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The Covid-19 stock market puzzle and money supply in the US

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Abstract

In the first five months of 2020 industrial production in the US fell 15% due to the Covid-19 shut down. At the same time the S&P500 stock market index first dropped by 30% and then recovered to almost pre-crisis levels. This seems puzzling as the most severe economic recession in nearly a century unfolds. However, central banks have supported financial markets with unprecedented money supply and this might explain the observed stock market resilience. Within a cointegration framework, we estimate the relation between macroeconomic variables and the US stock market. Results show that approximately half of the stock market recovery can be attributed to the increase in money supply.

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1. Introduction.

According to the OECD, the COVID-19 pandemic has triggered the most severe economic recession in nearly a century and is causing enormous damage to the global economy.[1] The FED chairman Powell raised concerns recently that the US economy could easily contract 20-30% and the downturn may last until late 2021.[2] Although the S&P500 stock market plummeted by 30% to the 23rd March, it almost reached the pre-crisis level by the end of May.

Generally, research has found a positive relation between economic output and the stock market (see, inter alia, Fama, 1990). While output dropped sharply in 2020, central banks reacted to the crisis by a massive increase in money supply. On 15th March, the Federal Reserve announced a zero-percent interest rate policy and on 23rd March, extended the $700 billion quantitative easing program to an unlimited amount (Zhang et al., 2020). A consequence might be a positive effect of money supply on risky assets, like equites, due to a portfolio shift from non-interest bearing money to financial assets (see, inter alia, Chaudhuri and Smiles, 2004). Furthermore, money supply might impact stock prices through the influence on inflation uncertainty and the risk channel (McMillan, 2017). In this paper we estimate the long-run relation between the stock market and macroeconomic variables, including money supply, in a cointegration framework to analyse the effect of money supply on the stock market recovery of 2020. Beside money supply, we include industrial production, short and long-term interest rates and inflation. While industrial production is a measure of economic output driving corporate cash flows, interest rates are proxies for the discount rate of those cash flows in determining stock prices via a discounted cash-flow model (Humpe et al. 2020). Further, inflation might impact interest rates and output alike (for a discussion see Fama, 1981; Campbell et al., 2004).

2. Data and Empirical Method.

The following model is specified to examine the long-run relation between macroeconomic variables and the stock market:

$$sp_t = \alpha_0 + \alpha_1 ip_t + \alpha_2 cpi_t + \alpha_3 10y_t + \alpha_4 3m_t + \alpha_5 m2_t + \varepsilon_t \qquad (1)$$

where sp_t is the logarithm of real stock prices in period t, ip_t is the logarithm of real industrial production, cpi_t is the logarithm of the consumer price index, $10y_t$ is the real interest rates, $3m_t$ is the real 3 month T-bill rate, $m2_t$ is the logarithm of real money supply M2 and ε_t the random error term. Stock price and CPI data is obtained from the OECD, while industrial production and the two bond yields are from the IMF. Money supply M2 is provided by the US Federal Reserve. All variables are collected monthly and the sample period is from January 1980 to May 2020.

Equation (1) is estimated in a cointegration framework. Johansen (1991) specifies the following general vector autoregressive model with error correction to test for cointegration relations:

$$\Delta X_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \prod X_{t-k} + \emptyset D_t + \varepsilon_t \qquad (2)$$

where the term X_t is a p x 1 vector with the variables from equation (1). The p x p matrix Γ and $\prod$ contain information about the rank of the long-run relationship among the variables. The error correction is captured by $\prod = \alpha\beta$ where the columns of matrix α are adjustment factors

[1] Source: http://www.oecd.org/economic-outlook/june-2020/

[2] Source: https://www.bbc.com/news/world-us-canada-52701420

and the rows of matrix β are the cointegration vectors. The term D_t are seasonal dummies and ε_t is the error term.

3. Results.

Table I presents the unit root tests, with the results supporting the view that all series are I(1).

Table I. Unit Root Tests

Variable	Constant and Trend	Constant Only	No Constant or Trend
ADF – Fisher Chi-square in levels			
Stock prices	-1.9723	-0.9020	2.0332
Industrial production	-0.6019	-2.1593	1.2720
CPI	-1.8916	-3.7511***	3.7909
10-year yield	-5.4993***	-2.0527	-1.2320
M2 money supply	0.6657	2.4275	4.4534
3-month yield	-2.8909	-1.5924	-1.5481
PP – Fisher Chi-square in levels			
Stock prices	-7.709	-1.386	0.388
Industrial production	-0.898	-1.583	0.101
CPI	-7.250	-1.780	0.184
10-year yield	-31.237***	-14.840**	-5.600
M2 money supply	2.204	1.948	0.249
3-month yield	-32.638***	-17.508**	-14.655***
ADF – Fisher Chi-square in first differences			
Stock prices	-21.0989***	-21.1195***	-20.9425***
Industrial production	-5.1318***	-4.9096***	-4.8705***
CPI	-6.2958***	-5.2139***	-3.2557***
10-year yield	-8.4856***	-8.4726***	-8.4865***
M2 money supply	-8.2925***	-7.9533***	-7.2852***
3-month yield	-8.7732***	-8.7995***	-8.8117***
PP – Fisher Chi-square in first differences			
Stock prices	-465.123***	-465.086***	-460.661***
Industrial production	-448.760***	-446.203***	-448.257***
CPI	-242.433***	-239.624***	-152.754***
10-year yield	-329.719***	-332.970***	-333.009***
M2 money supply	-232.756***	-232.732***	-232.654***
3-month yield	-215.287***	-215.258***	-215.182***
Notes: Entries are the panel unit root tests of equation (3), statistical significance is denoted at 10% *, 5% ** and 1% ***			

The Johannsen test for cointegration indicates one cointegrating vector at the 1% level (Table II), whereas Table III presents the error correction model. The cointegrating equation shows that all variables have a significant long-run relation with stock prices. Industrial production, money supply and 3-month interest rates exhibit a positive relation with stock prices whereas the coefficient for CPI and 10-year interest rates is negative.

Table II. Johansen Cointegration Test

Maximum rank	Parms	LL	Eigenvalue	Trace statistics	1% critical value
0	42	6282.8504	-	208.6024	103.18
1	53	6337.9043	0.20385	98.4945	76.07
2	62	6363.2104	0.09948	47.8823	54.46
3	69	6375.4552	0.04944	23.3927	35.65
4	74	6381.8558	0.02616	10.5915	20.04

Table III. Cointegration Relation and Error-Correction Model

US cointegration (1980M1 – 2020M5: Dependent Variable: Stock Prices				
Variable	Coefficient	Standard Error	z-Statistic	Probability
	Long Run Equation			
Real industrial production	2.462877	0.8285254	2.97	0.003
Real 10-year yield	-0.3635381	0.0472629	-7.69	0.000
CPI	-2.953643	0.8788063	-3.36	0.001
Real M2	1.050752	0.3880841	2.72	0.007
Real 3-month yield	0.2272822	0.0429317	5.29	0.000
C	5.032036			
Error-Correction Term (t-1)				
D(Stock price)	-0.002	0.001	-1.909	0.056
D(Industrial Production)	0.000	0.000	1.590	0.112
D(Real 10-year yield)	-0.004	0.012	-0.325	0.745
D(CPI)	0.000	0.000	-7.470	0.000
D(Real M2)	-0.001	0.000	-4.967	0.000
D(Real 3-month yield)	0.008	0.014	0.569	0.569
Notes: Selected Model: AIC model selection with 2 lags				

Examining the long-run relations, as expected, higher economic output leads to higher stock prices as it signals both higher future cash flow and lower risk. The 10-year real interest rate shows a negative effect on stock prices while short-interest rates have a positive effect. An explanation might be that short-term interest rates are low in recessions and high in booms due to monetary policy (for a discussion see Humpe et al., 2009). Inflation also shows a negative relation with real stock prices while the effect of money is positive. These findings are in line with the theoretical model of Geske et al. (1983) that predicts a negative relation between inflation and real stock returns if money is counter-cyclical. On the basis of a continuous-time process for output and money,

$$\frac{dy_t}{y_t} = \mu_y dt + \sigma_y d\omega_{y,t} \tag{3}$$

$$\frac{dM_t}{M_t} = \mu_M dt + \sigma_M d\omega_{M,t} \tag{4}$$

where μ_y and μ_M are the expected growth rates and σ_y and σ_M are standard deviations of output y and money M. The terms $\omega_{y,t}$ and $\omega_{M,t}$ are Browning Motions with the comovement captured by the correlation coefficient ρ (Bakshi et al., 1996; Sellin, 2001). Following Sellin (2001) it follows that real equity prices q_t are proportional to real output:

$$q_t = \delta^{-1} y_t \tag{5}$$

where δ is the subjective rate at which utility is discounted and the real rate of return on equity is equal to the growth rate of output:

$$\frac{dq_t}{q_t} = \mu_y dt + \sigma_y d\omega_{y,t} \ . \tag{6}$$

The price level P_t is given by the quantity theory pricing function with constant velocity of money and parameter $\emptyset$ that captures the relative importance of consumption and real money,

$$P_t = \frac{\emptyset}{1-\emptyset} (\delta + \mu_M - \sigma_M^2) \frac{M_t}{y_t} \ . \tag{7}$$

With the dynamics of this equation, inflation is driven by money and real shocks,

$$\frac{dP_t}{P_t} = \pi_t dt + \sigma_M d\omega_{M,t} - \sigma_y d\omega_{y,t} \tag{8}$$

where expected inflation might be constant: $\pi_t = \mu_M - (\mu_y - \sigma_y^2) - \rho\sigma_y\sigma_M$. In this model, positive shocks to money and negative output shocks have a positive effect on unanticipated inflation. From (6) and (8) we get,

$$cov_t\left(\frac{dq_t}{q_t}, \frac{dP_t}{P_t}\right) = cov_t\left(\frac{dy_t}{y_t}, \frac{dM_t}{M_t}\right) - var_t\left(\frac{dy_t}{y_t}\right) \tag{9}$$

According to Fama (1981) 'proxy hypothesis' real equity returns and output growth are closely connected. With a given money stock that would imply a zero covariance between output and money in equation (9), the covariance between real equity returns and inflation is negative. Furthermore, if monetary policy is counter-cyclical causing a negative covariance between output and money, the covariance between real equity returns and inflation must also be negative (Sellin, 2001).

Our results are therefore consistent with theory and current economic conditions. Thus, the fall in economic activity occurs with the fall in stock prices between February and March while the rebound is consistent with the higher money supply that began in March and has continued since. A higher money supply is consistent with improving future economic prospects, allowing firms and households to maintain spending as well as increasing levels of business and consumer confidence. The higher money supply will also engender a portfolio rebalancing effect towards stocks and away from interest-bearing assets. The error-correction results reveal that both stock prices and money supply (as well as inflation) respond to disequilibrium.

4. Summary and Conclusions.

The estimated long-run relation between macroeconomic variables and the stock market shows a positive relation between the stock market, industrial production and money supply. According to the estimated long-run relation, a 1% fall in industrial production causes a 2.46% decline in the stock market, while a 1% increase in money supply raises stock prices by 1.05%.

Hence, the 18% increase of money supply in 2020 might have supported the stock market by 19% while the 15% drop in industrial production reduced stock prices by 37%. The changes in CPI, 10-year and 3-month yields are small and do not have a major impact on stock prices. These results suggest that the recovery in the stock market from late March is partly due to the increase in money supply in a direct fashion, while they may also have an indirect influence through forming improved expectations regarding the economy.

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