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The Czech National Bank's monetary policy since 2008 and its (un)intended consequences in the long run

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Abstract

Aim: The article aims to show that the monetary policy of the Czech National Bank (CNB) between 2008 and 2021 was mainly expansionary, especially due to foreign exchange interviews realized by the bank from November 2013 to April 2017 to prevent CZK appreciation. The policy contributes to higher Czech inflation from the first half of 2022 to the first half of 2024.

Methodology: The relationships between monetary aggregates (M1, M2 and M3 and the stock of CNB foreign exchange reserves) and between the reserves, money stock and inflation are statistically investigated. The article uses, among others, the Augmented Dickey-Fuller test and F-test of the ANOVA procedure. It also discusses how household consumption and government expenditure, mainly in the period since 2021, contributed to the Czech inflation.

Results: The study revealed the strong dependence of the development of Czech monetary aggregates (both M1 and M2, and M3) on the development of the stock of the CNB's foreign exchange reserves. It further proved, using the quantitative equation of money, that the growth of Czech money stock, although partly offset by the negative value of Czech money velocity growth rate, led to the increase in Czech inflation numbers.

Originality/value: The article emphasizes that although monetary policy, including forecasts of economic development, focuses on a period that usually does not exceed two years from taking a specific

monetary policy step (e.g. a decision by the central bank to increase or decrease rates) or from the publication of a forecast, i.e. the monetary policy horizon covers up to two years, especially if an expansionary monetary policy is carried out for a longer period. Thus, a central bank should evaluate such a policy, including the issue of how the growth of the value of monetary aggregates can influence inflation values behind the monetary policy horizon. The article further proved that money is neutral in the long run and money growth higher than the growth rate of real GDP must inevitably lead to an increase in inflation. Thus, the CNB expansionary monetary policy had some (un)intended consequences and the central bank faced in the period 2022-2024 higher inflation.

Keywords: foreign exchange intervention, quantitative theory of money, inflation, monetary aggregates, Czech National Bank, Czech Republic/Czechia

1. Introduction

Economic theory typically assumes that monetary policy is neutral in the long run (Friedman, 1968; Lucas, 1996; also Cerra et al., 2023 for a more recent literature review). That is, central bank actions such as lowering policy interest rates cannot be used to stimulate the economy indefinitely because the result of such a policy will ultimately only be an increase in inflation. It is accepted (e.g., Bernanke, 2020) that, in the short run, a central bank decision can bring effect after some time lag (usually between 12–24 months; see Czech National Bank, 2022 for details) value of inflation, GDP, and real interest rate. Due to lags in its efficiency, the central bank's monetary decision should not only concentrate on the current level of inflation, but especially target the inflation value in time when a monetary decision becomes effective. The actual value of inflation in the future is then affected by relevant past central bank decisions affecting expected inflation, demand and supply shocks that occurred after those decisions, and other factors. Central banks now usually do not pay special attention to the development of the money supply because the relationships between this indicator and variables such as GDP growth and inflation became over recent decades (for many economies at least from the nineties of the 20th century) quite unstable (Federal Reserve, n.d.). However, in the medium and long-run monetary policy should not affect either output or the real interest rate (Lucas, 1996; Bullard, 1999, also see Vary, 2021 or Jordá et al., 2023 for current research, including the objections to long-run money neutrality). Output returns to potential, and the real interest rate returns to its natural rate. Money growth that does not correspond in the long run with real output growth still causes inflation or deflation. From that point of view, central banks should ask about the long-term consequences of their decisions and investigate the impact of the change in money supply on the price level.

The last approximately 15 years have brought to the field of monetary policy many extraordinary events, such as the financial crisis after 2007 (the so-called Great Recession, see Akerlof et al., 2014), the euro-debt crisis, the period of low or even zero/ negative interest rates in many countries, when some of them were hit by deflation, the use of unconventional inflation tools like quantitative easing, the Covid-19 crisis connected with both negative demand and supply shock or with the breakdown of traditional business relations, the Russian-Ukraine conflict leading to the shortage in many inputs, and other circumstances. Such an unstable and unclear environment obscures the fact that the quantity of money still in the long run affects the value of nominal GDP and inflation. The central bank decisions causing money supply growth, when growth gets ahead of the real GDP growth rate, had in this environment often no or little impact on current or medium inflation due to unstable demand, uncertainty, and the unwillingness of business people to start new projects as they do not believe in their success (negative "animal spirit" and low "state of confidence" – see Keynes, 1936; Koppl, 2014), etc., but this will become evident after some time. The relationship between money supply and inflation can be blurred – a relatively long-term lag hides its essence.

The article concentrates on the monetary policy of the Czech National Bank (CNB) for the period 2008-2021, when the Czech economy, similarly to other economies, was hit firstly by the global financial

crisis (Great Recession) and then, after some years, by the Covid-19 crisis. As the figures show, the CNB's response to both crises was EU monetary expansion. Unlike other banks, the CNB combined a policy of reducing interest rates when they reached the value of "technical zero" (see Section 3 of the article) with a policy of foreign exchange interventions. The interventions took place between November 2013 and April 2017 to prevent the appreciation of the Czech crown (CZK) to the euro (EUR); the CZK formally followed the floating exchange rate regime, but the CNB decided to intervene if the currency appreciated on the exchange market below the exchange rate of 27 CZK per 1 EUR (expressed in direct quota). The exchange rate had to be kept above this value. When it intervened, the CNB bought foreign currency and increased both the stock of foreign exchange reserves and the amount of domestic money (CZK) in circulation, i.e., realized monetary expansion. The study investigated how, in the case of the Czech Republic, the change in the stock of foreign exchange reserves affected monetary aggregates and how the change in money supply affected Czech inflation, and further discussed whether Czech monetary expansion caused inflation. The article is organized as follows: Section 2 gives a short literature review and theoretical background concerning foreign exchange intervention, concentrating on the interventions by the CNB in the above-mentioned period. Section 3 describes the CNB's monetary policy since 2008, while Section 4 describes the material and the methods. Section 5 provides the research results, which are then discussed in Section 6. Conclusion summarises the main points.

2. Foreign exchange intervention: literature review and theoretical background

The standard monetary policy (the New Keynesian Macro model) used by the central banks of most developed countries is based primarily on the concept of a new consensus in macroeconomics (Brčák, & Křížek, 2021). It synthesizes the teachings of Keynes, improved by his successors and neoclassical economics schools. The main instrument was interest rates, set up based on current and expected inflation, targeted inflation or inflation that a central bank tries to achieve, and GDP, including the output gap to potential GDP (Taylor, 2000; Cottrell, 2018). However, the policy of changes in central banks' interest rates proved insufficient during the financial and subsequent economic crisis. Thus many central banks adopted an unconventional monetary policy, which took different forms, but always with the common goal, namely stable price level growth and, at the same time, support for economic growth. The most common form was – mainly in the second decade of this century – the so-called quantitative easing (QE). This can be defined (Blanchard, 2021; Rasure, & Munichiello, 2022) as the situation when a central bank buys assets other than short-term bonds to decrease the premium on those assets and thus decrease the corresponding borrowing rates to stimulate economic activity. Central banks did this by financing their purchases through money creation, leading to a large increase in the money supply. QE creates new bank reserves, providing banks with more liquidity and encouraging lending and investment.

Both quantitative easing and exchange rate intervention increase the money supply, but exchange rate intervention does not directly decrease the risk premium and interest (yields) of assets. Using exchange rate interventions as a tool to increase inflation and prevent deflation is quite unusual. The interventions are typically used to affect the value of an exchange rate (Ghosh et al., 2016); the effectiveness of this policy has been broadly discussed. Cavusoglu (2010) and Filardo et al. (2022), reviewing studies investigating interventions' effectiveness, found that they have a significant short-term effect on exchange rates, mainly through the signalling and coordination channels. However, whether these interventions have been effective in the longer term is questionable. They were later typically used in the situation of positive interest rates (higher than 1%).

Lízal and Schwarz (2017) mentioned that if the zero lower bound (ZLB, i.e. interest rates of a central bank are close to zero) is taken into consideration, only two countries have had experience with such interventions – Switzerland and Japan. Both of these countries were, however, very specific cases being considered to be safe haven currencies and reserve currencies and their central banks struggled to keep their currencies from further appreciation during periods of flight to safe assets (see Vesna

2020 for other details). Israel can be used as another example; it is, just like the Czech Republic, a small open economy. The Bank of Israel (BoI) targets inflation, and the Israeli spot FX market is similar in size to the Czech one. The BoI implemented some interventions during the Great Recession between 2008 and 2012, but they were motivated by exchange rate policy considerations rather than by FX being a monetary policy tool.

To the best of the author's knowledge, the CNB is the only central bank that carried out foreign exchange intervention in the ZLB situation, aiming to increase inflation. This intervention was based on the model given in the article by Svensson (2001), which discusses the transmission mechanism of monetary policy in an open economy with ZLB. Svensson's model shows that domestic inflation positively depends on expected future domestic inflation (the inflation-expectations channel to domestic inflation) and marginal cost of production. The latter is affected by the output gap (the aggregate demand channel to domestic inflation) and by the exchange rate (via imported intermediate inputs; the exchange rate channel to domestic inflation). If a central bank depreciates its currency, it (ceteris paribus – mainly if other central banks do not realize the same policy) causes a real depreciation of the domestic currency which stimulates aggregate demand and inflation via exchange-rate channel when changes in the exchange rate induce changes in the relative prices of goods and services, and the level of spending by individuals and firms. Depreciation should lead to higher demand for domestic goods and thus increase their prices which are also affected by higher prices of imported inputs (such as oil), generally resulting in higher inflation. Alichi et al. (2015), based on Svenson's study, emphasized that: 1) pegging temporarily at a depreciated exchange rate is always feasible. The central bank can purchase as much foreign currency as it wishes, thereby putting a floor on the exchange value of the foreign currency; 2) the abandonment of the exchange rate peg in favour of targeting price levels and/or inflation once the higher announced price level target is reached, will minimize concerns about long-term inflation, and thereby maintain an anchor for long-term inflation expectations.

3. Analysis of Czech central bank monetary policy since 2008

CNB has been targeting inflation since 2007. Since 2010 its current target is 2% with a tolerance of ± 1%. The bank generally follows the rule that if current and forecast inflation values are above/below the target, it increases/decreases its interest rates. As the bank mentions on its website (CNB n.d.a): "The CNB's key interest rate is the two-week (2W) repo rate. The central bank uses it as the upper-limit interest rate on its repo operations, through which it steers short-term market interest rates. Owing to a long-standing liquidity surplus in the Czech economy, the CNB absorbs liquidity in its repo operations and provides banks with securities as collateral. When the transaction is arranged, the two parties conclude a repurchase agreement, which means that at maturity, the CNB repays the principal of the loan plus interest, and the creditor bank returns the collateral to the CNB." Increasing the repo rate should lead to a higher willingness of the commercial banks to offer their liquidity to central banks and reduce their loans to other subjects, whereas decreasing the repo rate should have the opposite effect. It must be stressed that the CNB, due to long-term liquidity abundance in the Czech economy, absorbs liquidity from commercial banks, i.e., it borrows money from commercial banks. Hence, it behaves opposite to most central banks. The development of the repo rate since 2008 can be divided into several periods (the CNB absorbed liquidity in all cases):

- the rate decrease (August 2008–May 2010), when it fell from its initial value of 3.75% to 3.50% and then gradually to 0.75%, mainly as a response to the ongoing financial crisis since 2008;
- stabilization (May 2010–June 2012), when the rate stayed at the value of 0.75%;
- further decrease (June 2012–November 2012), when the rate fell firstly to 0.50%, then to 0.25%, and then to the value of "technical zero," i.e. 0.05%;
- stabilization (November 2012–August 2017), with the rate at the value of 0.05%. Czech inflation was also only slightly above zero for some part of this period (2014 and 2015). As mentioned in Introduction, the CNB intervened between November 2013 and April 2014 against the Czech crown (CZK) when the bank did not allow appreciation of the euro exchange rate below 27 CZK per 1 EUR;

- gradual increase (August 2017–March 2019), when the rate was at first increased to 0.20, and then six times by about 0.25 percentage points to the value of 2.00%;
- stabilization (March 2019–February 2020), when the rate stayed at the level of 2.00% and then slightly increased to 2.25% in February 2020;
- quick decrease and approximately one-year stabilization (March-May 2000), when the rate, mainly due to the Covid 19 crisis, decreased three times between March and May 2020, first by about 0.50 percentage points, and then twice by about 0.75 percentage points to 0.25%, and stayed at this level until 24 June 2021.
- gradual but essential increase (June 2021–June 2022), when the rate was several times raised to the value of 7.00%, mainly due to high current and expected inflation. The rate remained unchanged from June 2022 to the 21st December 2023 when it decreased by 0.25 points.

Table 1. The main Czech macroeconomic indicators and Czech repo rate since 2008

Year	GDP (1)	Inflation (2)	Unemployment (3)	Value of repo rate (4)
2008	2.7	6.3	4.4	3.75 (8th February:) 3.50 (8th August:) 2.75 (7th November:) 2.25 (18th December]
2009	-4.7	1.0	6.7	1.75 (6th February} 1.50 (11th May:) 1.25 (7th August) 1.00 (17th December]
2010	2.4	1.5	7.3	0.75 (7th May)
2011	1.8	1.9	6.3	
2012	-0.8	3.3	7.0	0.50 (29th June) 0.25 (1st October) 0.05 (2nd November
2013	0.0	1.4	7.0	
2014	2.3	0.4	6.1	
2015	5.4	0.3	5.0	
2016	2.5	0.7	4.0	
2017	5.2	2.5	2.9	0.25 (4th August) 0.50 (3rd November)
2018	3.2	2.1	2.2	0.75 (2nd February) 1.00 (28th June) 1.25 (3rd August) 1.50 (27th September) 1.75 (2nd November)
2019	3.0	2.8	2.0	2.00 (3rd May)
2020	-5.2	3.2	2.6	2.25 (7th February) 1.7 (17th March) 1.00 (27th March) 0.25 (11th May)
2021	3.6	3.8	2.8	0.50 (24th June) 0.75 (6th August) 1.50 (1st October:) 2.75 (5th November) 3.55 (23rd December]
2022	2.5	15.10	2.2	4.50 (4th February) 5.20 (1st April) 5.75 (6th May) 7.00 (23rd June)

Notes: (1) = growth rate of real GDP, the annual change in %, (2) = the percentage change in the average price level for the twelve months of the year against the average price level of the twelve months of the previous year, (3) in %, average mean, (4) in %, brackets show the date of settings: the value

Source: Czech Statistical Office (n.d.a), Czech National Bank (n.d.b).

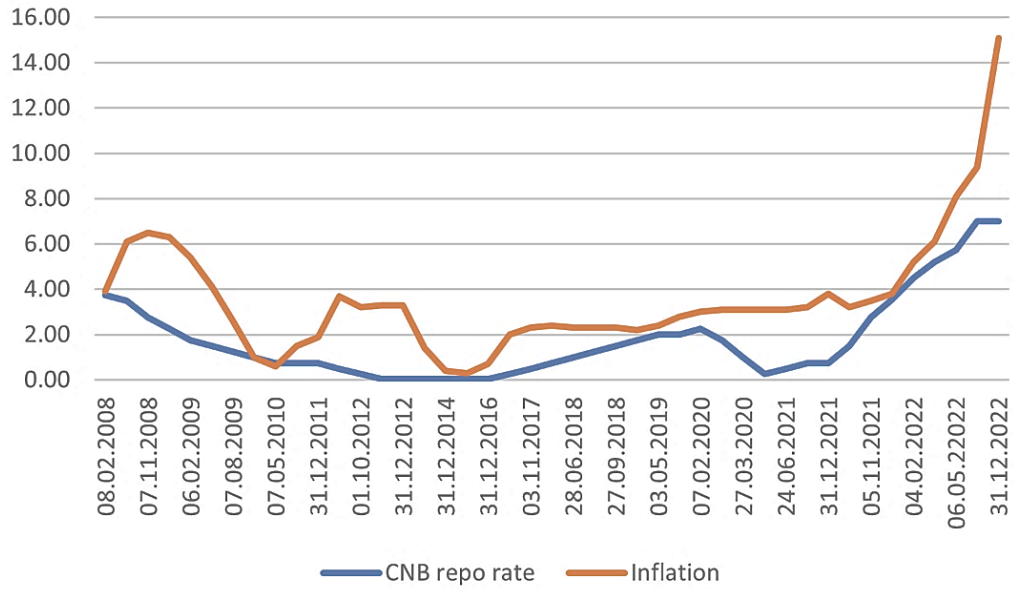


Fig. 1. The development of the CNB repo rate and Czech inflation, 2008-2022

Source: own work based on the data from the Czech National Bank and Czech Statistical Office websites.

It can be stated that for 14 years (2008-2021) the CNB interest rate policy was mainly expansive. The repo rate was kept under the value of 1.00 for more than 10 years, and foreign exchange intervention was carried out for more than three years. The CNB (its board) decided on intervention in November 2013 when GDP growth was slightly negative, with expected inflation under the CNB inflation target of 2% due to the decline in aggregate demand. The bank was concerned about possible deflation. It can be asked why the CNB did not decrease after 2010 its rates to below zero just as other central banks, including the ECB (see more in Wawrosz, & Traksel, 2023). There were two main reasons for this (Lízal, & Schwarz 2017, Hledík et al. 2016).

1. Unlike most other countries, the Czech financial system is characterized by abundant liquidity. Its source is the inflow of foreign exchange into both the private and the public sector. The further reduction of CNB interest rates, in the situation of liquidity abundance, would not have decreased the willingness of commercial banks to lend money to the central bank and would not have increased the value of their loans to other subjects.
2. Legislative factors: In some items of legislation in the Czech Republic, penalty interest is bound in a multiplicative manner to the discount rate. This may lead to severe legal complications if the rate is lowered below zero. In addition, the general legislation forbids negative interest rates in certain types of contracts.

The CNB experienced this type of situation as it intervened against the CZK (i.e. it tried to depreciate the CZK exchange rate) several times before November 2013, specifically in March 1998, June 1998, October 1999, March 2000, October 2001, and April 2002 (see Svoboda 2014 for more). However, these interventions were one-time episodes with a short duration and the central bank repo interest rate was in all of these cases above 3 %. The primary aim of all six interventions before 2013 was also different – to prevent the strong and usually sudden appreciation of the CZK when it was argued (see www.cnb.cz, reviews from central bank board meetings) that the exchange rate appreciation does not correspond with the development of other variables, and that the interventions were not connected with an actual or forecasted value of inflation.

It should be emphasized that the CNB did not buy EUR during the whole period between November 2013 and April 2017 and only intervened if the CZK exchange rate declined under the value of 27CZK/1EUR. When the intervention was announced in November 2013, the CNB had to act and the

interventions were quite massive (EUR 7.499 bn) and increased foreign exchange reserves to about 8% of GDP. The level of CZK 27/1EUR was quickly reached, and the CZK was traded above it until mid-2015. The CNB succeeded in persuading the market participants that it would intervene if it were necessary and they saw the CNB´s commitment as trustworthy. The second intervention was made in July 2015, when the CNB floor was again broken. The total sum of intervention was estimated (Lízal, & Schwarz, 2017) at around 75.9 billion EUR. However, such interventions are not the only source of growing reserves. From the beginning of 2013 until April 2017, client operations (mostly connected with the conversion of EU funds) amounted to EUR 12.7 billion.

The volume of the Czech monetary expansion in the period 2008-2021 is shown in Table 2. Concerning the end of the analysed period, the author intentionally mentioned the data for:

- 31 December 2019, i.e. before the Covid 19 crisis, when the monetary policy did not deal with this crisis,
- 31 December 2021, when the money monetary policy was mainly affected by the Covid 19 crisis.

The table clearly shows that the money supply growth rate for each monetary aggregate for the periods 2008–2019 and 2008–2021, and 2019–2021, exceeded many times the growth rate of the Czech real GDP. The monetary aggregates M2 and M3 in comparison with the real GDP grew:

- 4 times faster for the period 2008–2019, their average annual growth rates were more than 8.00%, while the real GDP growth rate was only 2.08%;
- approximately 6.5 times faster for the period 2008–2021, their average annual growth rates were around 10.00%, while the real GDP growth rate was only 1.54%.

Regarding the years 2020 and 2021, monetary aggregates grew between 17% and 22.5% (the average annual growth rate was above 4% for all of them). However, the GDP real growth was negative – it declined in total by -2.73%, the annual average decrease was -1.73%. According to the quantitative theory of money (cf. Friedman, 1989; Wang, 2017; Atkin & La Cava, 2017), if money growth exceeds the growth of real GDP and the decline of money velocity does not offset it, the price level must also grow, resulting in higher inflation. As Mndebele et al. (2023) mention, abundant research supports the results of the existing quantity theory of money (see Abate, 2020; Rasool, & Tarique, 2017; Akinboade et al., 2004; Atil, & Saouli, 2020).

Table 2. The value of Czech money supply (monetary aggregates) Czech real GDP and their growth rates between 31 December 2007 and 31 December 2019, and 31 December 2021

	Values					
	1st January 2008		31st December 2019		31st December 2021	
M1 (1)	1526564.8		4130174.7		5057113.9	
M2 (1)	2308662.8		4680322.5		5542017.3.	
M3 (1)	2380012.7		4779395.3		5610994.2	
Real GDP (1)	4240675		5303361		5158532	
	Growth rates					
	Period 2008-2019		Period 2008-2021		Period 2020-2021	
	Total growth rate	Average annual growth rate	Total growth rate	Average annual growth rate	Total growth rate	Average annual growth rate
M1 growth rate (2)	170.55	14.21	213.27	15.23	22.44	4.73
M2 growth rate (2)	102.72	8.56	140.05	10.00	18.41	4.29
M3 growth rate (2)	100.81	8.40	135.75	9.69	17.39	4.17
Real GDP growth rate (2)	25.05	2.08	21.64	1.54	-2.73	-1.65

Note: (1) = in millions of CZK, (2) = in %.

Source: own calculation, input data taken from the websites of the Czech National Bank and the International Monetary Fund.

4. Material and methods

The study generally tried to find out, whether:

1. there was a relationship between Czech monetary aggregates and the stock of foreign exchange reserves of the Czech National Bank;
2. the growth of Czech monetary aggregates was connected to the growth of the Czech price level.

Therefore, the author used time series of monetary aggregates (as the dependent variable) and foreign stock reserves. Each series in this article was based on secondary data obtained from the Czech National Bank database. The components of monetary aggregates *M1*, *M2* and *M3* were defined on the website of the CNB as follows (see Table 3).

Table 3. Harmonized monetary aggregates in the Czech Republic

Liabilities	*M1*	*M2*	*M3*
Currency in circulation	X	X	X
Overnight deposits	X	X	X
Deposits with agreed maturity up to 2 years		X	X
Deposits redeemable at notice up to 3 month		X	X
Repurchase agreements			X
Money market fund (MMF) shares/units			X
Debt securities up to 2 years			X

Source: website of the Czech National Bank (n.d.c).

For the values of foreign exchange reserves the Foreign Exchange Reserves indicator was used. According to the Czech National Bank (n.d.d): "International reserves are the Czech National Bank's liquid external assets in convertible currencies. International reserves include monetary gold, special drawing rights, the reserve position in the International Monetary Fund and external short-term assets (i.e. deposits, securities, foreign exchange and other assets)."

In addition to these main indicators, GDP at constant prices and the inflation rate at consumer prices are used, and data are taken from the database of the CNB. The analysis is made, if the database allows, in monthly, if not in quarterly data. Unless otherwise stated, values are in millions of CZK. The author's approach comes from the quantitative theory of money, based on the following formula (see Friedman, 1989; Buthelezi, 2023):

$$M \times V = P \times Y, \tag{1}$$

where *M* represents all money in circulation. Money is seen as a stock, not a flow, and *V* represents the transaction velocity of money in circulation. In general, *V* can be expressed using a relation obtained by simply modifying equation (1) as follows:

$$V = \frac{P \times Y}{M}. \tag{2}$$

where the expression $P \times Y$ represents the nominal value of all transactions made during the period, i.e. nominal gross domestic product.

The geometric mean (G_A) is calculated when it is necessary to express the growth rate based on a time series to reveal a relative trend rather than an absolute value.

$$G_A = \sqrt[n]{x_1 \times x_2 \times \ldots \times x_n} \tag{3}$$

The time series were examined by empirical analysis. The applied model in each situation was tested in terms of quality using model diagnostics. As mentioned, the relationship between the select indicators and the strength and direction of the dependencies were examined. The linear regression method was used, the basic equation of which has the form

$$Y_t = c + \beta_1 X_{1t} + \beta_2 X_{2t} + \cdots + \beta_n X_{n,t} + \delta D_t + \varepsilon_t\,, \tag{4}$$

where $X_{1t}, \ldots, X_{n,t}$ are the given selected real explanatory variables, and Y_t represents the explanatory variable at time t, while ε represents the random component and c is the constant; $\beta_1, \ldots, \beta_n$ denote the parameters of the regression equation. The estimation of these parameters determines the extent to which each regressor *X* affects the explained variable. Variable *t* represents a time index in the range $t \in \langle 1; n \rangle$, where value 1 is the oldest observation and value *n* is the most recent. Time index t represents here monthly or quarterly time series. Within each analysis, the frequency of the time series was specified. It is important whether parameter β reaches a positive value, as then there is a direct proportion between the indicators, or a negative value, as then there is an inverse proportion between the indicators, or if it is equal to zero, in which case the indicators have no mutual influence.

The regression diagnostics examines the coefficient of determination R^2, expressing the model's usefulness and how much of the variable under study was explained by the model. It indicates how much of the variation in the dependent variable is accounted for by the independent variable or how much variance there is in the observations. Values are in the interval [0, 1]. In the case of a zero value, this is an indicator whose changes are not determined by the independent variable (Starnes, & Tabor, 2014). The next test value is then the *p*-value, which represents the lowest significance level of the model and the lower the value, by default below 5% or 1%, the more statistically significant the result at that significance level $\alpha = 0.05$ or $\alpha = 0.01$.

The Dickey-Fuller test, more precisely the Augmented Dickey-Fuller test (ADF test), is a statistical test used to assess the stationarity of time series. Extended versions of the ADF test include more variables in the analysis and account for autoregressive components. Stationarity is a basic assumption of many statistical models, and therefore it is important to determine whether a time series is stationary. The Augmented Dickey-Fuller test is based on two hypotheses (Starners, & Tabor, 2014):

H0: The null hypothesis states that there is a unit root in the time series and that it is non-stationary

H1: The alternative hypothesis states that there is no unit root in the time series and that it is stationary or trend-stationary.

If the ADF test rejects the null hypothesis, it means that the time series is stationary. If it does not accept the null hypothesis, it means that the time series is non-stationary.

A statistics are obtained by:

Type 0: no constant, no trend $\Delta y_t = \gamma y_{t-1} + \sum_{i=1}^{p} \beta i \Delta y_{t-i} + \varepsilon_t$,

Type 1: constant, no trend $\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=1}^{p} \beta i \Delta y_{t-i} + \varepsilon_t$,

Type 2: constant and trend $\Delta y_t = a_0 + \gamma y_{t-1} + \gamma_2 i + \sum_{i=1}^{p} \beta i \Delta y_{t-i} + \varepsilon_t$,

where Δ is the difference operator, α, β and γ are the coefficients to be estimated, y is the variable whose time series properties are being examined, and ε is the error term (Enders, 2015). To reject the null hypothesis of the presence of a unit root, the *t*-statistic in this case must be in the critical range. The critical values for the ADF test have their own distribution, and in this case, since the number of observations was less than 250 and the time series did not show a clear trend, the values at the 5% confidence level was -2.88.

5. Results

5.1. Foreign exchange reserve and monetary aggregates

First, the study concentrated on the relationship between the monetary aggregate M1 and the stock of foreign exchange reserves (FER) of the Czech National Bank. Time lags were examined based on lags of 1 month, 2 months, 3 months and 6 months, with the quality of the model decreasing with the

inclusion of time lags. Their evolution is shown in Figure 2 (monthly data). The graphical analysis shows a strong linear dependence of both indicators, and this relationship is conclusive. Without determining its strength, it was possible to formulate a thesis that there is a definite relationship between these variables. This is confirmed by the regression diagnostics shown in Table 4.

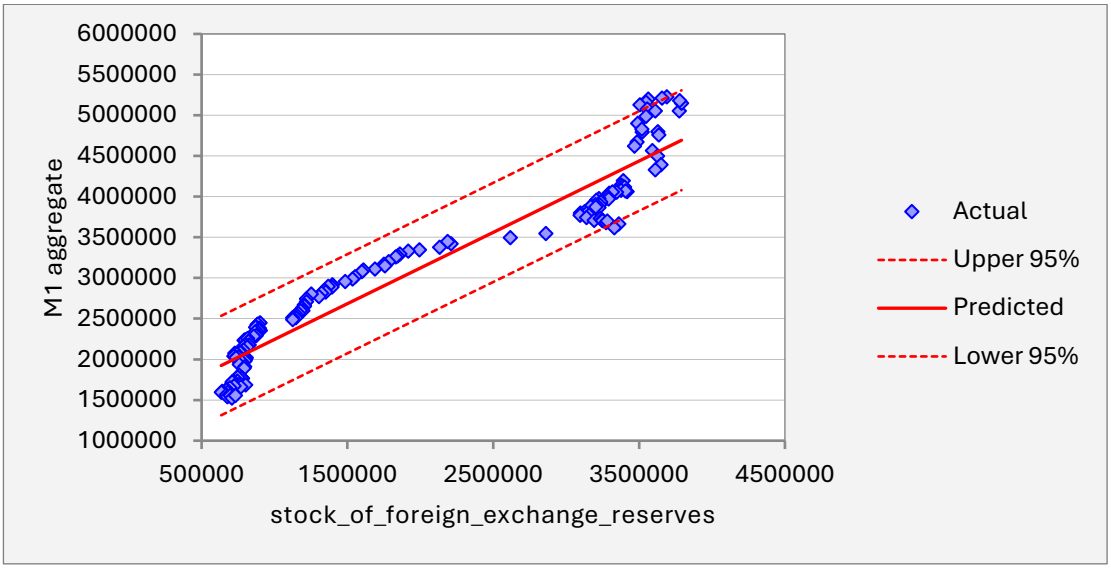


Fig. 2. Relationship between the monetary aggregate M1 and the stock of the CNB's foreign exchange reserves, 2008-2021, monthly

Source: own calculation, input data from the website of the Czech National Bank.

Table 4. Regression diagnostics of the relationship between the monetary aggregate M1 and the stock of foreign exchange reserves of the CNB

Dependent Variable:		M1_aggregate						
	R-Squared	Adj. R-Sq.	Std. Err. Reg.	Std. Dep. Var.	# Fitted	# Missing	Critical t	Confidence
	0.919	0.918	307 577	1 076 618	168	0	1.974	95.0%
Variable	Coefficient	Std. Err.	*t*-Statistic	*p*-value	Lower95%	Upper95%	VIF	Std. Coeff.
Constant	1 367 111	44 535	30.698	0.000	1 279 184	1 455 039	0.000	0.000
Stock_of_foreign_ exchange_reserves	0.877	0.020	43.360	0.000	0.837	0.917	1.000	0.959

Source: own calculation, input data from the website of the Czech National Bank.

The *p*-value of the regression coefficients determining the probability of the null hypothesis being valid, set at the value of zero taken by the regression coefficients, did not reach the significance level, which was set as $\alpha = 0.05$. Since the values were close to zero, the null hypothesis was rejected. Furthermore, then the goodness of fit of the model described by the F-test of the ANOVA procedure was confirmed since the p-value or the significance of F was close to zero, and this regression model appeared to be appropriate to explain the relationship between the two variables. The adjusted coefficient of determination then indicated that 92% of the variability in the endogenous variable was explained by the model – a significantly high number. This linear regression relationship can then be written as follows:

$$M1 = 0.88 \times stock_{exchange\_reserves} + 1{,}367{,}111 + \varepsilon. \quad (5)$$

The change in the CNB's foreign exchange reserves by one unit should be reflected as an increase in M1 of 1,367,111. Both values were given in millions of CZK. Over the period under review from 2008

to 2021, the change in foreign exchange reserves from 731,517.1 to 3,775,345.4 represented an increase by 3,043,828.3. According to the model, this change in foreign exchange reserves should increase M1 monetary aggregate by 4,161,251.15. In fact, there was indeed a growth from a value of 1,556,525.538 to 5,057,113.884, a difference of 3,500,588.346.

The difference between the residuals was found based on a linear regression of the two-time series with a requirement also on the output of the residuals. Next, the *t*-1 residuals were calculated, and a regression was performed using the time series of the difference between the residuals and the *t*-1 residuals. The *t*-test statistic was compared with a critical value of 2.88. To reject the null hypothesis that a unit root exists, the *t*-statistic, in this case, had to be less than the critical value. The observed value of the *t*-statistic was -1.05. Hence, the study rejected the null hypothesis that there was a unit root. One can state that the data of the pair were co-integrated.

Next is the monetary aggregate M2, again in relation to the CNB's foreign exchange reserves (FER). The observed relationship is shown in Figure 3. Time lags reduce the quality of the model, once again lags of 1, 2, 3 and 6 months were examined, then a linear direct dependence could be identified. Thus, it can be argued that there was a relationship between the M2 monetary aggregate and the stock of foreign exchange reserves of the CNB; for more on the regression diagnostics, see Table 5.

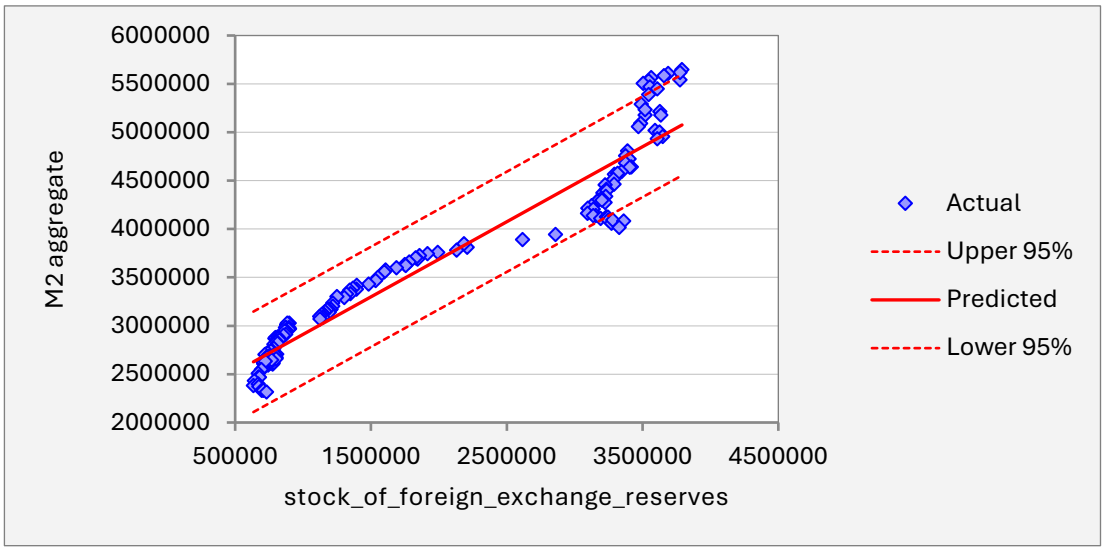


Fig. 3. Relationship between the monetary aggregate M2 and the stock of the CNB's foreign exchange reserves, 2008–2021, monthly

Source: own calculation, input data from the website of the Czech National Bank.

Table 5. Regression diagnostics of the relationship between M2 monetary aggregate and CNB foreign exchange reserves

Dependent Variable:	M2_aggregate							
	R-Squared	Adj. R-Sq.	Std. Err. Reg.	Std. Dep. Var.	# Fitted	# Missing	Critical t	Confidence
	0.925	0.924	261 353	948 938	168	0	1.974	95.0%
Variable	Coefficient	Std. Err.	t-Statistic	*p*-value	Lower 95%	Upper 95%	VIF	Std. Coeff.
Constant	2 135 032	37 842	56.420	0.000	2 060 318	2 209 745	0.000	0.000
Stock_of_foreign_exchange_reserves	0.776	0.017	45.118	0.000	0.742	0.810	1.000	0.962

Source: own calculation, input data from the website of the Czech National Bank.

The null hypothesis, which assumes equality of regression coefficients, was rejected because the *p*-values were close to zero and not even close to the chosen significance level $\alpha = 0.05$. This model as a whole was confirmed. The significance of *F* was close to zero, and hence this model can explain the direction of the relationship between the variables under study. The adjusted coefficient of determination then indicated that this model explained 93% of the variability of the endogenous variable. The regression equation then took the following form:

$$M2 = 0.78 \times stock_{exchange\_reserves} + 2{,}135{,}032 + \varepsilon. \quad (6)$$

A one-unit change in the CNB's foreign exchange reserves should be reflected in an increase in the M2 monetary aggregate of 2,135,032.

To reject the null hypothesis of the presence of a unit root, the *t*-statistic was found to be -1.4613 using the Augmented Dickey-Fuller test. In this case, it was below the critical value. Therefore, the null hypothesis was rejected and the pairwise data cointegrated.

The last monetary aggregate examined was M3, again in relation to the CNB's foreign exchange reserves (FER), shown in Figure 4. Time lags were tested for 1, 3, 6 and 12 months, with a reduction in model quality when time lags were included. Here, it can also be concluded that there was a direct linear dependence and that the securities, shares and other derivatives included in the monetary aggregate M3 followed the trend described for the previous two monetary aggregates M1 and M2; for regression diagnostics see Table 6.

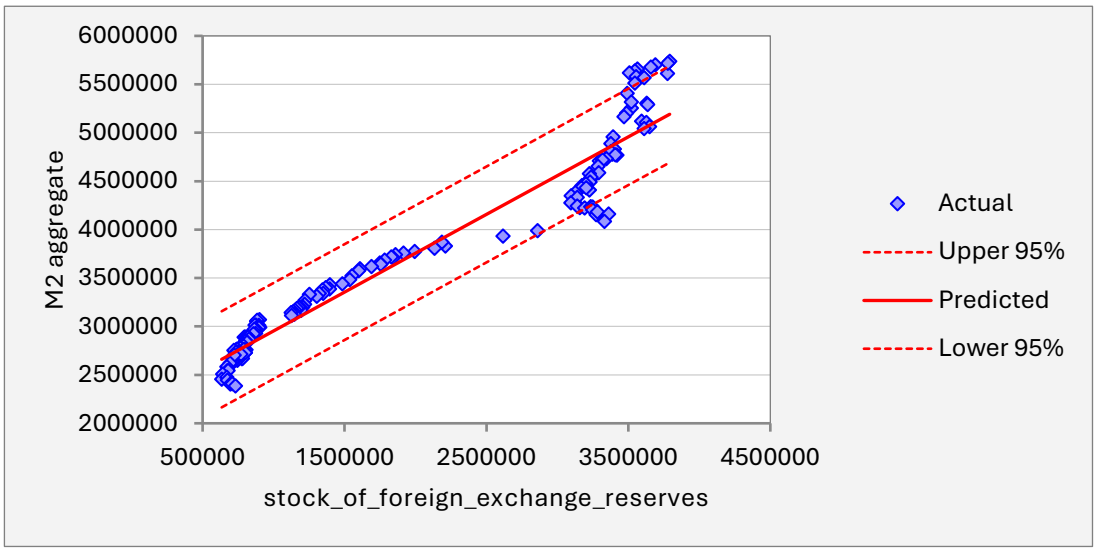


Fig. 4. Relationship between the monetary aggregate M3 and the stock of the CNB's foreign exchange reserves, 2008–2021, monthly

Source: own calculation, input data from the website of the Czech National Bank.

Table 6. Regression diagnostics of the relationship between monetary aggregate M3 and the stock of CNB foreign exchange reserves

Dependent Variable:		M3_aggregate						
	R-Squared	Adj. R-Sq.	Std. Err. Reg.	Std. Dep. Var.	# Fitted	# Missing	Critical t	Confidence
	0.935	0.934	249 737	975 276	168	0	1.974	95.0%
Variable	Coefficient	Std. Err.	t-Statistic	*p*-value	Lower 95%	Upper 95%	VIF	Std. Coeff.
Constant	2 152 073	36 160	59.515	0.000	2 080 680	2 223 466	0.000	0.000
Stock_of_foreign_ exchange_reserves	0.802	0.016	48.794	0.000	0.769	0.834	1.000	0.967

Source: own calculation, input data from the website of the Czech National Bank.

For this model, again the *p*-values did not reach the chosen significance level $\alpha = 0.05$, and the null hypothesis was rejected given the proximity of the *p*-values to zero. The applied model was also appropriate as the *p*-value of the F-test was close to zero and the model was able to describe the direction of the correlation. According to the adjusted coefficient of determination, it could then be stated that the model explained 94% of the variability of the endogenous variable. Then the regression equation took the form:

$$M3 = 0.80 \times stock_{exchange\_reserves} + 2{,}152{,}073 + \varepsilon. \quad (7)$$

The change in the stock of foreign exchange by one unit should be reflected as an increase in M3 of 2 152 073. The *t*-statistic found by the Augmented Dickey-Fuller test took the value of -1.5362, and therefore was below the critical value. Hence, the null hypothesis was rejected and the time series was not stationary.

5.2. Foreign exchange reserve, money stock and inflation

Did the CNB interventions against the Czech currency lead to inflation? The above results can then be further extended using the quantity theory of money containing the four variables explained in the previous section. In the case of the money supply, it has already been stated that there was stable growth over the whole period under review as the result of the CNB's foreign exchange interventions, and in the case of the M2 aggregate, the geometric mean of the year-on-year changes in quarterly data was 6.36%. The next parameter is the velocity of money, with its value calculated as the ratio of nominal GDP (i.e. real GDP times price level) to money supply according to the selected monetary aggregate. The evolution of GDP and the velocity of the money is shown in Figure 5.

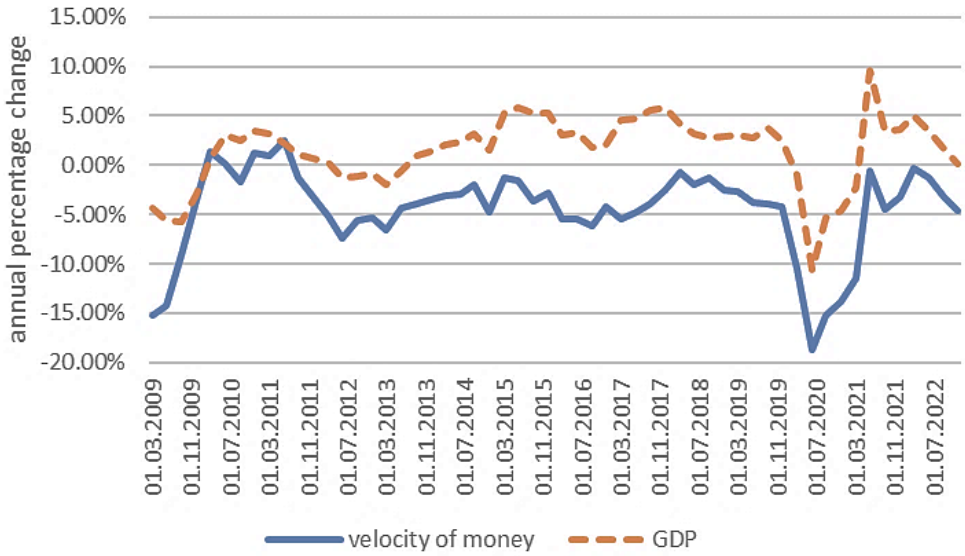


Fig. 5. Change in GDP at constant prices and money velocity, 2008–2022, quarterly

Source: own calculation, input data from the website of the Czech National Bank.

It is evident from Figure 5 that there were annual declines in the money velocity rate and, on the contrary, annual growth in GDP at constant prices over almost the entire period under review. Given the fact that the two variables are on opposite sides of the quantity theory equation, it was necessary to assess whether the opposing effects of these variables are neutral or have an impact. Therefore, the geometric mean of the year-on-year changes in the quarterly data for both variables over the investigated period was calculated. In the case of the money velocity rate, the value was -4.32%, whilst for the GDP, the growth rate was 1.34%, significantly higher than the decline in the money velocity rate. Thus, if there

was a significant increase in the money supply, where the geometric mean of the year-on-year changes in the quarterly data for monetary aggregate M2 was 6.36%, then the consequence, at least according to the quantity equation of the theory of money, is an increase in the price level, when the geometric mean of the year-on-year changes in the quarterly data for the observed period was 3.12%. The year-on--year change in inflation and aggregate M2 are shown in Figure 6.

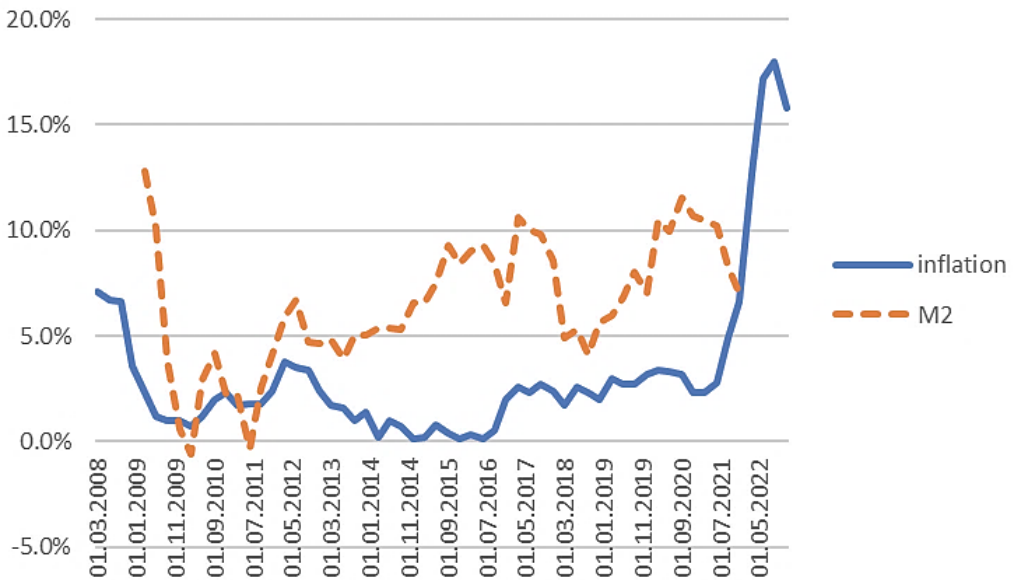


Fig. 6. Year-on-year change in consumer price inflation and M2 aggregate, 2008–2022, quarterly

Source: own calculation, input data from the website of the Czech National Bank.

6. Discussion

The results found a strong relationship between the development of the Czech monetary aggregates and the stock of CNB foreign exchange reserves in the investigated period and that the growth of the values of the monetary aggregates led to the increase in the Czech price level. However, why did the consequences of the CNB's mainly expansionary monetary policy after 2007 become apparent only in the second half of 2021 and in the following years 2022 and 2023? Table 7 shows that Czech inflation at the time of finishing this article (i.e. December 2023) still exceeded 10 %. The study also shows Czech inflation development for the years 2022 and 2023, although the analysis of the development of Czech monetary aggregates ended in December 2021. As already mentioned in the introduction, the effects of monetary policy occur after some time lag (usually between 18 and 24 months). Thus, the CNB monetary policy carried out in 2021 affected Czech inflation and other macroeconomic variables for many months after this year.

Table 7. Inflation rate expressed as an increase in average annual CPI indicates a percentage change in the last 12-month average over the preceding 12-month average (%)

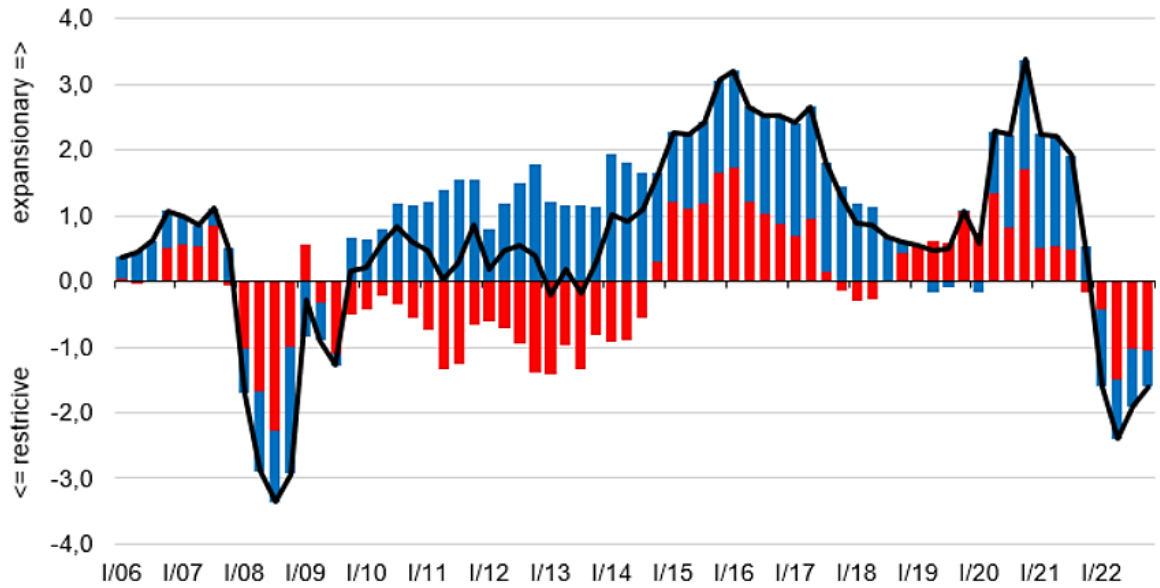
Month	1	2	3	4	5	6	7	8	9	10	11	12
2021	3.0	2.9	2.8	2.8	2.8	2.8	2.8	2.8	3.0	3.2	3.5	3.8
2022	4.5	5.2	6.1	7.0	8.1	9.4	10.6	11.7	12.7	13.5	14.4	15.1
2023	15.7	16.2	16.4	16.2	15.8	15.1	14.3	13.6	12.7	12.1	11.4	10.7

Source: Czech Statistical Office (n.d.b).

The CNB began intervening against the CZK at the point (November 2013) when inflation was below the CNB target and GDP growth equalled zero. Inflation still stayed in the next years (2014–2016) below the target but GDP started to grow – the growth in 2015 reached 5.2%. The author argues that

additional money supply gave economic subjects (mainly households and firms) sources for spending, respectively for the performance of their economic activities. Czech citizens, as a consequence of the previous crisis (not only the global crisis in 2009 but also the Czech recession in 2012 and partially in 2013), were afraid to increase their spending or to extend their activities. Additional money supply alleviated and later eliminated these concerns. As demonstrated, for example, in Sweeney and Sweeney (1977) and Koo (2012), the growth of the money supply can increase the confidence of the citizens, offer them resources, and encourage them to carry out their activities, and this is exactly what happened in the Czech Republic. The Czech GDP growth and decline of money velocity indicate that, at least from 2015, the Czech economy did not suffer from a shortage of money. This allowed the population to use money due to its availability, which was less often manifested in the negative values of the change in money velocity.

The expansionary character of the CNB's monetary policy was also confirmed by the development of the real monetary condition index that evaluates, especially for small open economies, how both interest rate and exchange rate affect monetary policy, how tight or easy the overall monetary policy stance is (details about the index can be found for instance in (Costa 2000, see also Bui, & Gábor, 2021; Bui, 2023). The index distinguishes a period when one component has an expansionary and the second one has a restrictive effect or periods when both components are expansionary or restrictive. Figure 6 shows that for most of the investigated period (2008-2021), monetary policy was expansive when the values of the index were positive. Although there were times when both components had a restrictive character (2008-2010), or the exchange rate component mitigated or sometimes briefly overcame the interest rate component (2010-2013), the policy was clearly expansionary from the first quarter of 2014, i.e. approximately three months after the CNB's decision about the exchange rate intervention, until the end of that period. The figure shows the change in the character of monetary policy that happened in 2022 when the monetary policy became restrictive due to the increase of the CNB repo rate and appreciation of the Czech currency, but it will take some time to overcome the previous expansion.



The red colour shows how the exchange rate component contributes to expansionary or restrictive monetary policy. The blue colour does the same for the interest rate component. The blue line describes the real money monetary index.

Fig. 7. Real monetary conditions in the Czech Republic: the effect of interest rates and the exchange rate

Source: Frait and Matějů (2023).

The money that was generated by expansionary monetary policy did not disappear in a vacuum. It was still in circulation or served as reserves of commercial banks and other subjects. The Covid 19 crisis caused further monetary expansion (see growth rates of monetary aggregates for the period between 31 December 2019 and 31 December 2021 in Table 2). This crisis was especially in 2020 and at the beginning of 2021 connected with the shift of aggregate demand to the left (i.e. with lower purchases – for instance expenses for final consumption declined by 3.5%, expenses of households declined by 7 % in 2020 (see Czech Statistical Office, 2023, counted from the constant price), so the abundance of money supply did not lead firstly to higher inflation. When the pandemic ended and consumers restored their demand, they met, at least in some markets, with disruptions in supplier-customer relations and insufficient supply. However, due to previous monetary expansion, they had enough money and could buy the goods for higher prices; inflation finally appeared. Its growth was further exacerbated by the Russian-Ukrainian conflict associated with a further shortage of resources (especially energy).

From the author's viewpoint, the main lesson from the Czech monetary and inflationary development since 2008 was confirmation (Dorman, 2014; Congdom, 2024) that a higher rate of money growth than the growth rate of real GDP does not lead to an immediate increase in inflation. In other words, there is no immediate and direct short-term relationship between money growth and inflation. Yet, if other conditions appear, in addition to a greater growth of money in circulation than the real GDP growth rate, supporting inflation, especially a decrease in the supply of resources, inflation growth is inevitable. Such conditions will very likely occur over time and central banks must take such possibilities into their models.

It should be emphasized that even when the amount of money in circulation grows simultaneously faster than real GDP and the growth rate of money velocity is negative, it would be a mistake to expect that this negative value will always offset the growth of money in circulation in the long run. The money velocity growth rate can easily change, and its previous negative rate does not implicate continuing this development. Here the author disagrees with the opinion of the so-called new Keynesianism (see Ball et al., 1988; Cogley, & Sbordone, 2008; Mishkin, 2009; Del Negro et al., 2015; Galí, 2015; Gharehgozli, & Lee, 2022 for other details) that an increase in the money supply has led to a decrease in the velocity of money and a rise in real income, which would stimulate aggregate demand and the economy would achieve full employment. Particularly in a situation of a negative supply shock, when consumers have enough money due to previous monetary expansion, there is a strong probability that they would be willing to pay higher prices for goods, at least for some time. They may fear that either a) the quantity of goods offered will decrease in the future due to a lack of resources, or b) prices will continue to rise and will be so high in the future that the goods will become unaffordable. Thus, it is more convenient to buy goods now than in the future, even at a higher price. The behaviour of Czech consumers in 2021 and 2022 seems to confirm this pattern. Consumer expenditure (expressed in real terms) in 2021 increased by 4.1%. It slightly declined (by -0.9%) in the next year, but households were generally able to adjust to inflation in 2021 and 2022, and their purchases increased. The same conclusion can be made in the case of investment expenditure of firms – it grew in real terms by 19.1% in 2021 and 8.5% in 2022, and this growth outpaced several times their decline of -9.3% in 2020 (details can be found in Czech Statistical Office, 2025).

Another sector that used the money created by the Czech central bank's monetary expansion was the government. Let´s take all government entities, including municipalities and regional self-governments (there are 14 regions, including Prague, in the Czech Republic, and each of them has its separate budget). It is clear from Table 8 that the general government performance (i.e. the sum of all government budgets) was in deficit with the largest deficits occurring in the period 2020-2022, when mainly the central government (state budget) heavily subsidized households, firms and other entities hit by the Covid 19 crisis and the Russia-Ukraine war (for instance, only those self-employed were subsidised during the Covid 19 crisis to the tune of CZK 48 billion). Czech banks and other financial organizations could easily lend money to all government sectors in a situation of excessive liquidity

instead of saving it as the reserve in central banks. The money that the Czech state borrowed and spent generated, due to the multiplication process of deposit, more money. In other words, there would have been no government deficit with less money in circulation and more in the form of commercial banks' reserve in the CNB. The study's conclusion is in accordance with Kubíček and Morda (2023), who calculated that the government deficit contributed to the growth of money only in the years 2020 and 2021 by 5.8%.

Table 8. Selected fiscal indicators of the Czech Republic, 2008-2022

	General government deficit or surplus in CZK mil.	General government deficit or surplus in % of GDP	General government debt in CZK mil.	General government debt in % of GDP
2008	-79 410	-2.0	1 136 774	28.1
2009	-213 982	-5.4	1 319 002	33.4
2010	-165 784	-4.2	1 480 097	37.1
2011	-109 697	-2.7	1 613 650	39.7
2012	-159 349	-3.9	1 805 307	44.15
2013	-53 189	-1.3	1 840 247	44.42
2014	-90 196	-2.1	1 818 888	41.85
2015	-29 779	-0.6	1 836 047	39.70
2016	34 143	0.7	1 754 737	36.58
2017	76 733	1.5	1 749 677	34.24
2018	48 292	0.9	1 734 602	32.06
2019	16 709	0.3	1 740 263	30.05
2020	-329 216	-5.8	2 149 822	37.66
2021	-310 628	-5.1	2 566 731	42.02
2022	-247 489	-3.6	2 997 083	44.11
Sum/Difference (1)	-1 612 842		1 860 309	

Note: (1) The sum in the case of the first column, the difference between the last and initial value in the case of the third column

Source: Czech Statistical Office (n.d.c), own calculation.

To summarize: the financial situation of most Czech households did not deteriorate during the Covid 19 pandemic thanks to government compensation. On the contrary, the growth of real estate prices and financial assets caused the growth of real wealth, which, together with low unemployment, increased optimism among consumers and led to their willingness to spend. Despite the financial compensation, retailers suffered lower revenues during the pandemic (mainly in 2020), which they tried to compensate for at the end of the Covid crisis and at the beginning of the Russia-Ukraine war by increasing prices. This led to a sharp rise in prices of goods and services across sectors quickly, reflected in higher inflation in 2021 and 2022. Such a development was described by Werning (2022), who showed in a new Keynesian model that if the expected cost growth exceeds a certain threshold, it is optimal for all traders to reprice their products, even if this has menu costs, while consumer price growth is then rapid and occurs in all sectors.

It can be argued that the value of average quarterly inflation (3.12%) is only 1.12% higher than the CNB inflation target of 2% (for simplicity, the study did not distinguish that the target is for CPI, not for GDP deflator). This value was also only slightly above the CNB's tolerance band of one percentage point in either direction around the target. From that point of view, the higher value of inflation in 2021 offset the lower values of inflation in previous years, mainly in 2014-2016. However, the consequences of higher inflation were unequally distributed – some consumers who spent their income mainly on necessities, including utilities, could face even higher inflation than its official figure. Higher inflation can also lead to higher inflation expectations and a cost (wage) inflation spiral when inflation causes an increase in suppliers' prices, including employees, which leads to an increase in the final prices and, thus, more inflation.

This section concludes with the statement that a central bank should not strive, even if inflation is below the inflation target, for values above this target to achieve the target on average. It can, of course, try to keep inflation on target level in the future. However, Czech inflation in 2022 and 2023 (see Table 7) was significantly above the inflation target for more than a year, which does not make the central bank's policy credible. The CNB's exchange intervention, the policy of technical zero interest rates and other unconventional tools and subsequent higher inflation confirm in practice the words of the former governor of India's Central Bank, Raghuram Rajan, that "… [central banks] have triggered a variety of imbalances that not only make fighting inflation harder but also make it difficult to exit the prevalent policy mix, even as the inflation regime has changed to one of substantially higher inflation. Central banks are not the innocent bystanders they are sometimes made out to be" (Rajan, 2023). Long-run deviation above the target can lead to both financial and political bankruptcy and even armed conflict (Ogachi et al., 2021).

7. Conclusions

The study revealed the strong dependence of the development of Czech monetary aggregates (both M1 and M2, and M3) on the development of the stock of the CNB's foreign exchange reserves. It further proved, using the quantitative money equation, that the growth of Czech money stock, although partly offset by the negative value of Czech money velocity growth rate, led to the increase in Czech inflation figures. The article emphasizes that although monetary policy, including forecasts of economic development, focuses on a period that usually does not exceed two years from taking a specific monetary policy step (e.g. a decision by the central bank to increase or decrease rates) or from the publication of a forecast, i.e. the monetary policy horizon covers up to two years, especially if an expansionary monetary policy is carried out for a longer period. Thus, a central bank should evaluate such a policy, including the issue of how the growth of the value of monetary aggregates can influence inflation values behind the monetary policy horizon. In other words: central banks must consider the long-term consequences of their policies.

In particular, the combination of monetary aggregates growing faster than real GDP deserves special attention, even if the value of the money velocity rate is negative. If there is a subsequent negative supply shock, inflation will inevitably occur. Consumers have enough money to be able to buy scarce goods at higher prices. The value of money velocity can easily change due to higher purchases. The Covid 19 crisis and the Russia-Ukraine conflict showed that a negative supply shock can be a quite common event; both were associated with high strategic uncertainty. It is difficult for consumers to estimate how long these crises will last or whether the lack of resources and goods caused by them will be short, medium, or even long-term. It is then rational for consumers to use their money to buy goods and resources at higher prices. In the future, purchases may be even more expensive, or goods and resources may not be available at all. Central banks must learn from these crises, as well as from consumer behaviour during them, and incorporate this knowledge into their models. In particular, they should prepare for sudden inflation increases due to negative supply shocks and use or develop tools to mitigate them and their consequences. As Gharehgozli and Lee (2022) emphasized, current models of inflation forecasts may not capture all the macroeconomic behaviour during a pandemic or other negative supply and demand shocks.

One should add that the CNB has now begun to realise the importance of the amount of money in the economy and its effect on inflation and other macroeconomic indicators. As stated by central bank governor A. Michl, the CNB has added elements of monetarism to new Keynesianism, which was the prevailing bank paradigm (Michl, 2023). The bank DSGE model created according to the theory of new Keynesianism ended with the three-month PRIBOR interest rate (Michl, 2019). However, the bank's board is now also discussing the development of longer-term client interest rates, and considering how the transmission interest mechanism works and how a change in the short-term rate could affect the long-term rate. The CNB attributes a larger role to credit in the economy and borrowing, which the

model previously neglected. Similarly, CNB's vice-governor J. Frait emphasized that central banks must rethink what the term inflation means and how central banks should assess whether economic development generated imbalances in the economy that may eventually manifest themselves in inflation or deflation (Frait, 2023). Central banks also need to focus more on the inflationary or deflationary potential stemming from both medium and long-term factors of a fundamental nature, not just on estimates of what inflation could look like in two years' time in a forecast generated by any macroeconomic model. For these reasons, banks will also have to rethink the quantities – money, credit, debt – and estimate the effects of changes in them over a longer horizon.

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