Supply Chain Disruption: The Real Cause of Inflation

Joshua Simangunsong

Johns Hopkins University – School of Advanced International Studies

Research Question

How much of the increase in inflation is explained by supply chain disruption or monetary policy?

Importance

COVID-19 Exposed the Supply Chain

- Shocked the supply chain and disrupted the timing of goods
  - Vessels were rerouted and containers missing
  - Exacerbated the prices of goods due to the disruption
  - Goods were in high demand and supply of them was lacking
  - Businesses shut down due to the lack of goods
  - Lack of labor

COVID-19 Led the Fed to Print Monies to Stimulate Economy

- Federal Reserve has printed a total of $13 trillion
  - $5.2 T for COVID, $4.5 T for QE, $3 T for infrastructure
  - Annual Inflation rate is now 8.2%

Importance – continued.

Quantitative Easing in 2007 - 2008

- During the Financial Crisis, quantitative easing was performed
  - Inflation was not declared
- If there was quantitative easing during that time, why wasn't inflation declared?

M1 – Methodology Change

Description of M1 Money Stock Methodology Change

Footnotes

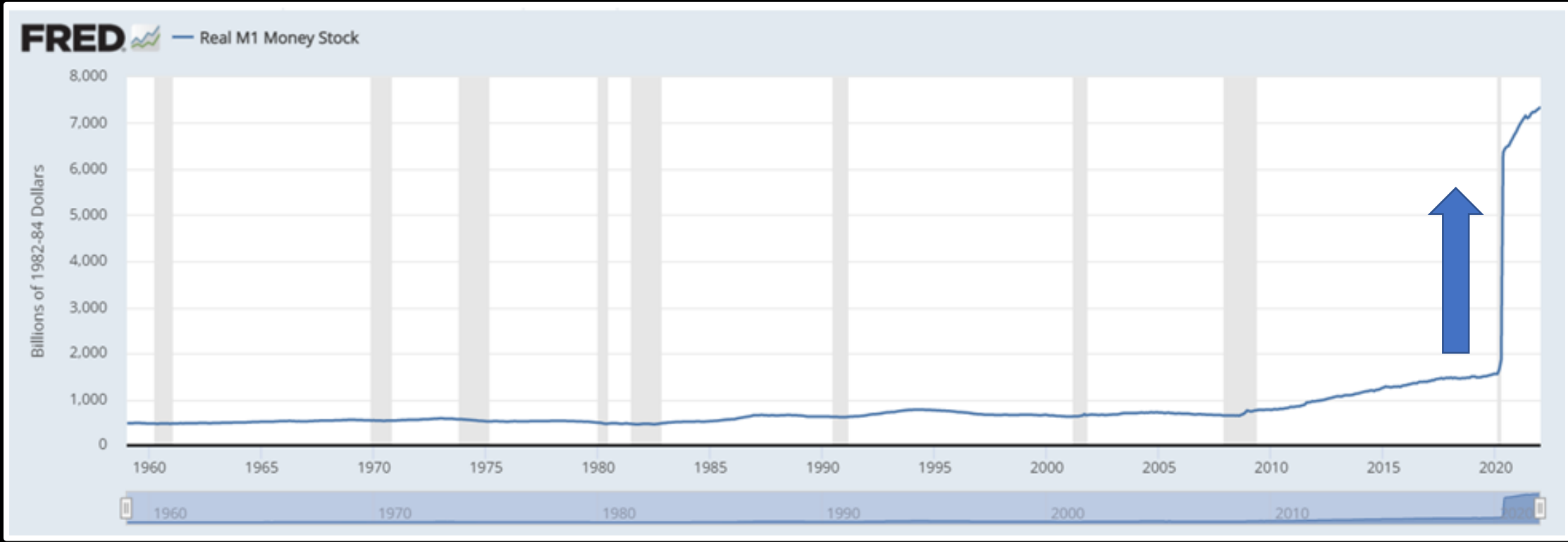
Components may not add to totals due to rounding.

1. Before May 2020, M1 consists of (1) currency outside the U.S. Treasury, Federal Reserve Banks, and the vaults of depository institutions; (2) demand deposits at commercial banks (excluding those amounts held by depository institutions, the U.S. government, and foreign banks and official institutions) less cash items in the process of collection and Federal Reserve float; and (3) other checkable deposits (OCDs), consisting of negotiable order of withdrawal, or NOW, and automatic transfer service, or ATS, accounts at depository institutions, share draft accounts at credit unions, and demand deposits at thrift institutions. Beginning May 2020, M1 consists of (1) currency outside the U.S. Treasury, Federal Reserve Banks, and the vaults of depository institutions; (2) demand deposits at commercial banks (excluding those amounts held by depository institutions, the U.S. government, and foreign banks and official institutions) less cash items in the process of collection and Federal Reserve float; and (3) other liquid deposits, consisting of OCDs and savings deposits (including money market deposit accounts). Seasonally adjusted M1 is constructed by summing currency, demand deposits, and OCDs (before May 2020) or other liquid deposits (beginning May 2020), each seasonally adjusted separately. For more information on the H.6 release changes and the regulatory amendment that led to the creation of the other liquid deposits component and its inclusion in the M1 monetary aggregate, see the H.6 announcement and Technical Q&As posted on December 17, 2020.
2. Before May 2020, M2 consists of M1 plus (1) savings deposits (including money market deposit accounts); (2) small-denomination time deposits (time deposits in amounts of less than $100,000) less individual retirement account (IRA) and Keogh balances at depository institutions; and (3) balances in retail money market funds (MMFs) less IRA and Keogh balances at MMFs. Beginning May 2020, M2 consists of M1 plus (1) small-denomination time deposits (time deposits in amounts of less than $100,000) less IRA and Keogh balances at depository institutions; and (2) balances in retail MMFs less IRA and Keogh balances at MMFs. Seasonally adjusted M2 is constructed by summing savings deposits (before May 2020), small-denomination time deposits, and retail MMFs, each seasonally adjusted separately, and adding this result to seasonally adjusted M1.
3. Currency in circulation consists of Federal Reserve notes and coin outside the U.S. Treasury and Federal Reserve Banks.
4. Reserve balances are balances held by depository institutions in master accounts and excess balance accounts at Federal Reserve Banks.
5. Monetary base equals currency in circulation plus reserve balances.

As of May 2020, M1 Money Stock now consists of OCDs and saving deposits. As a result, the M1 Money Stock has increased significantly

M1 – Methodology Change

M1 Money Stock



In a single month, the increase of there was an increase from $4.9 billion to $16.2 billion, not solely due to QE, but from the methodology change

Monetary Policy – M1 Methodology Change

U.S. Federal Government passed the CARES Act on March 27th, 2020

- $2 Trillion to all qualifying adults of up to $1200
  - Increased Money Supply

Theory of Money Equation – Milton Friedman

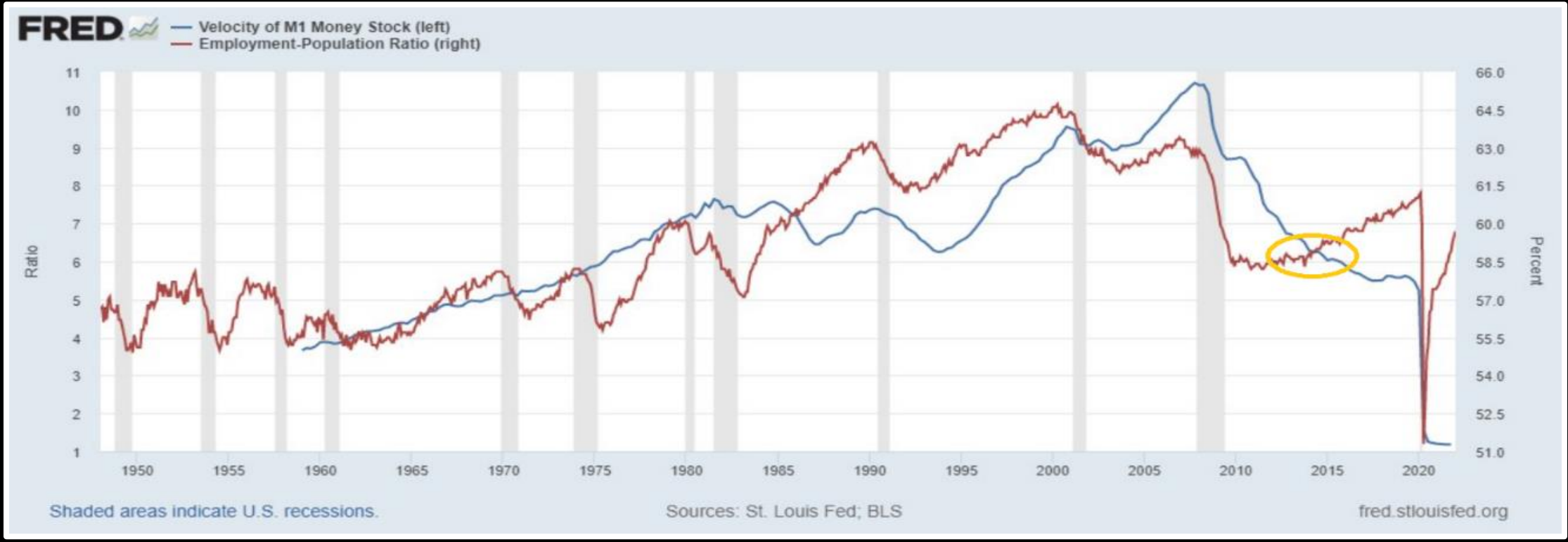
- MV = PQ
  - In theory, if GDP and Velocity were to increase at a constant, any increase in the money supply should increase prices

Methodology Change in M1

- Quantitative easing is measured in the Money Supply (M1)
  - In May 2020, the Fed decided to add saving deposits and checkable money funds, which were from M2, to M1
  - M1 is now M1 (before May 2020) + M2
    - This is seen in Figure 1

M1 – Methodology Change

Velocity of M1 Stock and Employment-Population Ratio

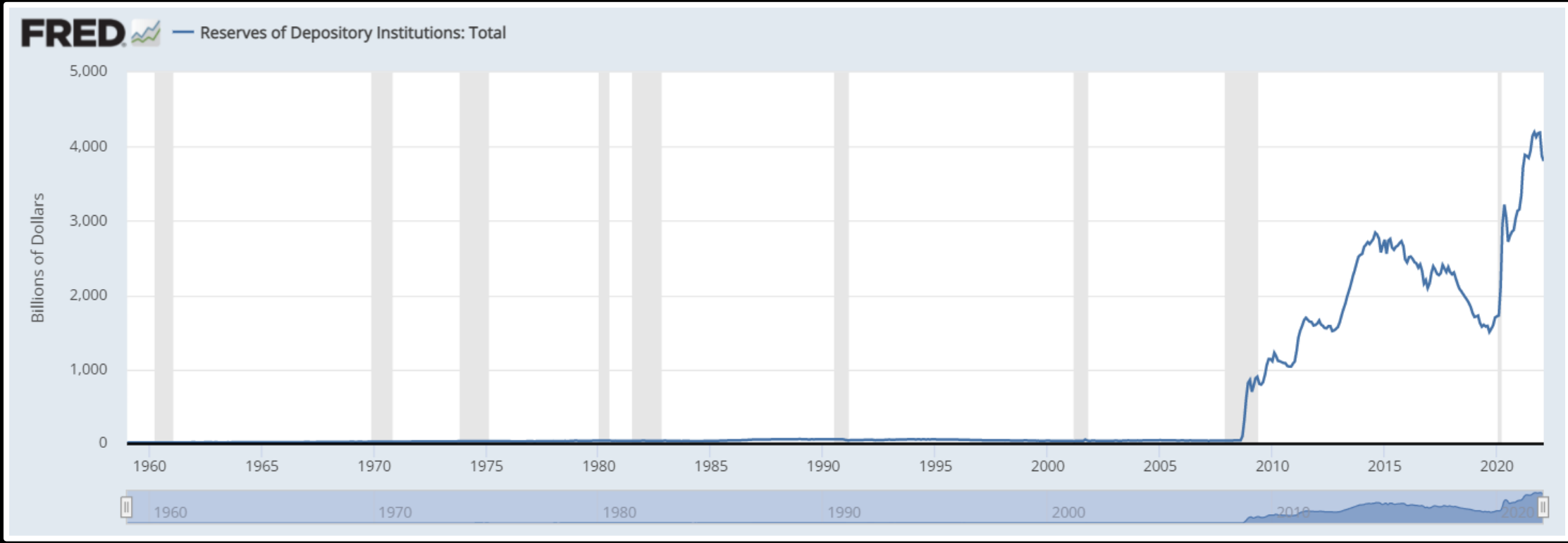


The decrease of Velocity in M1 Money Stock is not a result of unemployment

- Despite the increase in employment, the Velocity of M1 Money Stock was still decreasing, which is circled in yellow

M1 – Methodology Change

Reserves of Depository Institutions: Total



The money being printed was not utilized by the general public

- Institutions have accumulated the excess monies from the Federal Reserve

Regression – M1 Money Stock

Begs the Question:

Did the increase of the M1 Money Stock due to quantitative easing and does it have explanatory power for inflation?

Regressing for Inflation as M1 Money Stock as a dependent variable

Dependent Variable: INF_FD
Method: Least Squares
Sample (adjusted): 2008M12 2021M11
Included observations: 156 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.423861	0.050323	8.4228	0.0000
M1_FD	-4.00E-05	5.46E-05	-0.733421	0.4644

R-squared	0.003481	Mean dependent var	0.419045
Adjusted R-squared	-0.002990	S.D. dependent var	0.622231
S.E. of regression	0.623161	Akaike info criterion	1.904713
Sum squared resid	59.80270	Schwarz criterion	1.943814
Log likelihood	-146.5676	Hannan-Quinn criter.	1.920594
F-statistic	0.537906	Durbin-Watson stat	0.937764
Prob(F-statistic)	0.464417		

- M1 Money Stock is not significant at a 10% level and does not hold much explanatory power for inflation
- Therefore, inflation is not to be entirely blamed on quantitative easing, but COVID

Disruption in the Supply Chain

COVID-19 Disrupted the Supply Chain

- Changed trading pattern between countries
- Trade imbalances
- Immobilized individuals to conduct business
- Items became scarce
- Containers shipped to the wrong places

Commodity Prices

- Commodity prices have skyrocketed, which is illustrated on the right
  - Final goods have dramatically increased due to the disruption

Disruption in the Supply Chain – Port Data

Port of Los Angeles Data of Vessels

Year	Average POLA Vessels at Anchor	Average POLA Vessels at Berth	Average POLA Vessels Departed	Average Days at Berth	Average Days at ANC + Berth
2019	0	9	3	3	3
2020	2	10	3	3	3
1/2/2020 - 2/28/2020	0	7	2	3	3
3/2/2020 - 12/31/2020	2	11	3	3	4
2021	17	16	3	6	13

During COVID – 2020 & 2021

- The average vessels at berth have increased during the time of COVID
- The average days at ANC and Berth, time spent at the port, have increased
- These vessels are waiting to be cleared to unload the containers - an exact result of the container crises we currently face due to the pandemic

Disruption in the Supply Chain - Containers

Port of Los Angeles Data - Containers

Port of Los Angeles							
Year	Loaded Imports	Empty Imports	Total Imports	Loaded Exports	Empty Exports	Total Exports	Total TEUs
2019	4,714,266	149,579	4,863,845	1,756,177	2,717,611	4,473,788	9,337,632
2020	4,827,040	49,311	4,876,351	1,531,406	2,805,639	4,337,045	9,213,396
2021	5,513,286	26,707	5,539,993	1,184,145	3,953,472	5,137,617	10,677,610

Port of Los Angeles

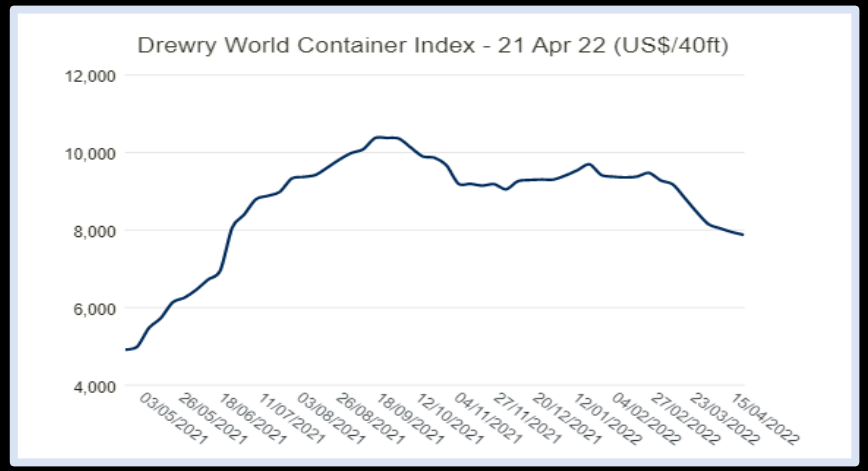
- Total amount of empty containers in 2021 was 5,164,324 from 4,386,356 in 2020 – this was an increase of 18%.

Port of Long Beach							
Year	Loaded Inbound	Loaded Outbound	Total Loaded	Empties Inbound	Empties Outbound	Total Empties	Total Throughput
2019	3,758,438	1,472,802	5,231,240	74,706	2,326,087	2,400,792	7,632,032
2020	3,998,340	1,475,888	5,474,227	146,370	2,492,718	2,639,088	8,113,315
2021	4,581,846	1,437,916	6,019,762	154,289	3,210,317	3,364,606	9,384,368

Port of Long Beach

- Total amount of empty containers was 2,639,088 in 2020, in 2021, 3,464,606 – a 27% increase
- Caused a huge imbalance between the total amount of inbounded and empty containers that were outbound

Disruption in the Supply Chain - Containers



Increased Costs per 40 Ft Container

- September 2021, freight costs reached an all-time high of $10,375 per 40-foot container
  - Bottlenecks and trade imbalances have increased container costs
  - Costs are passed down to the consumers

Inventories of Containers in Factories

- With prices at all-time highs and from lack of demand, the inventory of containers has been drastically cut during COVID
- Container factories have also reduced their production
  - There are more containers scrapped than produced

Model and Regression Results

$$\Delta inflation = \alpha_0 + \Delta \boldsymbol{InflExp}\beta_1 + \Delta MS\beta_2 + \Delta Oil\beta_3 + \Delta Unemp\beta_4 + \Delta Trucking\beta_5$$

Dependent Variable: INF_FD
Method: Least Squares
Sample (adjusted): 2007M12 2021M11
Included observations: 168 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.358114	0.046566	7.69042	0.0000
EXPINF4YR_FD	0.414285	0.258474	1.602812	0.1109
M1_FD	-5.04E-05	1.42E-05	-3.548846	0.0005
OIL_FD	0.058058	0.008172	7.10462	0.0000
UNRATE_FD	-0.125634	0.018942	-6.632647	0.0000
TRUCKING_FD	0.139207	0.03448	4.037309	0.0001

R-squared	0.586011	Mean dependent var	0.402917
Adjusted R-squared	0.573234	S.D. dependent var	0.732751
S.E. of regression	0.478687	Akaike info criterion	1.399521
Sum squared resid	37.12086	Schwarz criterion	1.511091
Log likelihood	-111.5597	Hannan-Quinn criter.	1.444801
F-statistic	45.86299	Durbin-Watson stat	1.475664
Prob(F-statistic)	0.000000	Wald F-statistic	137.1654
Prob(Wald F-statistic)	0.000000		

Model

The model is regressing for the first difference of inflation and its independent variables were selected for its explanatory power of inflation. The PPI of Freight Trucking is included in the model because it is highly relevant to the supply chain disruption effects. The sample size is from late 2007 to late 2021 and regressed using HAC standard errors to fix serial correlation.

Independent Variables

- First difference of each variable to make the regression stationary
  - Infl Exp – 4-Year Inflation Expectation
  - MS – Money Supply
  - Oil
  - Unemployment
  - Trucking

Results

- Nearly all the variables are statistically significant at a 1% level
- Expected inflation rate is almost significant at a 10% level

Model and Regression Results

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Results

Expected Inflation: If to increase by 1 percentage point, inflation is to increase inflation by 40 percentage points, which is almost significant at a 10% level.

M1 Money Stock: If to increase by 1 percentage point, inflation is to increase by virtually 0, and significant at a 1% level.

Oil: If to increase by 1 percentage point, inflation is to increase by .5 percentage points, significant at a 1% level.

Unemployment Rate: If to increase by 1 percentage point, inflation is to decrease by 12.5 percentage points, significant at a 1% level.

Freight Trucking: If to increase by 1 percentage point, inflation is to increase by 13.9 percentage points, significant at a 1% level.

Conclusion

In conclusion, the results of the regression align with my sentiments on inflation. The Producer Price Index (PPI) for the freight trucking industry, which reflects supply chain disruptions, has a statistically significant (at the 1% level) positive impact on inflation, even exceeding the influence of money supply. This finding is profound because many believe quantitative easing (QE) is the sole driver of inflation. However, the regression suggests that supply chain disruptions caused by COVID-19 may be a more significant factor. Therefore, this analysis suggests that QE is not the sole cause, and perhaps not a major cause at all, of inflation. The real cause of inflation is the disruption of the supply chain.