

# András Komáromi: The effect of the monetary base on money supply – Does the quantity of central bank money carry any information?

*In discussing the transmission mechanism, basic macroeconomics textbooks focus on changes in money supply, which the central bank can control by manipulating the monetary base. Modern central banks, however, take a considerably more complex view of the transmission mechanism, and the operational target of most central banks is to set a short-term interest rate. Under such circumstances, the direction of the mutual effect of the monetary base and money supply is rather the reverse in today's practice, i.e. the results of the portfolio decisions of economic agents are reflected in the central bank's balance sheet, determining the size of the monetary base. The article explains the direction of the actual mechanism and argues the point that, contrary to the view still widely held in academic circles, a great deal of the factors affecting the monetary base are exogenous for the central bank. Accordingly, the growth rate of M0 (monetary base or base money) carries no direct information on either the intentions of the central bank or the outlook for inflation.*

## INTRODUCTION

Both the findings of economic theory and historical experience have shown that, apart from inflation, monetary policy is unable to exert lasting influence on macroeconomic real variables such as GDP, real wages or the level of employment. Consequently, over the past twenty years, an increasing number of professionals have taken the view that the primary objective of central banks is to control inflation. During recent years, *price stability* as the ultimate goal of the central bank has gained ground in the general consciousness in Hungary as well, primarily as the result of the communication efforts of the MNB, which have been aimed to ensure clarity.<sup>1</sup> While the ultimate goal is clear for many, there are frequent misunderstandings and misbeliefs even among economic professionals regarding the tools and mechanisms the central bank should employ in order to achieve this goal.

In a market economy environment, the central bank should utilise the available indirect (market conform) means at its disposal to encourage the economy to move towards the ultimate goal. In other words, it must define the chain of target variables that can be directly influenced by the central bank (*operational targets*) and the other economic variables, through which monetary policy can exert a genuine influence on its final target. This chain of economic variables and the system of relations between such variables are called the transmission mechanism. The transmission mechanism thus

describes the relationships through which the monetary policy measures of a central bank affect the rate of inflation.

In the current *practice*, central banks attempt to achieve their ultimate goal through their respective interest rate policies, which means that their operational target is to set the short-term money market interest rate. However, the basic university textbooks used in macroeconomics and finance *education* (e.g. Mankiw, 2005) tend to suggest, sometimes quite unambiguously, sometimes by their general approach only, that central banks are influencing economic trends by directly controlling the money supply, which is achieved by controlling the quantity of central bank money (the monetary base). Under that approach, the transmission mechanism sets out from the quantity of base money as the operational target and moves toward inflation, the final target variable, through the money supply in the economy. This approach is based on the traditional monetarist theory of inflation, which argues that (over the long run) the price level is determined by the amount of money available in the economy and derives the central bank's operational target concerning the monetary base from the so-called money multiplier model.<sup>2</sup>

In order to understand the above argument, let us first take a look at the definition of money and base money and how their quantities can be measured in practice. In the light of these definitions, we can then discuss the way the textbook model links the central bank's control over the monetary base to the control of the broader money supply.

<sup>1</sup> According to a 2006 survey by Gallup, 60 percent of the population regards controlling inflation to be the responsibility of the MNB, and 20 percent believes this to be the primary duty of the central bank. 56 percent of the respondents felt that the rate of inflation would be higher without the MNB.

<sup>2</sup> In order to illustrate the above, let me include a few quotations from Mankiw's (2005) widely used macroeconomics textbook. 'The control of the money supply is called monetary policy.' (p. 183) 'In fact, the Fed indirectly controls the money supply through changes in the monetary base or the reserve-deposit ratio.' (p. 510) '... the inflation rate is ultimately determined by the growth rate of the quantity of money.' (p. 528).

## DEFINITION OF THE MONETARY BASE AND MONETARY AGGREGATES

In practice, the classification of instruments as ‘money’ is far from being unproblematic. The various financial instruments differ according to their transactions costs, the range in which they can be used for payment and the extent to which they preserve their value, i.e. the extent they have the functions of money (Kiss et al., 2005). The narrowest subset comprises the financial instruments available for payment in the fastest way, at the lowest transaction costs and without restrictions (*M1 money aggregate*). It includes currency, i.e. banknotes and coins and the demand deposits available for direct payment. In addition to the above, the broader categories of money (*M2 and M3 money aggregates*) also include the less liquid liabilities of monetary financial institutions (MFIs), i.e. financial instruments not available for direct payment (time deposits and certain types of securities), depending on the respective transaction costs, maturities and risk levels.

The currency in circulation, issued by the central bank, and the balance on the current accounts of credit institutions kept with the central bank, constitute the *monetary base* ( $M0$ ). The latter means the bank accounts on which credit institutions keep the liquidity required for their day-to-day operation and which are used to meet their reserve requirements. They are collectively referred to as *bank reserves*.<sup>3</sup> The monetary base is not part of the money supply. The reason it is relevant for our discussion is that, in the textbook model, this is the basis of the so-called money multiplication process, i.e. the central bank modifies the quantity of the monetary base in order to influence the money supply. Let us now take a look at how this works.

## THE STANDARD MONEY MULTIPLIER MODEL

The underlying idea behind the argumentation is that, proceeding from the monetarist theory of inflation, the central bank is responsible for controlling the growth rate of money, which, as a supply-side monopoly on the market of central bank money, it can achieve by controlling the monetary base. The money multiplier model tries to provide an explanation for the relationship between base money and the monetary aggregates. While the form of the model presented here can be most easily interpreted for the most

liquid transaction money, the  $M1$  money aggregate, the argumentation is similar for the broader money categories. There are three exogenous variables in the model:

- The **monetary base**, i.e. the sum of the amount of currency held by economic agents ( $C$ ) and the amount of reserves deposited on commercial banks’ accounts with the central bank ( $R$ ).
- The **reserve-deposit ratio** ( $rr$ ) is the ratio of deposits the banks keep in reserve. This may be affected by the rules on reserve requirements imposed on credit institutions or, even in the absence of such rules, banks hold reserves to the extent required for their payment turnover.
- The **cash-deposit ratio** ( $cr$ ) reflects the preference of economic agents as to how much money they should keep in cash ( $C$ ) and in demand deposits ( $D$ ).

Using the definition of the monetary base and the  $M1$  aggregate:

$$M1 = C + D$$

$$M0 = C + R$$

It follows from the two equations that:

$$\frac{M1}{M0} = \frac{C/D + 1}{C/D + R/D} = \frac{cr + 1}{cr + rr} = m \Rightarrow M1 = m \times M0$$

The equation shows the way the money supply, measured with the  $M1$  aggregate, is a function of the exogenous variables. According to the model, the money supply is in proportion with the monetary base; the proportionality factor ( $m$ ) is called the ‘money multiplier’.

The above formula, particularly in its latter ‘reduced’ form, is responsible for the (erroneous) view, held even by a great number of economists not specialising in monetary macroeconomics, that the central bank’s operational duty is to manipulate the size of the monetary base. Under that understanding of the transmission mechanism, through the money multiplier, the operational target (the monetary base) affects the money supply, whose growth rate determines the rate of inflation. Obviously, that line of thinking is based on the underlying assumption that the money multiplier remains relatively stable.

<sup>3</sup> If required reserves are sufficient to cover the bank’s everyday liquidity requirement, it will not keep any surplus. Otherwise, the difference between total bank reserves and required reserves is referred to as excess reserves.

## THE MESSAGE OF THE STANDARD MODEL AND PRACTICE

This view of the transmission mechanism can essentially be broken down to two key steps, with a simple theoretical construction assigned to each (Bindseil, 2004):

1. through the active regulation of the monetary base, the central bank is able to set the development of money supply (money multiplier theory);
2. since the inflation process is related to the amount of money, it is practical for the central bank to influence the size of the monetary aggregates (quantity theory of money).

This paper does not discuss the latter (2) point of the argumentation in detail. The subject has a vast and extensive literature (see, for example, Woodford, 2007). We limit ourselves to stating that, as the various financial substitutes for money have gained increasing ground, the definition and the measurement of the quantity of money relevant for the transmission mechanism have raised an increasing number of questions and the short-term relationship between the monetary aggregates and inflation has become uncertain. Faced with that situation, central banks have stopped actively influencing the money supply and now try to achieve their goal by setting the interest rate of a base instrument. Thus, the role of monetary aggregates as an intermediate target<sup>4</sup> has gradually ceased to exist and been replaced by other nominal variables, such as the exchange rate or the inflation forecast itself (in the inflation targeting system). Since 2001, following the period of the crawling peg, Hungary has been operating with an inflation targeting regime, i.e. monetary policy utilises the available means in order to achieve the goal of forecasted inflation remaining close to a pre-defined target value (currently 3 per cent) over a time horizon of 5 to 8 quarters.

Therefore, these days hardly any modern central banks take on the task of directly influencing changes of monetary aggregates. Instead, they try to achieve their final target via their interest rate policies.<sup>5</sup> Despite the fact that most Hungarian economists are well aware that the National Bank of Hungary, like other central banks, uses other tools than the shaping of the money supply in order to influence economic trends, the changes in monetary aggregates and the monetary base have received a great deal of attention at times. For example, jumps in the growth rate of the monetary

base are often interpreted as inflationary pressure, which has been generated by the central bank or at least as one that the central bank would have the opportunity to suppress by reducing the quantity of base money. This kind of argument leads us to the statement presented in point (1), i.e. the nature of the operational target of the central bank. The essentially quantitative approach of the money multiplier model suggests that the central bank is supposed to achieve a quantitative target concerning the monetary base in order to control the growth of the money supply. That approach, however, is the sheer opposite of the everyday practice of modern central banks, which focus on the short-term money market interest rate, the so-called overnight interbank interest rate.

By putting the emphasis on the interbank interest rate, the central bank renounces its control over the monetary base, and the causality between the base money and the size of the broader monetary aggregates turns to the opposite direction. In the following paragraphs we try to explain at more length that, in today's practice, many of the factors affecting the monetary base are exogenous for the central bank, given that the result of the portfolio decisions of the economic agents is reflected in the central bank's balance sheet, determining the amount of central bank money.

In order to delimit the issue under review with more accuracy and to emphasise the focus of the paper, two things must be noted in advance:

1. It should be emphasised that this analysis concerns the operational activity of the central bank. It seeks an answer to the question of whether, in day-to-day practice, the size of the monetary base carries any information content with respect to the current and/or future monetary policy intentions. This set of issues can largely be discussed separately from the question of whether the broader money aggregates are suitable for the role of an intermediate target and whether the monetary aggregates have suitable indicator properties concerning inflation or output.
2. The most important conclusion of the analysis is that, rather than by meeting any target set for the quantity of base money, the central bank influences the economy by affecting the overnight interbank interest rate. However, this obviously does not preclude the possibility of certain central banks taking advantage of their monopoly over central bank money in order to achieve their operational

<sup>4</sup> The intermediate target is an economic variable, which has a relatively stable relation with the final target of monetary policy and can be regulated by the central bank at an acceptable level of accuracy.

<sup>5</sup> While the monetary pillar (the 4.5 percent target value for the growth rate of M3) is one of the components of the declared strategy of the European Central Bank, in practice it rather means the indicator role of monetary aggregates, which is completely subordinated to the primary goal of price stability.

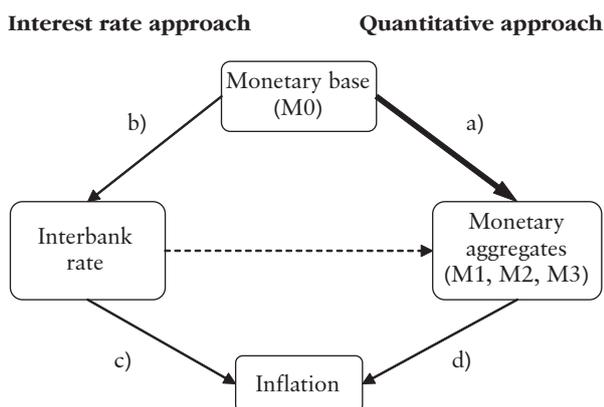
target. The operations of the MNB are ‘available’ to its partners without limitations, i.e. at the actual interest rate conditions, it allows banks to decide on the amount of central bank money they wish to hold, and *passively* adapts to the situation so arising. However, a number of central banks – taking into account the so-called autonomous liquidity shocks affecting the banking system – provide a daily forecast on the demand for central bank money, and accept deposits from the banking system (or sell government securities) and offer credit to the banks (or purchase government securities) at the quantities required in order that the overnight interbank interest rate should approximate its operational target. This may be termed *active* adaptation. It is important to note, however, that even in the latter situation, central banks decide on the supply of base money subordinated to their interest rate target, i.e. without trying to achieve a quantitative target for the monetary base.

economic relations marked with (c) and (d), as these issues can be interpreted independently of the operational target of the central bank.

## FACTORS DETERMINING THE SIZE OF THE MONETARY BASE

It has been explained that the monetary base comprises currency in circulation and credit institutions’ reserves, both of which are found on the liabilities side of the central bank’s balance sheet.<sup>6</sup> Bank reserves are deposited on the current accounts of credit institutions kept with the MNB. Therefore, in order to identify the factors determining the size of the monetary base, one must examine the factors that determine the balance of the *current accounts of commercial banks* kept with the central bank and the amount of the *currency* in circulation.

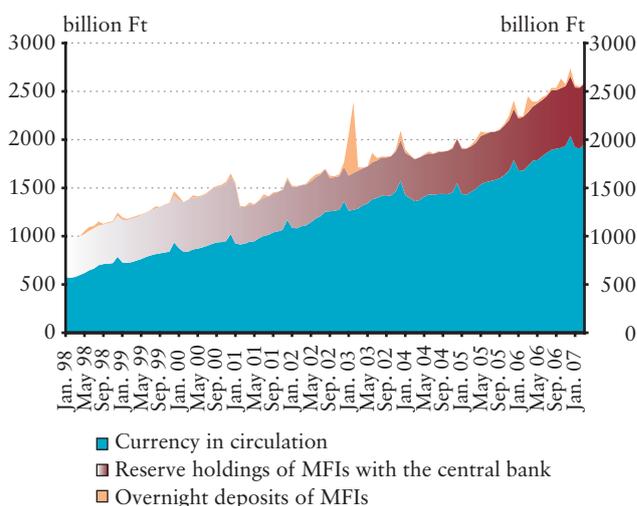
**Figure 1**  
The focus of the analysis and the related issues



a) Monetary base as a quantitative operational target (money multiplier model); b) short-term money market rate as an operational target; c) channels of interest rate transmission; d) quantity theory of money

On the basis of Figure 1, the above two remarks can be summarised as follows: while the analysis argues that role (a) (bold arrow) of the monetary base is empirically untenable, it does not contest the important function of central bank money in mechanism (b). At the same time, it is outside the scope of our study to formulate statements concerning the

**Figure 2**  
Components of the monetary base



The *current account* kept with the central bank serves two fundamental purposes: it is used by credit institutions to manage their everyday payment turnover (*working balances*) and to comply with their reserve requirements (*required reserves*).<sup>7</sup> Similarly to the practice of all modern central banks, the most important function of the compulsory reserve system among the monetary policy instruments of the MNB is currently that it helps in the smoothing of overnight interbank interest rates.<sup>8</sup> The goals

<sup>6</sup> In Hungarian practice, in accordance with the monetary statistics classification of the European Central Bank, the overnight deposits of credit institutions with the central bank are added to the former items. During ‘normal’ periods, however, the amount of overnight deposits is negligible. Any significant surge in their amount is an indication of some irregularity, such as the speculative attack against the forint’s band in early 2003, when the central bank refused to fully sterilize the excess liquidity arising from the sudden influx of foreign currency, which thus flowed into overnight deposits (Figure 2).

<sup>7</sup> Under the effective Hungarian regulation, the reserve obligation concerns deposits maturing in up to 2 years, the loans and securities embodying a credit relation received by banks unless they arise from a transaction with another credit institution or the MNB.

<sup>8</sup> The averaging mechanism of reserve regulation enables the smooth flow of liquidity management by credit institutions, and thus helps in smoothing interbank interest rates. It means that the reserve requirements must be met over the average of one month, i.e. the balance of the current accounts may temporarily be lower or higher than the required level. In accordance with that, however, the published monthly amount of the monetary base is also an average stock, which means that the averaging mechanism is irrelevant in terms of our subject.

of the reserve system do not include the diversion of income from banks or the influencing of the volume of the money supply. The rate of interest paid on the reserves equals the central bank's base interest rate, i.e. financial institutions are not burdened with the diversion of income through the reserve system. Also, the central bank does not actively modify the reserves rules in order to achieve any money quantity-related target.

In Hungary, the 5-percent reserve ratio combined with the averaging mechanism ensures the liquidity required for the operation of the entire banking system. Since the reserve rate represents an effective lower bound for banks and the MNB does not pay any interest for the excess balance on top of required reserves, on a monthly average, credit institutions keep exactly the required amount on their accounts. Any excess liquidity on the level of the entire banking system will automatically 'precipitate' in the main monetary policy instrument of the MNB, currently the two-week central bank

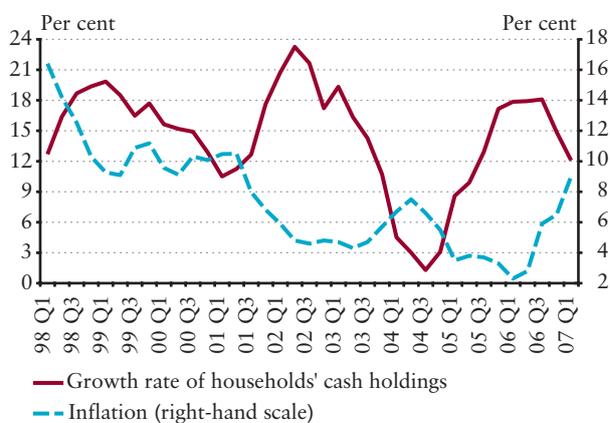
bill. Consequently, the balance of the current accounts is dependent on the amount of liabilities falling under the reserve obligation, which in turn essentially reflects the type and maturity of instruments in which the private sector wishes to keep its financial savings.

Similarly, the MNB does not exert any influence on the amount of currency in circulation through any direct means. To the debit of the amount kept on their current account, commercial banks can obtain banknotes and coins without restriction at any time. Banks do not keep more than the minimum amount of currency required for daily operations, as lost interest represents an opportunity cost for them. Therefore, the banking system withdraws no more currency from the MNB than is required in order to satisfy the currency requirements of customers (e.g. demand typically surges before public holidays and long weekends). Thus, the stock of currency in circulation is again determined by the demand of the private sector.

**The stock of currency held by households and the rate of inflation**

One of the most important factors affecting the currency demand is inflation, as the alternative cost of keeping currency, a non-interest-bearing instrument, can increase significantly when prices increase at a fast rate. The currency demand of households, one of the crucial factors of the monetary base, is particularly sensitive to inflation trends. Looking at the time series of the last near ten years, it is apparent that a decrease in the rate of inflation in Hungary has been accompanied by an increase in the growth rate of households' currency stock, while rising inflation has generally gone together with lower currency growth (Figure 3). This correlation is an example for a mechanism, which, *ceteris paribus* increases the amount of the monetary base at a low rate of inflation. Therefore in that situation, the growth of central bank money is the consequence of decreasing inflation rather than an indication of inflation pressure.

**Figure 3**  
**The annual growth of the amount of currency held by households and inflation**



In summary, it can be concluded that the central bank does not exert direct influence on the size of the monetary base. Instead, the latter depends on the portfolio decisions of the private sector. Households and non-financial corporations have a choice between a wide range of financial assets when making the decision on the form in which they wish to keep their financial wealth. While the central bank's base interest rate obviously plays a role in these decisions, it is ultimately the structure of the portfolio (e.g. the proportion of currency, the distribution of short-term and long-term deposits or the weight of investment units) which will determine the quantity of base money on the liabilities side of the central bank's balance sheet. Consequently, the correlation suggested by the traditional money multiplier

model, which traces the changes in the broader money measures (M1, M2, M3) back to the increase of the monetary base, cannot be justified either theoretically or empirically.

**THE REAL DIRECTION OF CAUSALITY**

These days, most central banks intend to achieve their monetary policy goals by setting some kind of short-term interest rate. On the basis of the relationships presented above, it becomes clear that, in these economies, the growth rate of the monetary base is an endogenous variable, i.e. it is determined simultaneously with the rate of employment, output, prices, interest rates and other financial market variables. In addition to the real economy equilibrium, the

equilibrium is thus also achieved on the market of financial assets, i.e. private sector agents make the decision on the range of instruments in which they wish to keep their financial savings under the given circumstances.

Apart from the liquidity, the expected return and the risk of the available financial instruments, these portfolio decisions are affected by a number of other factors, such as the regulatory environment or technical innovations related to payment systems.<sup>9</sup> While some of the above are (indirectly) affected by the base interest rate, that relationship is difficult to forecast and may be highly volatile over time. Consequently, rather than subordinating its interest rate decisions to controlling the money supply, the central bank builds on far more complex channels of the transmission mechanism (see, for example, Vonnák, 2007). However, it thus has to accept that the monetary base is shaped by mostly exogenous factors:

1. households and corporations decide what portion of their financial assets they wish to keep in non-monetary instruments (e.g. shares and government securities) and

the portion to be kept in instruments having the functions of money;

2. economic agents decide on the instruments they want to keep their money in on the basis of their respective liquidity, interest rate and risk, thereby shaping the size of the money aggregates (M1, M2, M3);
3. the structure of instruments brought about by the portfolio decisions determines the quantity of reserves and the currency in circulation, i.e. the monetary base.

On the basis of the above, it is clear that the direction of the mechanism suggested by the money multiplier model is precisely the reverse, i.e. it is the broader money aggregates that determine the monetary base, to which the central bank, either passively or actively, adapts! Thus, on the determination of the quantity of base money, the essence is in the very factors which were 'enclosed' in the coefficient  $m$  in the money multiplication formula. In the example illustrated above, the latter also includes the currency-deposit ratio ( $cr$ ), which represents the portfolio decisions of the private sector in this largely simplified model.

### The relationship between the monetary base and money supply

Our statement on the direction between the base money and monetary aggregates can be illustrated by a simple statistical test. The Granger causality test serves to determine whether the historical changes in a variable carries any information as to the future value of another variable, i.e. whether it helps in forecasting the latter. Table 1 shows that

M0 does not Granger-cause either the M1 or the M2 aggregates, while the historical values of the broader money aggregates significantly explain the changes in the monetary base. That result confirms again that there is no express correlation between the quantity of central bank money and the money supply.

**Table 1**

#### The Granger causality test of the monetary aggregates

Null Hypothesis	Number of observations	F-Statistic	Probability
M0 does not Granger Cause M1	101	1.49	0.189
M0 does not Granger Cause M2	101	0.65	0.691
M1 does not Granger Cause M0	101	3.49	<b>0.004*</b>
M2 does not Granger Cause M0	101	2.44	<b>0.031*</b>

Note: \* indicates significant results at 5-percent level. The tests were carried out with seasonally adjusted monthly data for each time series between May 1998 and March 2007. The number of lags included was 6 (half a year). The estimates, however, appeared to be robust in that respect. The results show a similar picture when stated for the first difference of the variables.

<sup>9</sup> A good example for the effect of the changing regulations is the imposition of the interest gains tax in September 2006, diverting a great deal of the savings of households into long-term time deposits and investment units. (It should be noted, however, that investment trusts again placed a substantial part of their new funds in bank deposits, which means that the overall reserve obligation did not change significantly.) Amongst other things, the decrease of the currency demand as a consequence of the growing availability of ATM's and bank card-based payment is an example of the results of technological development.

## CONCLUSIONS

Rather than a quantitative target concerning the monetary base, in today's practice the *operational target* of the central bank is to determine the short-term *money market interest rate*. However, in that environment, many of the factors affecting the monetary base are exogenous for the central bank, given that the result of the portfolio decisions of the economic agents is reflected in the central bank's balance sheet, and determines the quantity of central bank money. Consequently, the growth rate of M0 (monetary base) does not carry any information on either the intentions of the central bank or the prospective rate of inflation.

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