



## The link between money and inflation since 2008

The unconventional monetary policies implemented by central banks in the wake of the 2008 financial crisis, and subsequently in that of the Covid-19 health crisis, have led to a faster increase in money than in prices, prompting a review of the link between the two. This article recalls in the first two parts the concepts linking money and inflation, i.e. the money multiplier and the velocity of circulation of money, using the cases of the euro area and the United States as examples. Part three shows that while the link between money and inflation is preserved in the long run, consistent with the quantitative theory of money, it has become significantly distorted in the recent period. One reason for this disconnect in the shorter term is that unconventional monetary policies do not act on inflation via the money multiplier and the quantity of money in circulation, but by lowering long-term interest rates and financing conditions for households and businesses. They have thus made it possible to avoid episodes of deflation, and inflation would have been significantly lower without them.

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**12% and 15%**

the average annual increase in the monetary base between 2007 and 2020 for the euro area and the United States, respectively

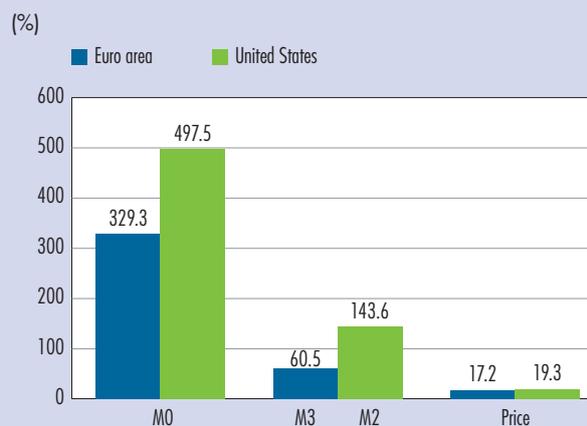
**3.8% and 7.0%**

the average annual increase in a broad monetary aggregate (M3 or M2) between 2007 and 2020 for the euro area and the United States, respectively

**1.25% and 1.40%**

the average annual increase in prices between 2007 and 2020 for the euro area and the United States, respectively

**Growth rate of the monetary base (M0), of a broad monetary aggregate (M2 or M3) and prices between Q4 2007 and Q2 2020, in the euro area and the United States**



Sources: European Central bank (ECB SDW, European Central Bank Statistical Data Warehouse); Saint Louis Federal Reserve (FRED, Federal Reserve Economic Database); Authors' calculations.

Note: Price changes are calculated using the Harmonised Index of Consumer Prices (HICP) for the euro area and the personal consumption expenditures (PCE) deflator for the United States.



Monetary issues are among the most discussed topics among economists, generating a wealth of academic literature. From David Hume<sup>1</sup> to Robert Lucas, different schools of thought have competed to attempt to shed light on the determinants of monetary dynamics, while empirical research has failed to resolve the debate. For example, the question of monetary neutrality has returned to the fore (Benati, Lucas, Nicolini and Weber, 2020) given that the increase in the money supply has not been accompanied by a corresponding rise in the level of prices since 2008.

At a time when assets are emerging that aim to compete with legal tender (local currencies and crypto-assets; Pfister, 2020), the question of how to manage the various monetary aggregates of central banks has become increasingly important.

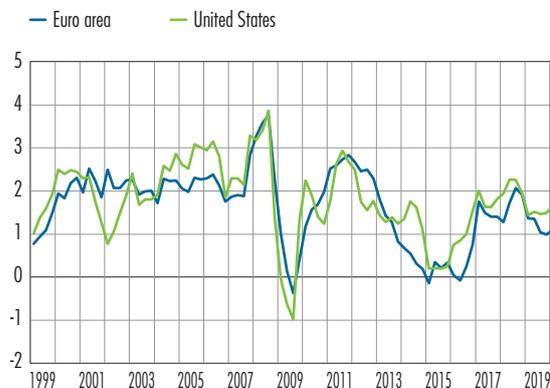
In the wake of the financial crisis of 2007-2008, major central banks, in particular the European Central Bank (ECB) and the Federal Reserve (Fed), adopted unconventional monetary policy measures (asset purchases, liquidity injections, forward guidance, etc.) to ward off the risks of deflation (Pfister and Sahuc, 2020). These policies have sometimes been criticised, with central banks being accused of significantly inflating their balance sheets, thus increasing the money supply, and paving the way for a sharp rise in future price levels. These criticisms are mainly based on the traditional quantitative argument that a high level of liquidity could lead to rapid credit creation and, ultimately, an increase in inflation that would jeopardise the price stability mandate of central banks.

However, since the introduction of these policies, there has been no surge in inflation, as shown in Chart 1 for the euro area and the United States. The relationship between money and inflation therefore needs to be re-examined. Is it evolving and if so how and why?

We will start by recalling the concepts linking money and inflation, i.e. the money multiplier and the velocity

### CI Inflation in the euro area and the United States since 1999

(%)



Sources: European Central bank (ECB SDW, European Central Bank Statistical Data Warehouse); Saint Louis Federal Reserve (FRED, Federal Reserve Economic Database); Authors' calculations.

Note: Inflation is calculated using the year-on-year change in the Harmonised Index of Consumer Prices (HICP) for the euro area and the year-on-year change in the personal consumption expenditures (PCE) deflator for the United States.

of money, using the cases of the euro area and the United States as examples. We will then show that while the link between money and inflation is preserved in the long term, in line with the quantitative theory of money, it has become significantly distorted in recent times, particularly due to these unconventional monetary policy measures, which act through channels other than the quantity of money itself.

### 1 Unconventional monetary policies and the money supply: the money multiplier

First, unconventional measures do not automatically lead to an increase in monetary aggregates. This can be illustrated with the concept of the money multiplier. This is defined as the ratio between the money available to the economy, measured by a monetary aggregate, and the money on the central bank's balance sheet (M0), known as "base money" or the "monetary base", made up of banknotes and sight deposits held by banks

<sup>1</sup> "Money is none of the wheels of trade: It is the oil which renders the motion of the wheels more smooth and easy. If we consider any one kingdom by itself, it is evident, that the greater or less plenty of money is of no consequence; since the prices of commodities are always proportioned to the plenty of money." David Hume, Political Discourses (1752).



with the central bank (reserves). In the multiplier approach, an increase in the monetary base eases the banks' liquidity constraint, allowing them to grant more loans and ultimately leading to an increase in the money supply, which brings the multiplier back to its initial value. Furthermore, structural factors can lead to variations in the multiplier. For instance, if it increases, the money created by a unit of base money is greater.

Chart 2 shows that the multiplier is not stable in the euro area and the United States and that, since 2008 and the introduction of unconventional measures by the ECB and the Fed, it has fallen sharply. In order to understand this development, we need to review the changes in the components of the monetary base. Chart 3 shows that, prior to 2008, it consisted mainly of banknotes in circulation, with a small amount of reserves imposed by the minimum reserve requirements.<sup>2</sup> Variations in reserves were determined by demand and reflected the increase in money, since reserve requirements are set as a percentage applying to a base close to the definition of the money supply. Moreover, the demand for reserves was fully satisfied where the institutions had the collateral

accepted by the central bank. As the latter aimed to achieve an interest rate target on the money market, the supply of reserves was therefore endogenous and the liquidity constraint resulting from the issuance of central bank money was significantly eased at the level of the banking sector as a whole (Drumetz, Pfister and Sahuc, 2015).

### C2 Money multiplier in the euro area and the United States since 1999

(In units)

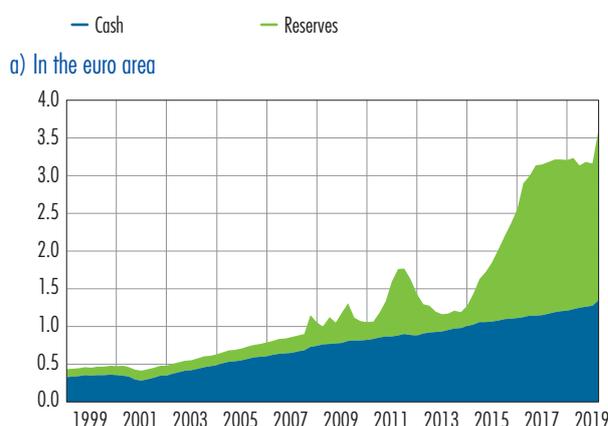


Sources: European Central bank (ECB SDW, European Central Bank Statistical Data Warehouse); Saint Louis Federal Reserve (FRED, Federal Reserve Economic Database); Authors' calculations.

Note: The money multiplier is calculated as the ratio of M3/M0 in the euro area and M2/M0 in the United States.

### C3 The monetary base since 1999

(Domestic currency trillions)



### b) In the United States



Sources: European Central bank (ECB SDW, European Central Bank Statistical Data Warehouse); Saint Louis Federal Reserve (FRED, Federal Reserve Economic Database); Authors' calculations.

Note: Cash includes banknotes and coins held both by the public and in the vaults of depository institutions. Reserves are the amount that financial institutions hold in central bank accounts to meet reserve requirements. In the case of the euro area, reserves consist of current account holdings and the deposit facility.

2 By increasing the demand for central bank money, minimum reserves help to stabilise interest rates on the money market.

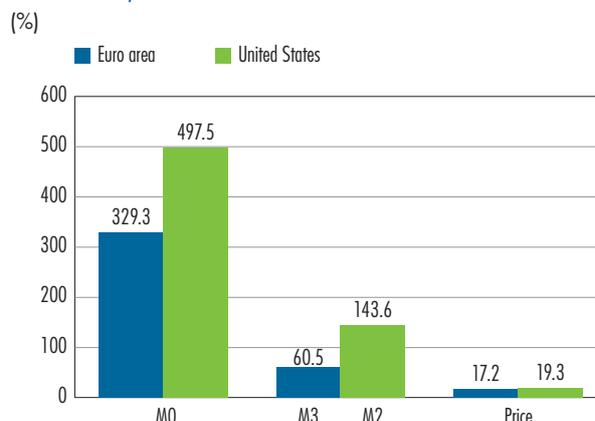


Since 2008, the monetary base has grown strongly due to two factors. The first is an increase in banks' demand for reserves in refinancing operations, not because they are offering more credit, but in order to protect themselves against difficulties in accessing the interbank market. The second is the creation of reserves when central banks purchase assets, which results in a structural liquidity surplus in the banking system.

In this situation, if the central bank chooses not to withdraw excess liquidity, banks are obliged to keep it in their accounts with the central bank and money market interest rates converge to those of the interest rate on excess reserves (i.e. the deposit facility rate in the euro area and the interest rate on excess reserves - IOER - in the United States). The money multiplier, which is of limited use when central banks provide liquidity to the banking system to achieve a money market interest rate target, is then no longer relevant.

Moreover, asset purchases are not intended to have a multiplier effect. Rather, their objective is to compress the term premia at the long end of the yield curve in order to act on long-term interest rates and, more broadly, on all asset prices, via portfolio rebalancing, a wealth effect, a signal effect, or an easing of financing conditions by flattening yield curves. For example, by buying bonds issued by the private and public sectors from investors (pension funds, banks and households), the central bank allows them to invest the funds they receive in other assets. The portfolio reshuffling mechanism at work here, by increasing the total demand for assets, pushes their prices up and their yields down, whether or not the assets are included in the central bank's asset purchase programme. Asset purchases thus contribute to improving monetary and financial conditions by reducing the cost of access to financing for businesses and households, supporting investment and consumption and helping inflation to return to its target level. The literature has shown that unconventional monetary policies, and asset purchases in particular, have had a significant impact on inflation (estimated at between 1.3% and 2.6% cumulatively between 2015 and 2019 in the euro area)

#### C4 Growth rate of the monetary base (M0), and of a broad monetary aggregate (M2 or M3) between Q4 2007 and Q2 2020, in the euro area and the United States



Sources: European Central bank (ECB SDW, European Central Bank Statistical Data Warehouse); Saint Louis Federal Reserve (FRED, Federal Reserve Economic Database); Authors' calculations.

Note: Price changes are calculated using the Harmonised Index of Consumer Prices (HICP) for the euro area and the personal consumption expenditures (PCE) deflator for the United States.

and have prevented episodes of deflation (see, inter alia, Weale and Wieladek, 2016; Dell'Ariccia, Rabanal and Sandri, 2018; Mouabbi and Sahuc, 2019; Rostagno, Altavilla, Carboni, Lemke, Motto, Saint Guilhem and Yiangou, 2019).

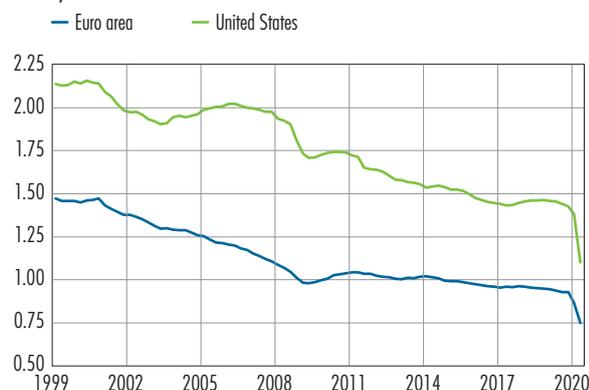
As a result, considering the most commonly used broad monetary aggregates in both areas, the increase in M0 since the financial crisis has not led to a proportional increase in M3 in the euro area nor in M2 in the United States. Thus, despite a 330% and 500% increase, respectively, in the monetary base in the euro area and the United States between the fourth quarter of 2007 and the second quarter of 2020, there was far less growth in money: the increases were 60% for M3 in the euro area and 143% for M2 in the United States between the same dates (see Chart 4).



### C5 Velocity of money and its determinants in the euro area and the United States since 1999

#### a) Velocity of money

(In units)



#### b) Growth rate of M3 and nominal GDP in the euro area (year-on-year)

(%)



#### c) Growth rate of M2 and nominal GDP in the United States (year-on-year)

(%)



Sources: European Central bank (ECB SDW, European Central Bank Statistical Data Warehouse); Saint Louis Federal Reserve (FRED, Federal Reserve Economic Database); Authors' calculations. Note: The velocity of money is calculated as the ratio of nominal GDP to a broad aggregate, M3 for the euro area and M2 for the United States.

## 2 Money supply, economic activity and prices: the velocity of money

Beyond the monetary multiplier, the academic literature inspired by quantitative theory is based on the following fundamental relationship (known as "quantitative theory of money")

$$M \times V = P \times T$$

where M is the money supply, V is the velocity of money, i.e. the average number of times a unit of money passes from one hand to another, P is the aggregate price level and T is the volume of transactions. As this volume is not directly observable, gross domestic product (GDP) is generally used as a proxy for it, which is the approach adopted here. In this approach, V is assumed to be constant or converging towards an equilibrium value sometimes called V\*.

Yet, as Chart 5a shows, since the early 2000s, the velocity of money circulation has been declining in both economic areas, as have the trends observed for the money multiplier (see Chart 2). In 2020, this decline accelerated due to the Covid-19 crisis, during which GDP declined sharply in both areas and money supply accelerated, especially in the United States (see Charts 5b and 5c).

Since the velocity of money circulation is not constant, an increase in the money supply in circulation should not lead, for a given GDP, to a proportional rise in the price level, according to the quantitative theory of money.

There are various explanations for this decline in the velocity of money circulation and, in turn, why the increase in the money supply has not been matched by an equivalent rise in prices. First, in the past, crises have been accompanied by a decline in the velocity of money circulation. Anderson, Bordo and Duca (2016) highlight the role of uncertainty, changes in risk premia, financial innovation and changes in banking regulations, all of which have played an important role in recent years. Some of these factors also played an important role during the Great Depression, which the authors study



in parallel with the Great Recession of 2009-20 and its aftermath. In particular, a crisis – financial or economic – goes hand in hand with an increase in uncertainty, leading to a wait-and-see attitude on the part of economic agents. This in turn leads to a rise in the share of monetary assets in their wealth and, consequently, to a decline in the velocity of money circulation. During the Covid-19 crisis, the sharp drop in the velocity of money in the euro area and the United States reflects precautionary savings behaviour. Moreover, contrary to what the liquidity trap theory would suggest, interest rates close to zero or even negative during the post-2008 period did not accentuate the slowdown in the velocity of money. In the euro area, the velocity of money even seems to have stabilised since 2008, with the exception of 2020.

Asset prices can also influence the transmission of a change in the money supply to the prices of goods and services. For example, an increase in the money supply may prompt the private sector to purchase more financial securities causing their price to rise rather than the prices of goods and services. For example, Bruggeman (2007) defines a period of sustained excess liquidity as at least three consecutive quarters in which the deviation of the broad money-to-GDP ratio from its trend level exceeds a statistical threshold. The author shows that, out of a panel of 18 industrialised countries, since 1970, one-third of excess liquidity situations have been followed by an increase in asset prices. This transmission of an increase in the money supply to asset prices is therefore not automatic.

Furthermore, Anderson, Bordo and Duca (2016) show that financial innovations play a significant role in reducing the velocity of money. For example, lower investment fund exit charges increase the liquidity of these funds and thus reduce the need for permanently available precautionary savings. Variables associated with payment infrastructures, such as the number of automated teller machines (ATMs), or socio-professional characteristics (e.g. the number of self-employed people)

may also explain the downward trend in the velocity of money (Cusbert and Rohling, 2013).

### 3 Is quantitative theory in question?

Academic research focuses on the relationship between the price level and monetary aggregates. For example, Benati, Lucas, Nicolini and Weber (2020) showed, using a panel of thirty-two countries, that aggregates have an impact on the long-term price level. As such, they confirm the approach of central bankers who, in order to take their decisions, use a battery of indicators, including changes in the different monetary aggregates. While Teles, Uhlig and Valle e Azevedo (2016) assert that this relationship has weakened since the early 2000s, the authors show that by adjusting the money supply growth by that of GDP, i.e. by subtracting the change in GDP from that of money rather than only considering the change in money, this relationship is found again.

The relationship between inflation and monetary aggregates can also be studied in terms of low-frequency movements. To this end, we use a band-pass filter that eliminates high frequencies such as those that characterise the business cycle. The first line of Chart 6 shows that money supply growth and inflation are strongly correlated at very low frequencies (20-40 years): an increase in the money supply is accompanied by an increase in the level of prices in the very long term in the euro area and the United States. In this respect, the quantitative theory of money is confirmed, but over a very long horizon.<sup>3</sup>

At the horizon of the economic cycle (2-8 years), which is relevant for a central bank, the transmission of the increase in the money supply to inflation depends on the conduct of monetary policy. Firstly, the shift to inflation targeting and the lesser emphasis on monetary aggregates by central banks (mid-1980s in the United States - Sargent and Surico, 2011 – and mid-1990s for Europe – Avouyi-Dovi and Sahuc, 2016) contributed to the disconnect between developments in these two categories

<sup>3</sup> The two curves are superimposed by bringing forward money growth by one year for the euro area and inflation by one year for the United States. The interpretation of this finding is that money "causes" prices in the euro area, while prices "cause" money in the United States.

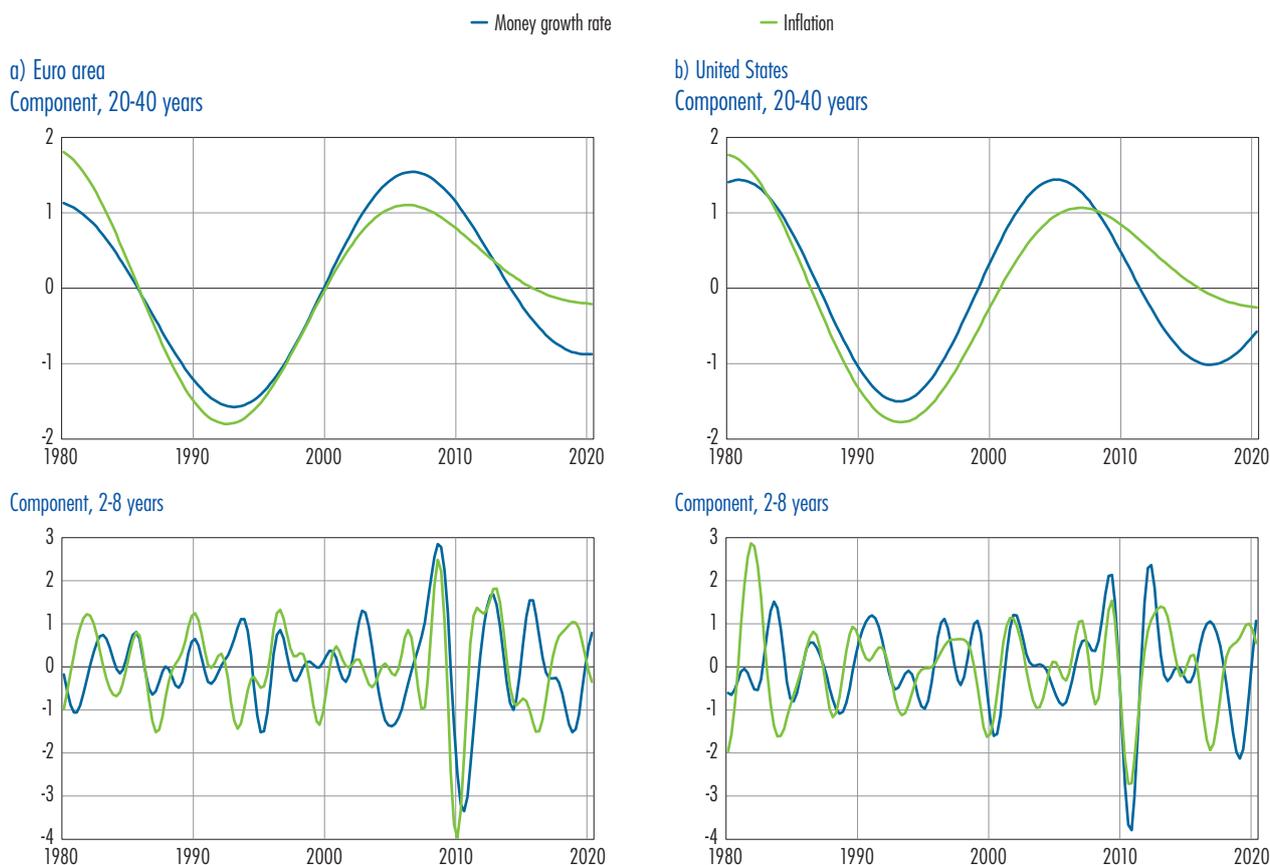


of variables. Second, the adoption of unconventional monetary policies has further blurred the relationship between money and inflation. For instance, the low interest rate environment has not led to a further decline in the velocity of money. Indeed, Dybowski and Kempa (2020) show, in the case of the European Central Bank, that monetary analysis influenced interest rate policy in the early years of its existence, but that this influence disappeared completely in the wake of the global financial crisis. The second line of Chart 6 shows that the disconnect between money and inflation tends to become more pronounced over time, as the two variables have even been moving in opposite directions in the most recent period.

To sum up, there is indeed in the short/medium term a weakening of the link between the monetary base and the money supply on the one hand, and between the money supply and the general level of prices on the other. This does not mean that monetary policy is becoming less effective, but that the effects of unconventional monetary policies on activity and prices pass through channels other than the quantity of money. In particular, asset purchase programmes affect the yield curve and financing conditions via the central bank's assets, rather than via the quantity of money issued on its liability side.

### C6 Filtered series of money growth rate and inflation

(%)



Source: Authors' calculations.

Note: The components of the money growth rate and inflation series (normalised) that belong to different frequencies are extracted using the band-pass filter proposed by Christiano and Fitzgerald (2003). Money growth (M3 for the euro area and M2 for the United States) and inflation (Harmonised Index of Consumer Prices (HICP) for the euro area and the personal consumption expenditures (PCE) deflator for the United States) are expressed in year-on-year changes. The curves representing respectively changes in inflation for the United States and changes in money for the euro area have been brought forward by one year.



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