economy because the nature of the monetary transmission mechanism changed. They found that the changes in the financial structure that were taking place during this period could have translated into the weakening effects of the monetary policy.

In turn, the results of Canova's and Gambetti's[24] study indicated that the transmission of monetary policy impulses on the U.S. economy was relatively stable over time. However, in contrast to the above-mentioned results of other authors' research, Canova and Gambetti[25] noticed that monetary policy shocks had a greater impact on inflation and economic activity in the period 1967–2006 than between 1959 and 1967.

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19 **J. Boivin**, **M.P. Giannoni**, *Has monetary policy become more effective?*, The Review of Economics and Statistics 2006/88 (3), pp. 445–449.

20 **B.S. Bernanke**, **I. Mihov**, *Measuring Monetary Policy,* Quarterly Journal of Economics, 113 (3), 1998, pp. 869–902.

21 **K.N. Kuttner**, **P.C. Mosser**, *The Monetary Transmission Mechanism: Some Answers and Further Questions*, Federal Reserve Bank of New York Economic Policy Review, May, 2002, pp. 15–26.

22 **F. Höppner**, **C. Melzer**, **T. Neumann**, *Changing effects of monetary policy in the US: evidence from a time-varying coefficient VAR*, Applied Economics 2008/40 (18), pp. 2353–2360.

23 **J. Boivin**, **M.P. Giannoni**, *Has monetary policy…*, pp. 445–462.

24 **F. Canova**, **L. Gambetti**, *Structural changes in the US economy…*, pp. 477–490.

25 *Ibidem*, p. 488.

The latest research on the Fed's monetary transmission mechanism has focused on the effects of the unconventional monetary policy measures which were taken by the Federal Reserve System during the last global financial crisis[26]. Particular attention was paid to the problem of the zero lower bound on nominal interest rates. In general, it may be concluded that unconventional monetary policy instruments have had a positive impact on the real economy by lowering the level of long-term interest rates, which is confirmed by the results of studies by Chung et al.[27] and Christiano et al.[28], among others.

4. Description of the study

To assess the effectiveness of the Fed's interest rate policy between 1962 and 2018, a vector autoregression model was employed, which was introduced into the economic literature by Sims[29] and Litterman and Weiss[30]. This research tool is used to measure the impact of monetary policy on the economy. Examples of such empirical analyses of the monetary transmission mechanism can be found in Peersman[31], or Boivin and Giannoni[32], among others. Analysis of the results of the VAR model estimation might make it possible to determine the manner, strength, and degree of the Fed's interest rate policy impact on the U.S. economy in the period considered in this paper.

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26 Many central banks, including the Fed, have changed their monetary policy from controlling short-term interest rates to liquidity management, with a more pronounced role for stabilising production. The higher liquidity preference of banks, resulting from the sharp increase in uncertainty in the financial market, caused problems with the transmission mechanism from the monetary policy instrument to money market rates and retail rates.

27 **H. Chung**, **J.P. Laforte**, **D. Reifschneider**, **J.C. Williams**, *Estimating the macroeconomic effects of the Fed's asset purchases*, Federal Reserve Bank of San Francisco, Economic Letter 2011/3, pp. 1–5.

28 **L.J. Christiano**, **M. Eichenbaum**, **M. Trabandt**, *Understanding the Great Recession*, American Economic Journal: Macroeconomics 2015/7 (1), pp. 110–167.

29 **C.A. Sims**, *Macroeconomics and reality*, Econometrica 1980/48 (1), pp. 1–48.

30 **R.B. Litterman**, **L. Weiss**, *Money, Real Interest Rates and Output: A Reinterpretation of Postwar US Data*, Econometrica 1985/53 (1), pp. 129–156.

31 **G. Peersman**, *The Transmission of Monetary Policy in the Euro Area: Are the Effects Different Across Countries?*, Oxford Bulletin of Economics and Statistics 2004/66 (3), pp. 285–308.

32 **J. Boivin**, **M. P. Giannoni**, *Assessing Changes in the Monetary Transmission*…, pp. 97–111.

4.1. Research method and assumptions of the model

In this study, similarly to Boivin and Giannoni[33], a simplified specification of the VAR model was employed, which contained a minimum set of variables necessary to estimate the parameters of individual equations. Three endogenous variables are included:

y_t – the natural logarithm of real GDP,
p_t – the natural logarithm of the CPI,
i_t – the Fed's interest rate.

In order to compare the relationship between changes in the Fed's interest rate and American economic activity over the past 50 years, three VAR models for different time intervals were estimated, i.e.:

1) model I, in which the period from the third quarter of 1962 until the 4th quarter of 1983 was considered,
2) model II, in which the sample covered the period from the first quarter of 1984 up to the 3rd quarter of 2007,
3) model III, taking into account the global financial crisis, in which the period from the fourth quarter of 2007 until the 4th quarter of 2018 was considered.

The selection of the first two subperiods was dictated by the fact that complete statistics for the US economy have been available since 1962, on the other hand, the mid-1980s is a special period in the history of the American economy. At that time, most economic indicators reduced their volatility by around 60–70% compared to the 1970s. In the literature, this period is referred as the Great Moderation of the US economy. In most scientific studies it is assumed that this period lasted from the beginning of 1984 until the end of 2007.

Before estimating the VAR model using the Ordinary Least Squares (OLS) method, the time series were tested for the presence of the unit roots, since the desirable feature of the VAR system is its stationary nature. Non-stationary levels of the variables representing the U.S. economy has forced the transformation of the functional form of the model by using the first differences in natural logarithms for individual variables. Due to the fact that the study included quarterly data, the first differences of the variables (annualized) were calculated according to the following formula:

$$\Delta x_t = [\ln(x_t) - \ln(x_{t-1})] * 4 \qquad (1)$$

[33] **J. Boivin**, **M. P. Giannoni**, *Has monetary policy…*, p. 447.

where:
x_t – the value of the variable X in period *t*,
x_{t-1} – the value of the variable X in period *t*–1.

Modification of the variable representing the level of interest rates (i.e. calculation the first differences of the interest rates) would result in the loss of critical information from the point of view of this study. For this reason, ultimately, VAR models that incorporate interest rate levels were estimated. This practice is widely used in the current empirical analyzes on the effects of monetary policy in the U.S. economy, as might be seen in a study conducted by, among others, Höppner et al.[34] and Endut et al.[35]

In VAR models I and II, the effective federal funds rate was taken into account as the variable determining the level of the official Fed interest rate. This interest rate is commonly used in research on the monetary transmission mechanism of the Federal Reserve System, e.g., Bernanke and Blinder[36], or Bernanke and Mihov[37], even though the Fed's operating procedure has changed over the last 50 years. In turn, in model III, which takes into account the period of the zero lower bound on nominal interest rates, the monetary policy impulse is approximated by the shadow federal funds rate, estimated by Wu and Xia[38]. The main advantage of such a VAR model specification is that the shadow federal funds rate is not limited by the zero lower bound and adopts negative values from mid-2009 to the end of 2015 (see Figure 2).

The lag value of the VAR models was determined as a result of the information criteria, which include the information criterion of Akaike (AIC), Schwartz (BIC) and Hannan-Quinn (HQ)[39]. Based on the data presented in Table 1, the study adopted two lags (i.e., two quarters) between independent variables and dependent variable.

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34 **F. Höppner**, **C. Melzer**, **T. Neumann**, *Changing effects of monetary policy in the US…*, pp. 2353–2360.

35 **N. Endut**, **J. Morley**, **P. Tien**, *The changing transmission mechanism…*, pp. 959–987.

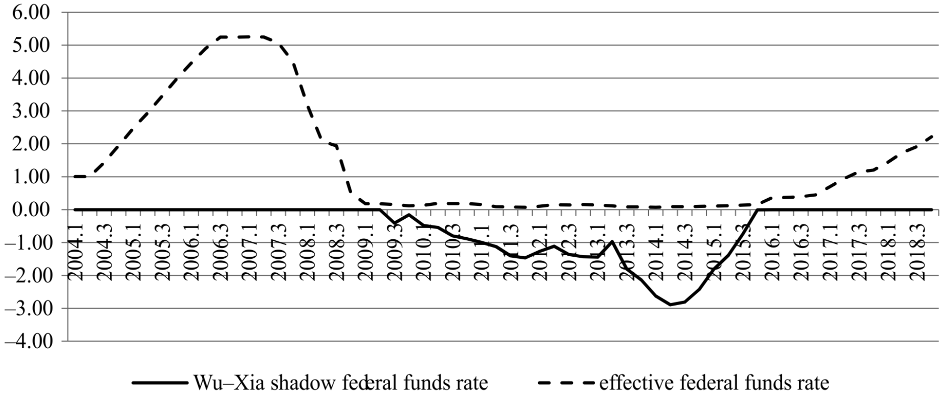
36 **B.S. Bernanke**, **A.S. Blinder**, *The Federal Funds Rate…*, pp. 901–921.

37 **B.S. Bernanke**, **I. Mihov**, *Measuring Monetary Policy…*, pp. 869–902.

38 **J.C. Wu**, **F.D. Xia**, *Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound*, Journal of Money, Credit & Banking 2016/48 (2–3), pp. 253–291.

39 **T. Kufel**, *Ekonometria. Rozwiązywanie problemów z wykorzystaniem programu GRETL*, Wydawnictwo Naukowe PWN, Warszawa 2007, p. 157.

FIGURE 2: *Level of the shadow federal funds rate in the period 2004–2018 (in %)*



S o u r c e: own study based on www.frbatlanta.org/cqer/researchcq/shadow_rate.cfm; accessed 13.03.2019.

TABLE 1: *The values of the information criteria for models I, II and III, which were estimated for data representing the U.S. economy in the years 1962–2018*

lags	logLik	p(LR)	AIC	BIC	HQC
1962:3–1983:4					
1	−529.56396		12.894380	13.241639	13.033975
2	−507.26022	0.00000	12.577624	13.185329*	12.821916
3	−492.93409	0.00074	12.450812*	13.318961	12.799800*
4	−487.69916	0.31380	12.540456	13.669050	12.994141
1984:1–2007:3					
1	−414.80940		8.985461	9.308056*	9.115814
2	−395.29017	0.00001	8.764004*	9.328545	8.992121*
3	−388.87845	0.17076	8.818494	9.624981	9.144375
4	−383.86884	0.34893	8.902502	9.950936	9.326148
2007:4–2018:4					
1	−211.74620		9.944276	10.426052*	10.123877*
2	−201.89052	0.01978	9.906245	10.749354	10.220548
3	−192.41823	0.02567	9.885254*	11.089696	10.334258
4	−185.34474	0.11719	9.970877	11.536651	10.554582

N o t e: The asterisks (*) indicate the best (that is, minimized) values of the respective information criteria.
S o u r c e: own calculations.

The single VAR model used in this study for three endogenous variables consists of three equations with an identical structure. In each equation, all variables are included in the system, as explanatory variables, but they are delayed by two quarters. The general form of the model can be written as follows[40]:

$$x_t = A_0 D_t + A_1 x_{t-1} + A_2 x_{t-2} + \varepsilon_t \tag{2}$$

where:

D_t – vector deterministic variables,
A_0 – parameter matrix (3 × 1) represents deterministic variables,
A_i $i = 1, 2$ – coefficient matrix (3 × 3) represents delays of endogenous variables,
$\varepsilon_t - 3$ – dimensional vector of random components (3 × 1),
$x_t = [\Delta y_t \ \Delta p_t \ i_t]'$ – vector of endogenous variables,
Δ – the difference operator.

The VAR model is useful for research when the development of endogenous processes in relation to random components is convergent and produces stationary processes. Kufel emphasizes that the basic assumption of the practical application of the VAR model is the condition which indicates that all elements of the characteristic polynomial should be less than module from unity[41].

Inverse Roots of AR Characteristic Polynomial for the VAR I, II and III models indicate that all roots lie inside the unit circle, which is an indication that the VAR models are stable and have good properties. After using the VAR model, impulse response functions (IRFs)[42] and forecast error variance decompositions (FEVD)[43] can be produced. Both computations are useful in assessing how shocks to economic variables reverberate through a system.

What is extremely important for this study is that, based on the VAR model estimates, the value of the monetary transmission effectiveness indicator (MTE) can also be calculated. This coefficient determines the degree of intensity of the monetary policy impulse transmission to the economy and might be recorded by using the following formula[44]:

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40 **E. Kusideł**, *Modele wektorowo-autoagresyjne VAR: metodologia i zastosowania*, Wydawnictwo Absolwent, Łódź 2000, p. 16.

41 **T. Kufel**, *Ekonometria*…, pp. 169–170.

42 Impulse response functions – it makes it possible to identify the strength and speed of the pass-through of monetary policy decisions to economic activity.

43 Forecast error variance decompositions of variables – it measures the contribution of each type of shock to the forecast error variance.

44 **T. Łyziak**, **J. Przystupa**, **E. Stanisławska**, **E. Wróbel**, *Monetary policy transmission disturbances*…, p. 81.

$$MTE_{y_1 \to y_2, y_A} = (1 - pv_{A,1})(1 - pv_{2,A}) \frac{\left| e_{y_2/y_1, y_A} \right|}{(1 + \left| e_{y_2/y_1, y_A} \right|)} \quad (3)$$

$$e_{y_2/y_1, y_A} \quad (4)$$

where:

y_1 – instrumental variable,

y_2 – target variable,

y_A – intermediation variable in the monetary transmission mechanism,

pv – the p-value for the parameters at respective variables,

$e_{y_2/y_1, y_A} = e_{y_2/y_A} \times e_{y_A/y_1}$ – standardized elasticity between instrumental (y_1) and target (y_2) variables with the intermediation of variable (y_A). Indirect elasticity can be decomposed into a product of direct elasticities between the extremities of each link inside the transmission chain.

It should be noted that the indicator defined by formula (2) depends on the estimates of the parameters (i.e., recursive coefficients) with endogenous variables accompanying the particular monetary transmission channel and their statistical significance. This coefficient has values arranging from 0 to 1.

4.2. The results of the empirical analysis

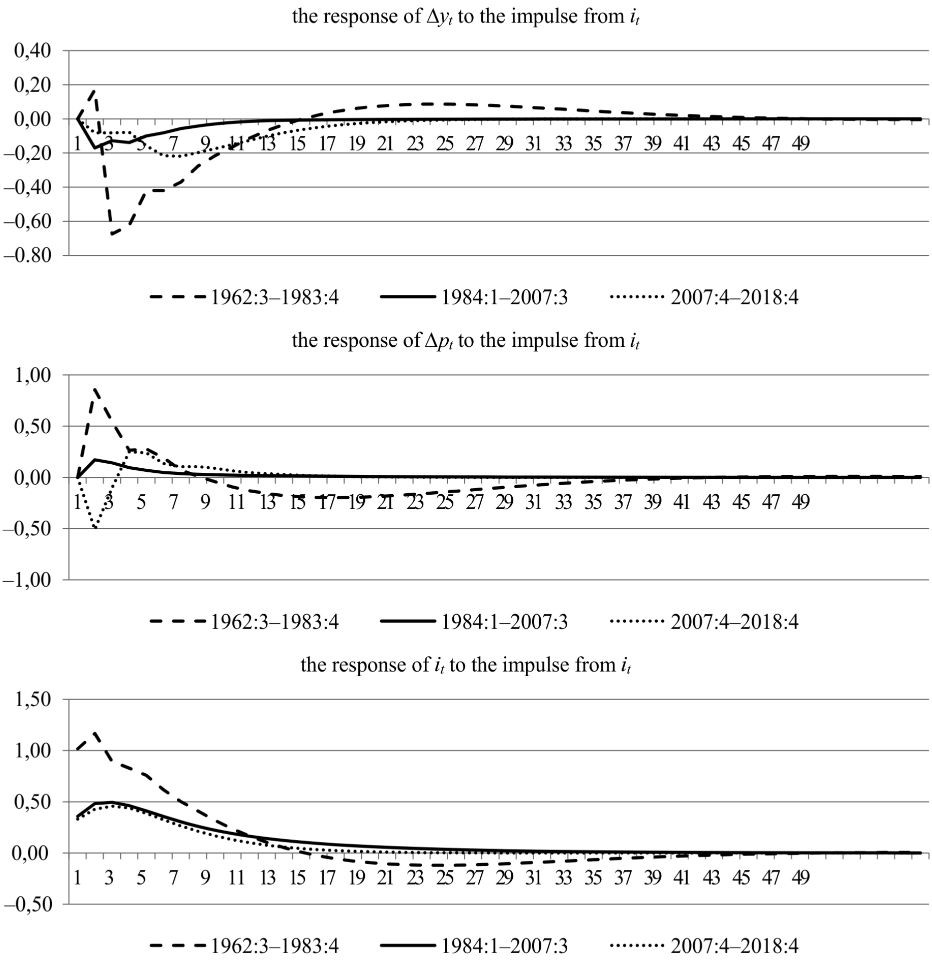
As can be seen from Figure 3, the curves present the responses of the macroeconomic variables to an unexpected increase in the effective federal funds rate in the next 50 quarters over the period 1962–2018. Considering the individual impulse response functions, a time-delayed reaction of variables included in the VAR model to the short-term interest rate shock[45] can be noticed.

In line with economic theory, the reaction function of the economic growth rate reveals that the rise in the Fed's interest rate causes a decline in the growth of real GDP and then there is a long return to equilibrium. The maximum impact of the monetary policy tightening on the change in the aggregate demand dynamics was observed between the 3rd and 4th quarters in the years 1962–1983 and after about three quarters in the years 1984–2007.

[45] The short-term interest rate shock means that it is an impulse of size a one-standard error in the equation of the effective federal rate.

Furthermore, the in-depth analysis indicates that since the mid-1980s, the effective federal rate has affected the real economy with almost three times less force than in the previous period. It should also be noted that during the global financial crisis, the interest rate impulse influenced the rate of economic growth with a large delay. The maximum negative reaction of this variable was visible six quarters after the occurrence of the monetary policy shock.

FIGURE 3: *Impulse response functions of macroeconomic variables to interest rate shock in the period 1962–2018*



S o u r c e: own calculations.

The analysis of the inflation rate response function to a monetary policy impulse shows that the rise in the effective federal rate had a maximum impact on the change in the general price level after around 15 quarters in 1962–1983 and after 12 quarters in 1984–2007 (see Figure 3). On the one hand, it is worth noting that since the mid-1990s, the time necessary for the price reaction to tighten the monetary policy stance has been shortened. On the other hand, the impact of the interest rate on this macroeconomic variable decreased.

What is more, it is worth stressing that the function of the inflation rate had an atypical course in response to the restrictive monetary impulse in the years 2007–2018 compared to the previous period. The effect of an increase in the shadow federal funds rate was an immediate decrease in the value of the indicated variable (after about 2–3 quarters), and then its increase and a gradual return to balance about 15 quarters after the shock. These observations may reflect the scale of the disorder which the U.S. economy was subjected to after the collapse in the subprime market in August 2007. It may also indicate the effectiveness of the Fed's monetary policy conducted under conditions of the zero lower bound on nominal interest rates.

Additionally, in Figure 3, the auto-responding graph of the effective federal funds rate between 1962 and 2018 is presented. The one-off short-term interest rate shift caused an even greater increase in the first two quarters, after which the interest rate impulse gradually disappeared over six years.

TABLE 2: *Forecast error variance decompositions of variables in the VAR I, II and III models*

	1962:3–1983:4			1984:1–2007:3			2007:4–2018:4		
	variance decompositions for Δy_t variable								
on average a year	shock Δy_t	shock Δp_t	shock i_t	shock Δy_t	shock Δp_t	shock i_t	shock Δy_t	shock Δp_t	shock i_t
1	96%	2%	2%	98%	1%	1%	99%	1%	0%
2	86%	6%	8%	96%	2%	2%	96%	2%	2%
3	81%	10%	9%	95%	3%	2%	93%	2%	4%
4	78%	13%	9%	95%	3%	2%	93%	2%	5%
5	77%	15%	8%	95%	3%	2%	93%	2%	5%

on average a year	variance decompositions for Δp_t variable								
1	3%	85%	12%	3%	95%	2%	30%	66%	4%
2	3%	84%	13%	7%	90%	3%	31%	61%	7%
3	3%	87%	10%	8%	89%	3%	31%	61%	8%
4	3%	86%	10%	8%	89%	3%	31%	61%	8%
5	4%	85%	11%	8%	88%	3%	31%	61%	8%
on average a year	variance decompositions for i_t variable								
1	16%	9%	75%	20%	11%	70%	12%	3%	86%
2	25%	15%	59%	42%	11%	47%	13%	5%	83%
3	23%	26%	51%	50%	9%	40%	13%	5%	82%
4	20%	33%	46%	53%	9%	38%	13%	5%	82%
5	20%	36%	44%	54%	8%	38%	13%	5%	82%

S o u r c e: own calculations.

The interaction analysis between the variables included in the VAR model has been supplemented with an assessment of the forecast error variance decompositions. In this study, the share of the interest rate shock in the variance decompositions of the individual variables was adopted as a measure of the relationship between monetary policy and the real sphere of the economy. The results presented in Table 2 show that until the mid-1980s, the volatility of real GDP growth rate at 8% and 15% was explained by the shock of the effective federal funds rate and the shock of inflation rate, respectively, after five years. In turn, between 1984 and 2018, the sensitivity of the real GDP growth rate to all structural shocks was marginal and did not exceed 3%, on average, after 5 five years.

The inflation rate equation – the VAR model covering the years 1962–1983 – suggests a significant impact of monetary shock (around 11%) on the volatility of the inflation rate. However, since the mid-1980s, as in the case of the economic growth rate, inflation volatility is no longer an effect of the Fed's interest rate policy shock. Between 1984 and 2007, the sensitivity of price processes to the shift in the effective federal funds rate was at a low level, around 3%, on average, after five years.

In turn, in the case of the effective federal funds rate, between 1984 and 2007, the shock coming from this variable had the biggest share in forecast error variance decompositions; initially, it was over 70%, then it decreased to about 40% after four years. The share of the price shock was lower, which in the initial period was at a level of about 20%, while in the period 1984–2007 it decreased to about 10%. Therefore, it may be assumed that by the mid-1980s, the Fed, while making decisions concerning interest rates, was trying to stabilize both the economy and price levels. From the mid-1980s, however, it primarily sought to support economic growth.

The results of the forecast error variance decomposition of variables included in the VAR models are consistent with the results of other authors' research. Both Boivin and Giannoni[46], as well as Leeper et al.[47] noted that the share of monetary policy shocks in changes in output and inflation had sharply decreased since the mid-1980s. While between 1963 and 1979, about 20% of the variance of production was explained by the interest rate shock, in the period 1984–1997, it dropped to 3%. The situation was similar in the case of price developments, as the inflation rate variance decreased by half after such shocks. According to some researchers, this situation may mean that monetary policy has decreasing impact on the functioning of the economy. In turn, Boivin and Giannoni[48] are convinced that the Fed's monetary policy is characterized mainly by an endogenous reaction to changes taking place in the economy, and even a small change in monetary policy can have a significant impact on production and inflation.

It is worth emphasizing that during the recent global financial crisis, the structure of the forecast error variance decomposition of variables changed slightly. In particular, it should be noted that the decomposition of the economic growth rate did not change compared to the previous period. In the case of the inflation rate and the Fed's interest rate, a significant modification in their variance decomposition took place. Firstly, between 2007 and 2018, in explaining the error of the inflation rate forecast, the share of the shock from the real GDP growth rate increased from 7 to 31%, and the share of the monetary policy shock from 3% to 7%. Secondly, in the period 2007–2018, the variable representing the Fed's monetary policy instrument (i.e., the shadow federal funds

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46 **J. Boivin**, **M.P. Giannoni**, *Assessing Changes in the Monetary Transmission*…, p. 102.

47 **E.M. Leeper**, **C.A. Sims**, **T. Zha**, *What Does Monetary Policy Do?*, Brookings Papers on Economic Activity 1996/2, pp. 1–63.

48 **J. Boivin**, **M. P. Giannoni**, *Assessing Changes in the Monetary Transmission*…, p. 102.

rate) was less sensitive to a shift in inflation expectations and economic activity, which confirms the non-standard nature of this tool used in the indicated period.

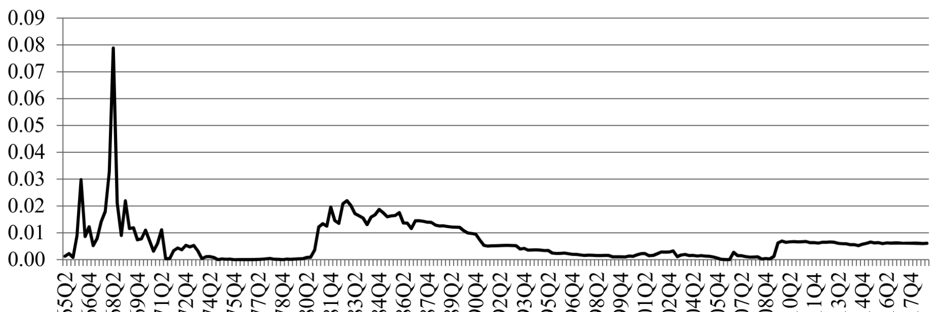
In order to conduct a more in-depth assessment of the Fed's monetary policy transmission mechanism over the last 50 years, the value of the MTE index was also calculated. The level of this measure was computed based on the VAR model estimated for the entire research period (i.e., the sample covering the years 1962–2018), where:

– from the equation of the real GDP growth rate (Δy_t), the parameter estimates at the effective federal funds rate (i_t) were selected,
– from the equation of the inflation rate (Δp_t), the parameter estimates at the real economic growth rate (Δy_t) were chosen,
– from the equation of the effective federal funds rate (i_t), the parameter estimates at the inflation rate (Δp_t) and at the real economic growth rate (Δy_t) were selected.

Therefore, it was accepted that movements in the effective federal funds rate affect the real economy, which has an impact on the inflation rate. However, the level of the effective federal funds rate is shaped by changes in the economic activity and price expectations in the U.S. economy.

As presented in Figure 4, the level of the MTE indicator for the Fed's monetary policy impulse makes it possible to observe several important regularities. Firstly, it may be noted that in the 1960s, the MTE index reached its highest level. The trend then reversed, and the indicator gradually lost its value after the early 1980s. Between 1981 and 1990, this coefficient level remained elevated and relatively stable. From the beginning of the 1990s until the outbreak of the global

FIGURE 4: *The level of the MTE indicator for the Fed interest rate policy in the period 1965–2018*



S o u r c e: own calculations.

financial crisis, the effectiveness of the Fed's monetary transmission mechanism gradually decreased. It is worth noting that between 2010 and 2018, the MTE index reached a level from the early 1990s, which confirms the relative effectiveness of the non-standard monetary policy adopted by the Fed in this period.

5. Summary

The results of that survey revealed that the way in which the Fed's monetary policy influenced the U.S. economy was diversified at particular time intervals. It may be concluded that the effectiveness of the U.S. central bank's interest rate policy has been decreasing since the mid-1980s, which is confirmed by several regularities.

Firstly, in the period 1962–1983, the real GDP growth rate and the inflation rate were more sensitive to change in the federal funds rate than in the period 1984–2018. Secondly, in the period 1962–1983, the effective federal funds rate had an almost threefold greater impact on economic activity and price processes. Thirdly, until the mid-1980s, the effects of monetary impulses were felt longer in the American economy than in the later period. Furthermore, there is no evidence to suggest that the period of historically low interest rates caused a decline in the effectiveness of the transmission of monetary policy impulses.

To summarise, the picture of the monetary policy transmission mechanism in the United States that emerges from this paper is consistent with the findings of previous research. However, it remains an open question why does the impact of monetary policy on real activity appear to be less than it was in the past? In order to answer this question, extended research requires a detailed analysis of the American economy's features that might have a potential impact on the monetary transmission mechanism.

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EFEKTYWNOŚĆ POLITYKI PIENIĘŻNEJ SYSTEMU REZERWY FEDERALNEJ W LATACH 1962–2018

Abstrakt

Przedmiot badań: Polityka pieniężna Systemu Rezerwy Federalnej wpływa na strukturę terminową stóp procentowych oraz ceny aktywów, znajdując w ten sposób odzwierciedlenie w zmianie wielkości zagregowanego popytu i poziomu cen. Ten skomplikowany proces jest określany w literaturze jako mechanizm transmisji polityki pieniężnej. Siła tego oddziaływania jest jednak wciąż przedmiotem badań, a sam proces transmisji impulsów monetarnych do realnej gospodarki podlega zmianom w czasie.
Cel badawczy: Celem artykułu jest ocena efektywności mechanizmu transmisji impulsów polityki pieniężnej Fed w latach 1962–2018. W opracowaniu tym zbadano w szczególności skalę i czas przekładania się zmian stopy procentowej Fed na gospodarkę realną oraz stopę inflacji w różnych interwałach czasowych.
Metoda badawcza: Zastosowano różne metody badawcze m.in. krytyczną analizę literatury przedmiotu oraz metody ekonometryczne – model VAR. Badanie przeprowadzono na podstawie danych statystycznych dla amerykańskiej gospodarki za lata 1962–2018, zaczerpniętych z internetowych baz danych FRED oraz BEA.
Wyniki: Wyniki empiryczne pokazują, że sposób, w jaki polityka pieniężna Systemu Rezerwy Federalnej wpływała na amerykańską gospodarkę, był zróżnicowany w określonych odstępach czasu. Wyniki wskazują, że efektywność polityki stóp procentowych amerykańskiego banku centralnego zmniejszyła się od połowy lat 80. XX w. Po pierwsze, w latach 1962–1983 tempo wzrostu realnego PKB i stopa inflacji charakteryzowały się większą wrażliwością na zmianę stopy funduszy federalnych niż w latach 1984–2018. Po drugie, w latach 1962–1983 efektywna stopa funduszy federalnych oddziaływała z prawie trzykrotnie większą siłą na aktywność ekonomiczną i procesy cenowe. Po trzecie, do połowy lat 80. XX w. skutki impulsu monetarnego były dłużej odczuwalne w amerykańskiej gospodarce niż w późniejszym okresie. Co więcej, nie znaleziono dowodów, by sądzić, że okres historycznie niskich stóp procentowych powodował spadek efektywności transmisji impulsów polityki pieniężnej.

Słowa kluczowe: polityka pieniężna, stopa procentowa, System Rezerwy Federalnej.