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***Imad A. Moosa*[*], *Khalid Al-Saad*[**], *Ibrahim N. Khatatbeh*[***]**

[*] *Department of Economics, Kuwait University, Kuwait City, Kuwait*

E-mail: imad.moosa@gmail.com

[**] *Department of Finance, Kuwait University, Kuwait City, Kuwait*

E-mail: khalid.alsaad@ku.edu.kw

[***] *Business School, Hashemite University, Zarqa, Jordan*

E-mail (corresponding author): ibrahim.khatatbeh@hu.edu.jo

The Quantity Theory of Money, Quantitative Easing and the Missing Inflation Phenomenon

Abstract: Several explanations have been put forward for the observation that massive inflation has not appeared as a result of the explosive monetary growth generated by quantitative easing that was in 2008. Several plausible explanations have been put forward for this observation, but none of them can explain the huge gap between monetary inflation and price inflation. The alternative explanation presented in this paper is that monetary inflation is more reflected in stock prices than the CPI. It is demonstrated that by adjusting the CPI to reflect changes in stock prices, the gap between the trends of the money supply the CPI can be almost eliminated.

Keywords: Quantitative Easing, Monetary Inflation, Price Inflation, Quantity Theory of Money.

JEL Classification: E31, E58.

Introduction

The idea behind the monetary theory of inflation is simple. If more money is created than what is required to buy goods and services, prices will rise—that is, the value of money in terms of goods and services (or the purchasing power of money) will decline. Inflation, in other words, arises when too much money chases too few goods. In the 19th century, the relation between the money supply and inflation was articulated by Joplin (1826) as follows: "There is no opinion better established, though it is seldom consistently maintained, than that the general

scale of prices existing in every country is determined by the amount of money which circulates in it". In the 20th century, Milton Friedman appeared as the most outspoken advocate of the monetary theory of inflation. A famous quote from Freidman that is often repeated in the literature and the media is that "inflation is always and everywhere a monetary phenomenon" (Friedman, 1963).

The relation between money and prices is explained in terms of the quantity theory of money. Casual empiricism tells us that the general price level is related to the money supply, a relation that becomes rather conspicuous under hyperinflation where monetary inflation mostly takes the form of massive increase in the currency issued by the central bank (the monetary base). If this is the case, why is it that massive growth in the money supply under quantitative easing has not led to the rise of inflation? Even the recent resurgence of inflation is not attributed to monetary expansion but rather to Covid-related production bottlenecks and disruption of global value chains (Moosa, 2021).

The validity of the monetary theory of inflation requires that the general price level and the money supply grow at the same rate or at close rates (strong but not perfect correlation). A look at the historical figures on the money supply and the CPI shows that for a long time they grew in tandem, but the divergence between them has been widening, particularly since the initiation of quantitative easing in 2008. Huge amounts of money have been created by quantitative easing which central banks resorted to in response to the global financial crisis and. more recently. to the Covid-19 pandemic. We have been told repeatedly that massive inflation caused by monetary expansion would emerge, but it has not, or at least this is what we are led to believe.

The objective of this paper is to present an explanation for the divergence between monetary inflation and price inflation in the US. While several explanations have been suggested in the literature, the explanation put forward in this paper is that price inflation has been apparent in asset prices, particularly stock prices, which have risen even during the Covid recession. It can be demonstrated that by adjusting the consumer price index (CPI) to reflect stock prices, and not only the prices of goods and services, that the divergence between monetary inflation and price inflation narrows or disappears. This exercise will be conducted by using monthly US data going back to January 1960.

Some Preliminaries

The quantity theory of money, also called the quantity equation of money, is based on the simple idea that the amount of money required to settle transactions depends on the volume of transactions—hence on real output and prices (that is, nominal output). The equation is written as follows:

$$MV = PY \tag{1}$$

where M is the money supply (which can be any monetary aggregate), V is the velocity of circulation of money, P is the general price level and Y is real output (real GDP)—hence PY is nominal output. The velocity of circulation is the number of times per year each dollar is spent or changes hands (hence, it represents the frequency of transactions). Unlike the other three terms, the velocity of circulation cannot be measured independently but rather as a residual item by manipulating equation (1) to obtain

$$V = \frac{PY}{M} \tag{2}$$

The quantity equation is an identity whereby each term is defined in terms of the other three variables. Just like V is defined by the other three in equation (2), P can be expressed in terms of the other three variables by rewriting the equation as

$$P = \left[\frac{V}{Y}\right] M \tag{3}$$

which shows the connection between the price level and the money supply.

For a proportional relation between P and M to exist, the ratio V/Y must be stable. In particular, if changes in the money supply do not affect V, an increase in the money supply leads to an increase in nominal output, PY. If also changes in the money supply do not affect real output (that is, the assumption of neutrality of money) an increase in M leads to a proportional increase in P. Those who believe in the quantity theory as providing an explanation for inflation argue that the velocity of circulation is stable and predictable and that money is neutral with respect to real output.

To understand the process described by the quantity theory of money in a better way, equation (1) can be written in percentage terms (or growth rates) as follows:

$$\Delta m + \Delta v = \Delta p + \Delta y \tag{3}$$

where Δx is the percentage change or growth rate in x, which is typically approximated by the first log difference. Equation (3) can be re-arranged to produce

$$\Delta p = \Delta m + \Delta v - \Delta y \tag{4}$$

which says that the percentage change in the general price level (inflation rate) is equal to the percentage change in the money supply plus the percentage change in velocity minus the percentage change in real output (real growth rate). If velocity is stable, then $\Delta v = 0$, implying that the inflation rate is equal to the excess of monetary growth rate over the growth rate of output. Hence, inflation will materialise only if $\Delta m = \Delta y$. If velocity changes, inflation could arise even without an increase in the money supply. Also, an increase in the money supply in excess of output growth may not cause inflation if it is offset by a drop in the velocity of circulation.

The relation between the general price level and the money supply can be seen by using an equation for the demand for money. The predictability (or lack thereof) of the velocity of circulation is equivalent to the predictability (or lack thereof) of the demand for money (since in equilibrium real money demand is simply Y/V). Consider the simple demand for money function

$$M_d = PY^{\beta} \tag{5}$$

where M_d is the nominal demand for money and β is the output elasticity of the demand for money, which is a measure of the responsiveness of the demand for money to changes in real output. If the money supply is exogenous (determined by the central bank as a policy variable), then in equilibrium

$$M_d = M \tag{6}$$

where M is the money supply. Hence

$$M = PY^{\beta} \tag{7}$$

which gives

$$\Delta p = \Delta m - \beta \Delta y \tag{8}$$

Equation (8) tells us that the inflation rate is equal to the rate of monetary expansion minus the growth rate of the demand for money resulting from growth in real output. Obviously, if the growth rate of real output is zero, the inflation rate will be identical to the rate of monetary expansion. If money is not neutral,

a monetary expansion leads to a rise in real output and, consequently, to a rise in the demand for money. This would produce a smaller than otherwise excess money supply and, consequently, a smaller rise in the price level.

The rationale for the relation between monetary growth and inflation is straightforward. Output seldom falls by more than two or three percentage points, except for exceptional circumstances (such as total macroeconomic mismanagement, natural disasters and a pandemic). Velocity may change over time, typically by no more than one percentage point. When high-inflation and low-inflation countries are compared, differences in monetary growth are much greater than differences in either real output growth or velocity. As a result, the rate of monetary expansion is the dominant factor accounting for differences in inflation rates across countries. High-inflation countries experience rapid monetary growth, which has no limit under a fiat money system, whereas changes in output and velocity are limited. Likewise, the dominant factor accounting for different inflation rates over decades in the same country is different monetary growth rates (for example, the lower US inflation rate in the 1990s compared with the 1970s). The dominance of monetary growth in accounting for inflation is particularly pronounced under hyperinflation (Moosa, 2013).

This nature of the causal chain from money to inflation is a subject of contention. Some economists argue that the money supply is endogenous, determined by the workings of the economy, not by the central bank. There is an element of truth in this proposition, at least under normal conditions. The money supply is determined by the central bank only to the extent that the central bank is solely responsible for issuing currency (the raw material used by banks to create deposits) and because it can affect the ability of banks to grant credit and create deposits by other means such as reserve requirements. However, the money creation process involves behavioural factors, the preference of people for currency as opposed to deposits (and other financial assets) and the desire of banks to extend credit, given the constraints imposed by the central bank. Preference for cash as opposed to bank deposits became quite clear during the Covid-19 pandemic as people withdrew and stored at home massive amounts of cash as a precautionary measure.

Furthermore, some economists argue that monetary inflation does not necessarily lead to price inflation. A monetary expansion is supposed to work its way to prices directly or indirectly: directly through increased demand for goods and services, and indirectly through higher demand for financial assets. The latter leads to higher asset prices, lower interest rates, more borrowing and less saving—hence more consumption (and inflation). Some economists dispute the

proposition of the neutrality of money and the stability of velocity. For example, it is plausible to suggest that an increase in the money supply, unless trapped in the financial system as excess reserves, can cause a sustained increase in real production instead of inflation in the aftermath of a recession, when resources are underutilised. It is also suggested that if the velocity of circulation changes, an increase in the money supply could have either no effect, an exaggerated effect, or an unpredictable effect on the growth of nominal GDP. There is, the argument goes, no limit to the velocity of circulation, which means that any quantity of money can sustain any price level (Taylor, 2004).

The Stylised Facts

The stylised facts and empirical results presented in this paper are based on monthly US data covering the period January 1960 - January 2020. The data sample, obtained from the database of the Federal Reserve Bank of St Louis (FRED, n.d.), covers four variables: monetary base (*B*), narrow money supply (*M*), stock prices (*S*) and the general price level measured by the consumer price index (*P*). Supplementary data on bank reserves (*R*) and bank credit to the non-financial private sector (*C*). The definitions of the variables can be found in Table 1.

If there is any validity to the monetary theory of inflation, the general price level should move in tandem with the money supply. This does not mean that they should grow at the same rate, but rather at close rates, so that they cannot diverge significantly from each other over time. Figure 1 shows the time paths taken by the US narrow money supply (M1) and the general price level (proxied by the consumer price index) over the period January 1960 - January 2020. We can see that the variables moved very closely until about the mid-1980s, when divergence started to appear as the money supply grew at a progressively higher rate than the general price level. The divergence accelerated dramatically after the initiation of quantitative easing in 2008. The same can be said about divergence between the growth of the monetary base and the general price level as shown in Figure 2.

Economists who advocate the monetary view of inflation present various explanations for the gap. The first is that the gap is accounted for by changes in the velocity of circulation. However, since independent measures of velocity are not available, this proposition cannot be confirmed or rejected?. Trying to confirm the proposition by calculating velocity as a residual item leads to the mere tautology that the inflation rate is equal to the inflation rate. Another explanation is that a significant portion of the US money supply, particularly currency, is held abroad. According to the estimates of Federal Reserve Bank of St Louis, approxi-

mately 50% of all US currency in circulation is held in other countries (Anderson and Williams, 2007). The gap may be attributed to determinants of inflation other than monetary growth, such as the fiscal balance, public debt, the exchange rate level and regime, wage inflation, the state of the economy, cost-push, political factors, supply bottlenecks, economic openness and imported inflation. While this explanation is plausible, as indicated by the resurgence of inflation during the Covid recession, the divergence is too big to be explained by these factors.

Yet another explanation is that the relation between monetary growth and inflation is lagged, not contemporaneous—that it takes time for changes in the money supply to affect the general price level. In the 1960s, Milton Friedman wrote about the "long and variable delays" involved in a causal relation running from money to prices (Freidman, 1963). The time lag can be explained as follows. As the central bank prints money and buys bonds, interest rates go down and consequently the velocity of circulation declines, initially offsetting the effect of monetary expansion restraining price inflation. However, a sustained increase in the money supply will eventually produce inflation. Moosa (2013) demonstrates that there is no significant difference between the contemporaneous and lagged relations across several countries, irrespective of how the money supply and general price level are measured.

Some commentators argue that hoarding of excess bank reserves neutralises the potential for inflation as monetary is offset by a reduction in velocity. Wade and Bilson (2012) suggest that hyperinflation is not currently a threat in the US because the growth in the monetary base generated by quantitative easing has been matched by a sizeable decline in the velocity of circulation. Holland (2012) states that "printing money doesn't necessarily fuel inflation, especially when people are paying down debt and banks are reluctant to create new credit". McTeer (2010) contends that the large expansion of the Fed's balance sheet remains as excess reserves, which are not used for money-creating lending and investing. He concedes that excess bank reserves (while potentially inflationary) are currently not. The accumulation of reserves reflects the conservative lending nature of bankers and the slowdown in demand from creditworthy borrowers. O'Brien (2012) argues that quantitative easing is not really printing money, but rather swapping one asset (cash) for another (bonds). Thus, "whatever money the Fed prints is stuck in the banks". That money, according to O'Brien, "isn't inflationary as long as the banks don't lend it out". If banks decided to lend the money out, the Fed can respond by "raising the interest on excess reserves or require the banks to set aside more money". It is true that banks have been accumulating reserves since late 2008, which is indicated by the observation that the monetary base has been growing at a higher rate than M1. However, the accumulation of reserves

was reversed for a long time (until the resumption of QE in response to the pandemic) and bank credit to the private sector has been growing steadily (Figure 3 and Figure 4).

Another explanation that is discussed in detail in Moosa (2020) is that inflation is under-reported because governments have the means and incentive to lie about inflation. For example, Weiner (2019) wonders whether inflation is under control or that "it is just a big lie". The first reason why governments under-report inflation is political gain because keeping inflation under control sounds good in campaign speeches. The second reason is that low reported inflation generates big savings for the government because social security payments are adjusted by the inflation rate. Boring (2014) argues that the CPI is tied to the incomes of about 80 million Americans, including social security beneficiaries, food stamp recipients, military and federal civil service retirees and survivors, and children on school lunch programmes. The third reason is that a central bank pursuing quantitative easing would always claim that it is not inflationary as indicted by low reported inflation figures. It is ironic that governments do not only deny the presence of inflation but also claim that they are keeping interest rates low to entice mild inflation, which is required for economic recovery. Naturally, enticing inflation is not required when inflation is already high (Kaličanin, Grubišić and Kamenković, 2023). Mauldin (2013) suggests that the Bureau of Labor Statistics (BLS), which compiles the consumer price index, "has engaged in methodological shenanigans over the past couple decades".

Some observers believe that inflation is under-reported because the inflation figures are not compatible with the growth of the money supply as predicted by the quantity theory of money and the very definition of inflation that it is a situation where too much money chases too few goods. It also follows from the official definition of inflation adopted by the BLS that it is "a process of continuously rising prices or equivalently, of a continuously falling value of money" (Boring, 2014). In this sense, Schiff (2013) mentions the impossibility of creating something out of nothing. His argument is that "printing a dollar diminishes the value of all existing dollars by an aggregate amount equal to the purchasing power of the new dollar".

Explaining the Divergence: The Effect on Stock Prices

While the explanations presented so far for the divergence between monetary inflation and price inflation are plausible, none of them can explain the divergence between monetary and price inflation, particularly since the initiation of

quantitative easing in 2008. The explanation presented here is that inflation is reflected more in asset prices rather than the prices of goods and services (CPI). It follows that the divergence between monetary inflation and price inflation is due to failure to take account of asset price inflation, which is not reflected in the consumer price index.

The dramatic rise of stock prices in the midst of the Covid recession has been explained mainly in terms of the availability of (cheap) liquidity, made possible by quantitative easing. The availability of cheap loans has kept zombie companies artificially alive. Otherwise, sound firms going through temporary difficulties can borrow and stay afloat until the health crisis is over. The other possibility is stock buy-backs, which have been rampant. Ultra-low and negative interest rates have forced conservative investors to put their savings in the stock market to realise higher returns than what can be obtained from bank deposits and fixed-income securities.

The effect of monetary expansion on stock prices has been observed for a long time, but it has become apparent since the initiation of quantitative easing (Allen and Hein, 2023; Mulaahmetović, 2022). Newman (2012) refers to "an unmistakable correlation between its [the Fed's] QE programs and a stock-market rally that's now in its fourth year". Hubble (2013) argues that "when the Federal Reserve's balance sheet expands (QE) the stock market rises" and that "since 2008, a pause in QE led to falling stocks". He believes that stock prices have soared since the Fed embarked on "QE Infinity at a pace of $85 billion a month" (meaning QE3). Lenzner (2013) suggests the presence of a one-to-one correspondence between the Fed's purchases of securities and stock prices and attributes the "100% of the stock market gains since 2009" to Ben Bernanke, implying that the only factor producing stock market gains was QE. Al-Jassar and Moosa (2019) demonstrate that QE had a sizeable, but not exclusive, effect on stock prices and that stock prices were also affected by missing variables and cyclical movements.

A look at the historical data shows that stock prices have followed monetary aggregates more closely than the consumer price index. In Figure 5 we can see monthly data on the monetary base (B), narrow money supply (M), stock prices (S) and the general price level (P), proxied by the consumer price index. The dotted lines represent the best-fit deterministic trends. We can see that the monetary aggregates and stock prices have been growing exponentially, as the best-fit trend is exponential. Conversely, the general price level has been growing moderately, following a liner or at best a quadratic trend. Long-term growth rates of the variables tell us that stock prices have been more closely related than the general price level to monetary expansion, as shown in Table 2. Between January 1960 and Jan-

uary 2020, there was a 68-fold increase in *B*, whereas the corresponding figures for the *M*, *P* and *S* are 29, 9 and 38. In terms of the average compound monthly growth rates, the figures show that stock prices registered a growth rate that falls between the growth rates of *B* and *M*, whereas the growth rate of *P* (inflation rate) was 0.3%, much below the growth rates of the monetary aggregates.

If monetary growth affects stock prices more than the prices of goods and services, then monetary growth will not be reflected fully in the general price level, which gives rise to the divergence between monetary inflation and price inflation. The divergence is shown in Figure 6 in terms of the trends. The gap is wider in the case of the monetary base because it has a big component of bank reserves, which do not represent purchasing power.

Adjusting the CPI

In this section it is demonstrated that by adjusting the CPI to reflect changes in stock prices, the divergence between monetary inflation and price inflation narrows or disappears. Let $\Delta p_t = p_t - p_{t-1}$, $\Delta s_t = s_t - s_{t-1}$ where lower case letters represents logarithms, which means that Δp_t is the inflation rate and Δs_t is the rate of change in stock prices. The adjusted CPI (P^*) is calculated as follows

$$P_t^* = P_{t-1}^*[1 + w_p \Delta p_t + w_s \Delta s_t] \tag{9}$$

where w_p and w_s are the weights assigned to price inflation and asset price inflation, respectively. The higher the value of w_s relative to w_p, the closer will be the trend of the adjusted CPI to the trends of monetary aggregates. In Figure 7 we can see how changes in the weights produce changes in the gap between the trends of monetary aggregates and the CPI, such that a narrower gap is obtained by assigning a bigger weight to stock prices.

A seemingly unrelated time series equations model with unobserved components can be used to estimate the weights w_p and w_s empirically (Harvey, 1989). The model consists of two equations with *P* and *S* as the dependent variable and the money supply as the explanatory variable. The model is specified as follows:

$$P_t = \mu_{p,t} + \varphi_{p,t} + \alpha_{p,t} X_t + \varepsilon_{p,t} \tag{10}$$

$$S_t = \mu_{s,t} + \varphi_{s,t} + \alpha_{s,t} X_t + \varepsilon_{s,t} \tag{11}$$

where *X* is a monetary aggregate (which can be B or M). The terms μ_t, φ_t and ε_t represent the (unobserved) time series components of the dependent variable,

respectively the trend, cyclical and random components. The trend is specified as a random walk with a drift factor, which follows a first-order autoregressive process. The cyclical component, which is assumed to be a stationary linear process, may be represented by $\varphi_t = \rho(\varphi_{t-1}\, cos\, \theta + \varphi^*_{t-1}\, sin\, \theta) + \omega_t$ such that $\varphi^*_t = \rho(-\varphi_{t-1}\, sin\, \theta + \varphi^*_{t-1}\, cos\, \theta) + \omega^*_t$ appears by construction Harvey, 1989; Koopman, Harvey, Doornik and Shephard, 2006). The effects of the money supply on P and S are measured by the time-varying coefficients α_p and α_s, respectively. The model is estimated by maximum likelihood, using the Kalman filter to update the state vector. The components are included in the model to take care of the effects of other variables that do not appear explicitly as explanatory variables.

The estimation results, for M as the dependent variable, are reported in Table 3, which displays the estimated components and coefficients of the final state vector as well as the coefficient of determination, R^2, the modified coefficient of determination, R^2_d, and the diagnostics for serial correlation, Q, and heteroscedasticity, H. Q is the Ljung-Box statistic, which has a χ^2 distribution and H is a test statistic for heteroscedasticity with an F distribution.

The weights w_p and w_s are calculated as the normalised values of α_p and α_s. Therefore

$$w_p = \frac{\alpha_p}{\alpha_p + \alpha_s} \tag{12}$$

$$w_s = \frac{\alpha_s}{\alpha_p + \alpha_s} \tag{13}$$

The calculated values of w_p and w_s turn out to be 0.374 and 0.626, respectively. By applying these weights, we can calculate the adjusted CPI, $P^*(0.374{,}0.626)$. The trend of this adjusted CPI appears in Figure 8, much closer to the trend of the money supply than that of the unadjusted CPI. Therefore, the gap between monetary inflation and price inflation can be almost eliminated by adjusting the CPI to reflect changes in stock prices. This seems to be a plausible explanation for the "missing inflation".

Concluding Remarks

The "missing inflation" phenomenon refers to the observation that massive inflation has not emerged as a result massive monetary expansion, particularly following the initiation of quantitative easing in 2008. For a long time, the general price level rose in tandem with the money supply, but divergence between mon-

etary inflation and price inflation started to appear and widen quickly. This observation is incompatible with the quantity theory (or rather equation) of money and the very definition of inflation that it is a situation of too much money chasing too few goods.

Several explanations have been put forward for the missing inflation phenomenon, including declining velocity of circulation, other determinants of inflation, a lagged rather than contemporaneous effect, the accumulation of bank reserves, the use of large amounts of the US currency in other countries, and the proposition that inflation is under-reported because governments have the means and incentive to under-report inflation. While all of these explanations are plausible, none of them can explain the huge gap between monetary inflation and price inflation. The alternative explanation presented in this paper is that monetary inflation is more reflected in stock prices than the CPI. It is demonstrated that by adjusting the CPI to reflect changes in stock prices, the gap between the money supply and the CPI can be almost eliminated.

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Table 1: Definitions of Variables

Variable	Symbol	Definition
Monetary Base	*B*	Currency issued by the Fed (billion dollars)
Money Supply	*M*	Narrow money (M1, billion dollars)
Stock Prices	*S*	Total share prices for all shares for the US (index, 2015=100)
General Price Level	*P*	Consumer price index for all urban consumers, all items (index 1982-1984=100)
Bank Reserves	*R*	Reserves of depository institutions (billion dollars)
Bank Credit	*C*	Total credit to private non-financial sector (billion dollars)

Table 2: Growth Rates and Trends of Money, Prices and Stock Prices

Variable	Multiples (2020 relative to 1960)	Monthly Compound Growth Rate (%)	Equation of Trend (t=1,2,… is time)
B	68	0.59	$B_t = 66.022e^{0.0064t}$
M	29	0.47	$M_t = 91.006e^{0.0046t}$
S	38	0.51	$S_t = 69.402e^{0.0057t}$
P	9	0.30	$P_t = 0.000rt^2 + 0.9291t + 35.402$

Table 3: Estimated SUTSE Model (M is the explanatory variable)

	P	S
μ_t	783.56 (43.34)	3163.24 (6.75)
φ_t	1.006 (1.01)	43.48 (3.01)
α_t	0.114 (5.37)	0.191 (2.96)
R^2	0.92	0.96
R_d^2	0.45	0.53
Q	28.84	20.71
H	1.14	1.23

Q has a chi-square distribution with 23 degrees of freedom (a 5% critical value of 35.17). *H* has an *F* distribution with (239,239) degrees of freedom (a 5% critical value of 1.24).

Figure 1: The Money Supply (M) and General Price Level (P) (indices, Jan 1960=100)

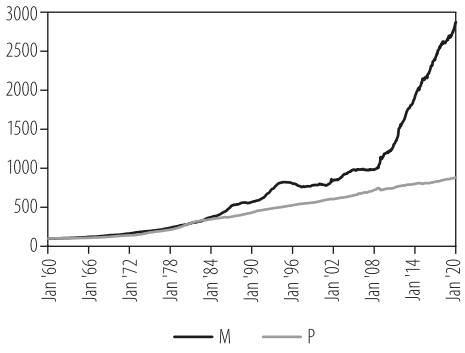

Figure 2: The Monetary Base (B) and General Price Level (P) (indices, Jan 1960=100)

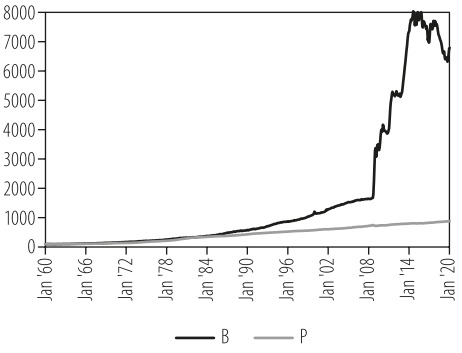

Figure 3: Reserves of US Banks ($ billion)

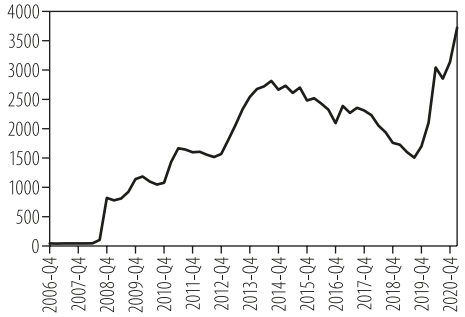

Figure 4: Bank Credit to the Non-Financial Sector ($ billion)

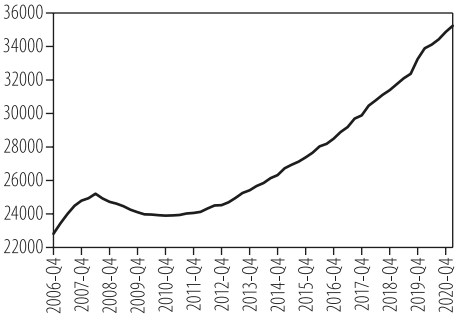

Figure 5: Time Series and Fitted Trends (Indices, Jan 1960=100

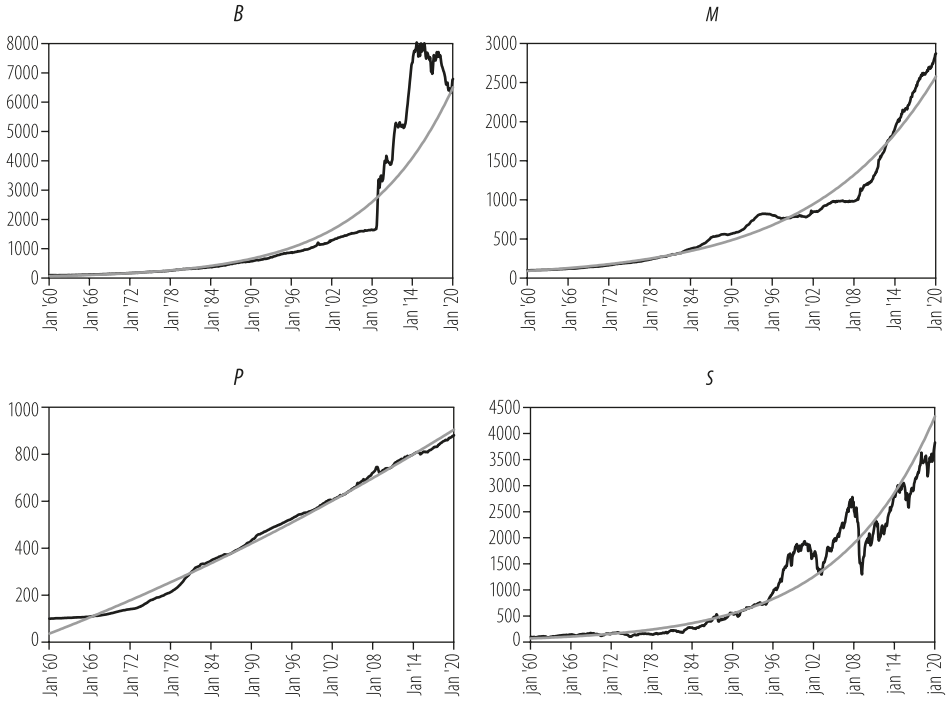

Figure 6: Time Trends of B, M and P

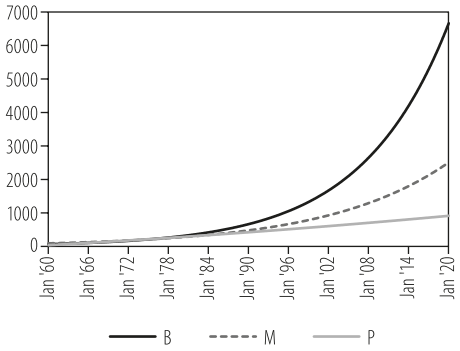

Figure 7: Trends of Actual and Adjusted CPI (various values of weights)

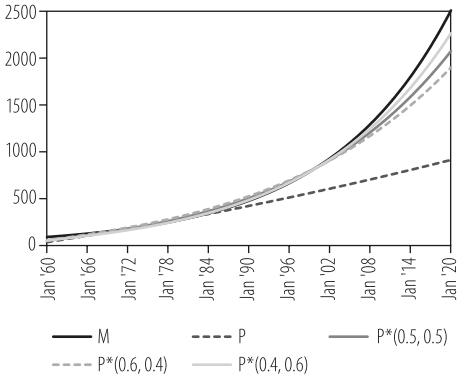

Figure 8: Trends of Actual and Adjusted CPI (estimated values of weights)

