Macroeconomic Forecasts, 1Q2020
Domestic Metrics

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Overview

The economic condition of the United States has changed significantly in the last 30 days. On March 1, 2020 the US had roughly 100 confirmed cases of COVID-19 - by April 1, 2020 there were more than 200,000 confirmed cases[1]. The increase in US cases and the classification of COVID-19 as a pandemic has brought the US to a unique economic crisis. As of April 11, 2020, all but 8 states have established shelter-in-place executive orders, closing virtually all non-essential businesses[2].

What is in store for the economy and where are we headed? In forecasting the next stages of our economy, we are relying, in part, on the shape and trends shown by the economy under other disaster scenarios. We will draw some similarities to the economic conditions presented in New Orleans after Hurricane Katrina[3] and then examine other possible scenarios.

Benchmark Case: New Orleans and Hurricane Katrina

In late August 2005, Hurricane Katrina (a Category 5 storm) hit landfall on the Mississippi and Louisiana coast. Katrina slammed into Biloxi, Mississippi on August 29 and then moved onto Louisiana, impacting the city of New Orleans and the surrounding Parishes[4]. Katrina was responsible for more than 1,800 deaths and more than $41 billion in property damages[5].

The economic damage to New Orleans and Louisiana as a result of Hurricane Katrina was significant. Within a few days of the hurricane the population of New Orleans plummeted[6] and the unemployment rate increased. Figure 1 shows the spike in unemployment resulting

[1] https://www.worldometers.info/coronavirus/country/us/

[2] https://www.nytimes.com/interactive/2020/us/coronavirus-stay-at-home-order.html

[3] A possible reference to gauge economic impact would be to look at the impact of SARS on China. See https://www.cnbc.com/2020/02/11/coronavirus-4-charts-show-how-sars-hit-chinas-economy-in-2003.html. However, it is not clear that the data from China is always reliable and accurate. Additionally, because of the quasi-free-market-Government-market condition in China, it is not clear that we can easily translate the impact of a catastrophe in China on China's economy to that of the US economy.

[4] https://www.livescience.com/22522-hurricane-katrina-facts.html

[5] https://www.cnn.com/2013/08/23/us/hurricane-katrina-statistics-fast-facts/index.html

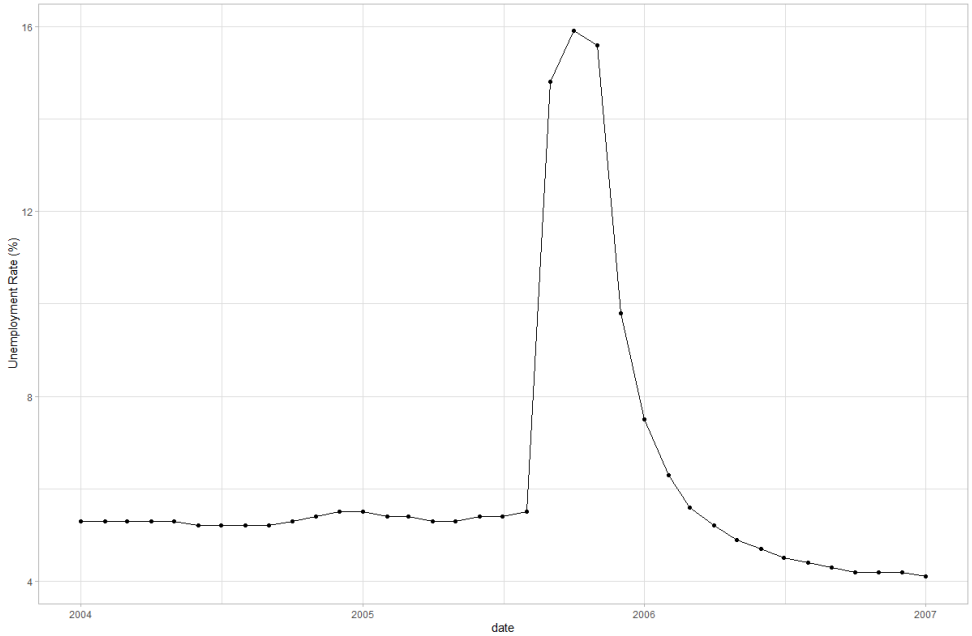
[6] The population of New Orleans fell from 484,674 before Katrina (April 2000) to an estimated 230,172 after Katrina (July 2006) — a decrease of 254,502 people and a loss of over half of the city's population. See: https://www.datacenterresearch.org/data-resources/katrina/facts-for-impact/

from Katrina. In August, 2005, the New Orleans unemployment rate stood at 5.5 %. Within a month, the unemployment rate nearly tripled to 14.8% and then rose again to 15.9% in October.

Figure 2 shows the percentage change in the number of private establishments (by quarter) for New Orleans, LA from 2004 through 2007. After Katrina, the number of private establishments dropped by 0.25%, 3% and 6.8% in consecutive quarters. Long run consequences of the hurricane and subsequent change in consumer behavior resulted in an additional drop in businesses of more than 13%.

Figure 3 shows the number of employees dropping significantly in the two months directly preceding Katrina. The number of employees did increase by November 2005, but the increases never reached the levels of pre-Katrina employment.

Figure 1: New Orleans Unemployment Rate (2004 - 2007)



Source: https://fred.stlouisfed.org/series/NEWO322UR

Figure 2: Initial Unemployment Claims by Week: Louisiana 2005 – 2020

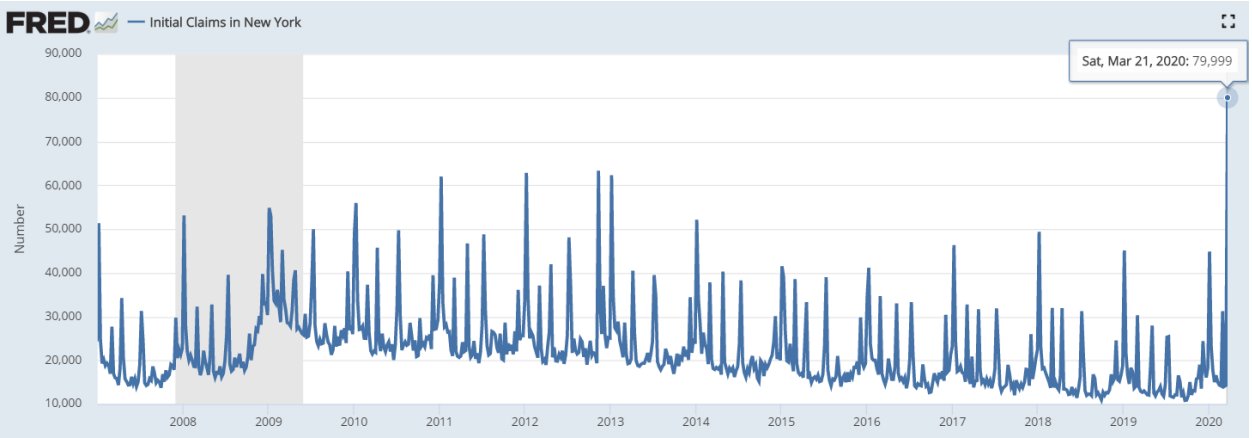
Source: fred.stlouisfed.org

Turning to the modern day, what is startling regarding Figure 2 is that unemployment claims on March 21, 2020 were only the first wave of initial unemployment claims. The new claims for March 28, 2020 for Louisiana topped 90,000. In New York state - the state with the most active COVID-19 cases - the initial unemployment claims spiked up to nearly 80,000 during the week of March 21, 2020.

Figure 3: Initial Unemployment Claims: United States (by week) 2000-2020

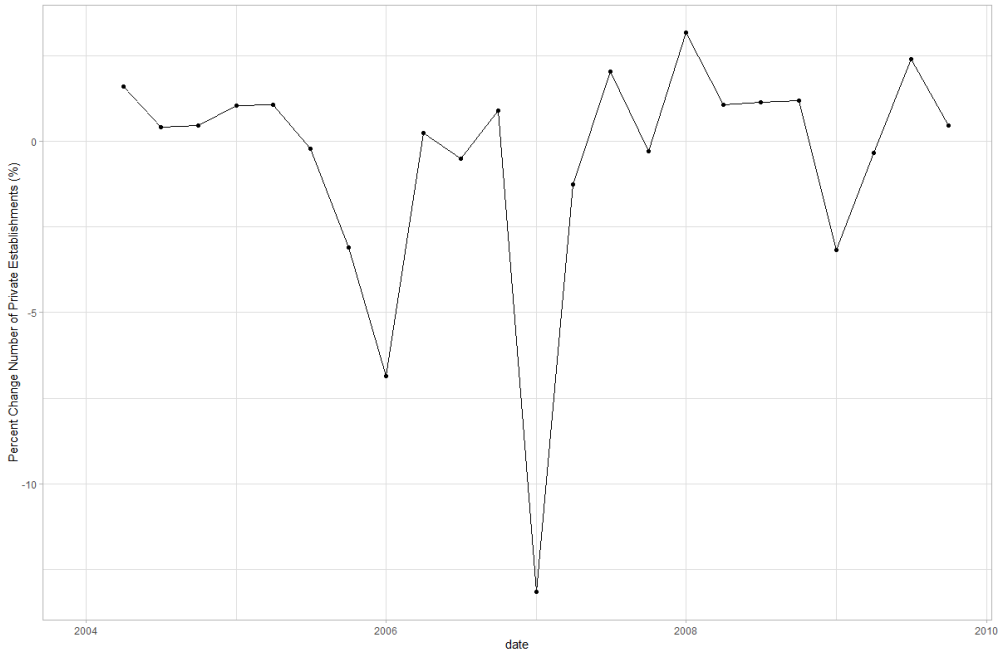
Source: fred.stlouisfed.org

Figure 4: Initial Unemployment Claims New York



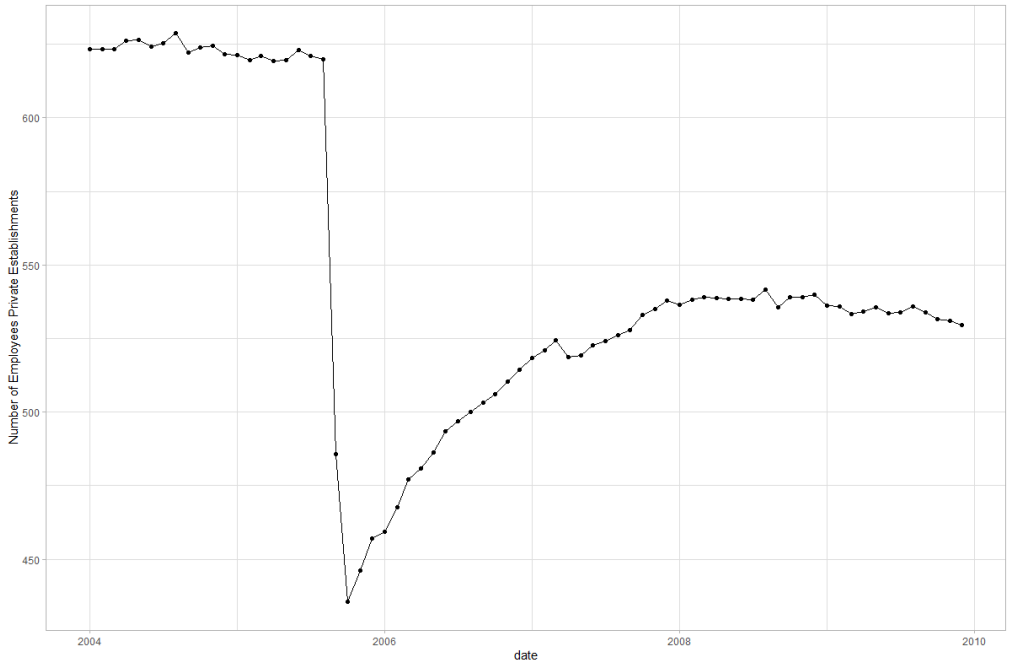
Source: fred.stlouisfed.org

Figure 5: Percent Change in Number of Private Establishments Orleans Parish (New Orleans, LA) 2004-2007



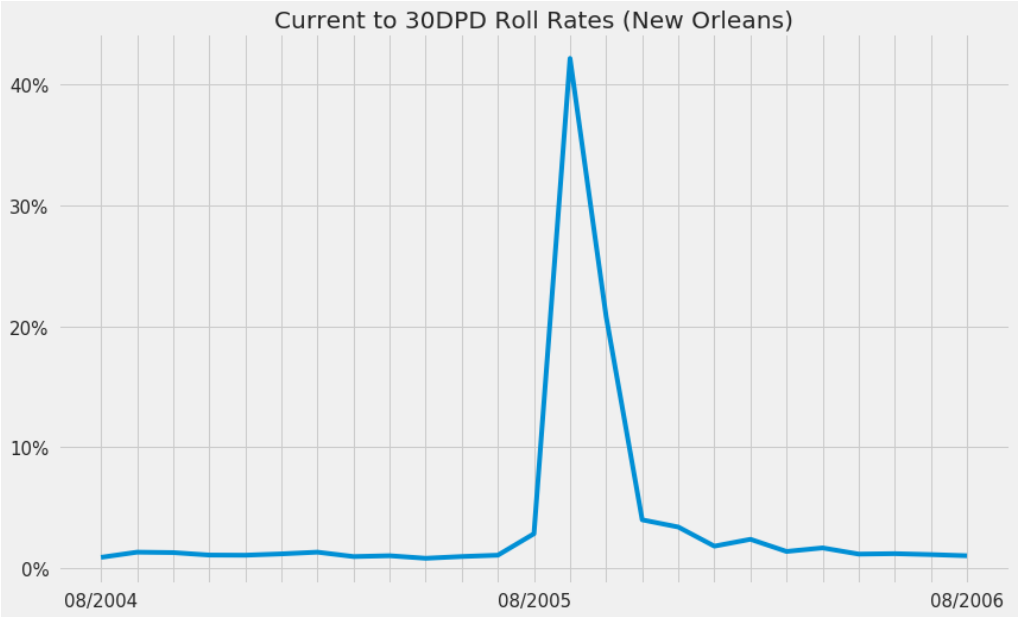
Source: https://fred.stlouisfed.org/series/ENU2207120510

Figure 6: Number of Employees (Total Non-Farm) New Orleans 2004 - 2010



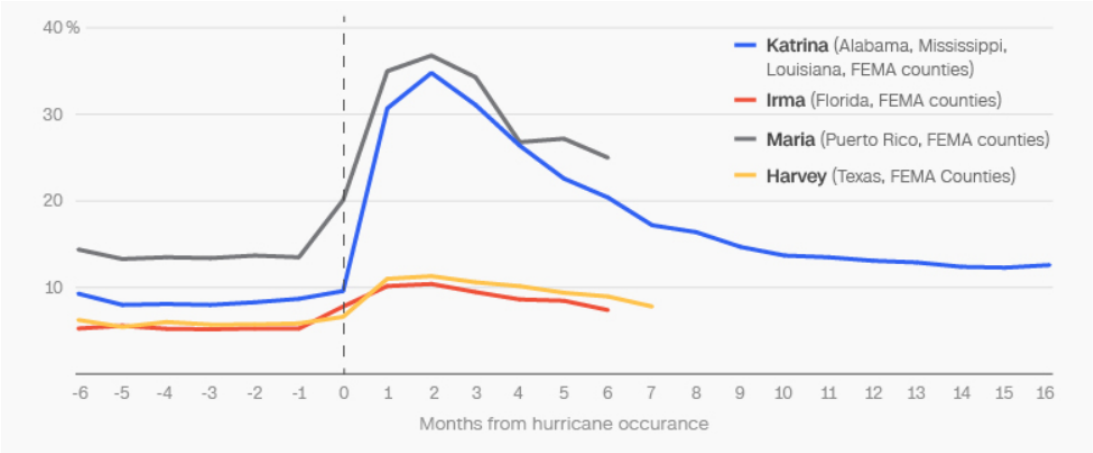
Source: https://fred.stlouisfed.org/series/NEWO322NA

Figure 7: Percentage of Residential Mortgages Moving from Current to 30 Days Past Due in New Orleans 2004 - 2006



Source: https://riskspan.com/news-insight-blog/hurricane_mortgage_recovery/

Figure 8: Percentage of Mortgages at 30 Days Past Due Relative to Start of Disruption due to Natural Disasters



Source: https://money.cnn.com/2018/04/22/news/economy/hurricane-foreclosures-houston/index.html

Figure 7 identifies the progression of mortgages from current to 30 days past due (dpd) mortgages in New Orleans . Figure 8 shows the percentage of mortgages that became 30 dpd relative to disasters in Texas, Puerto Rico, Florida and other gulf coast states. These figures reveal a consistent story about disruptions and mortgages: mortgage defaults increase in frequency in a municipality/region when a catastrophe occurs.

We believe that the economic fallout in New Orleans, LA related to Hurricane Katrina is a compelling case study for the COVID-19 outbreak. The current situation includes the following characteristics:

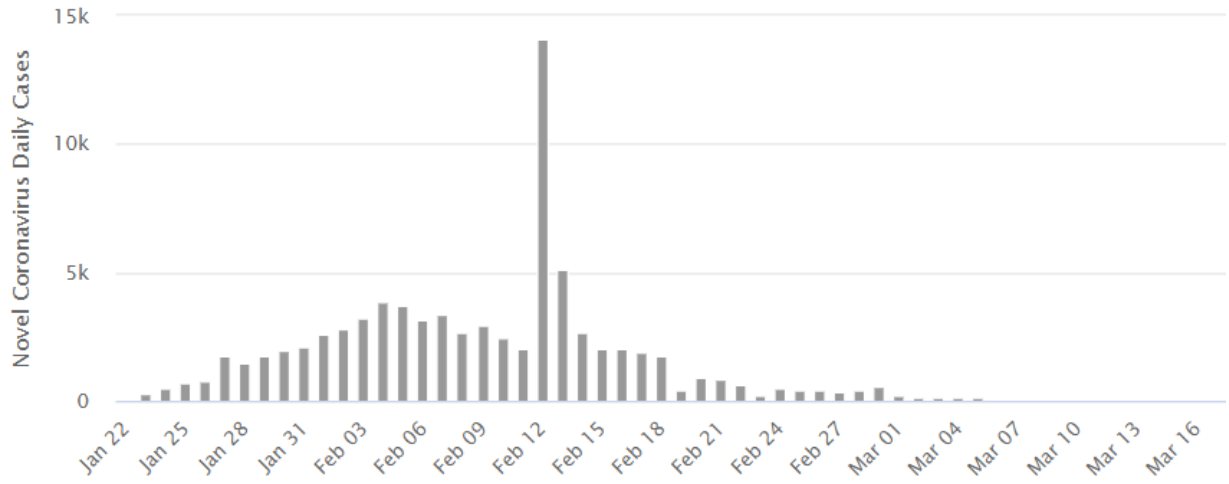
- A swift and sudden decrease in the number of people available to work
- A disruption in supply chains
- the inability for businesses to control their environment
- A delay in government responses to the disruption

The economic forecast built from a Katrina-like disaster but expanded to a much larger region (the contiguous United States) can go in one of three general directions.

Case 1. Significant Recession With a Quick Recovery by Q4

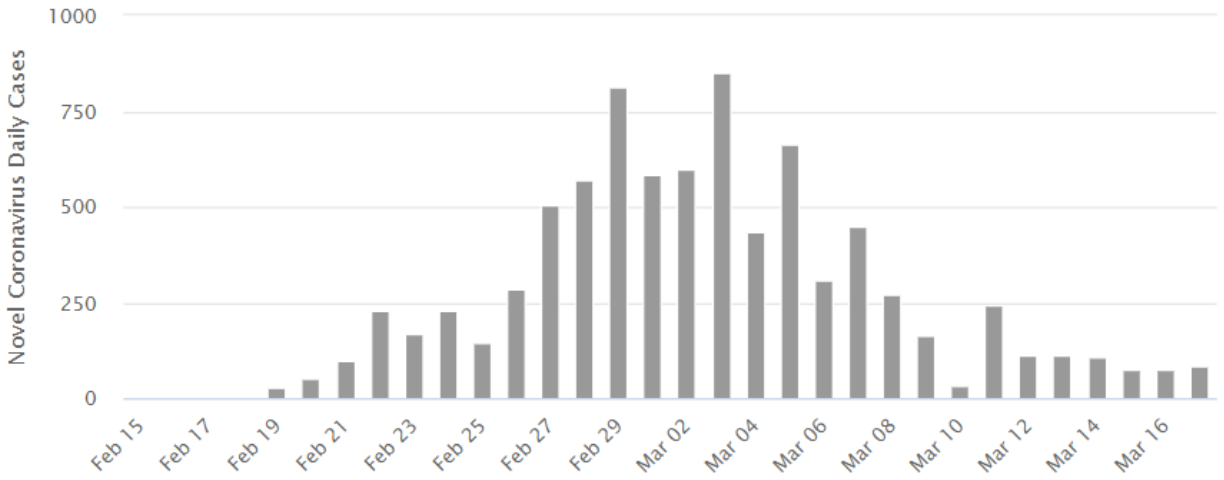
The flow of COVID-19 cases and deaths is still being evaluated. However, we've seen a pattern emerge from both China and South Korea regarding the number of new cases.

Figure 9: Number of Daily COVID-19 Cases- China



Source: https://www.worldometers.info/coronavirus/

Figure 10: Number of New Cases COVID-19 - South Korea



Source: https://www.worldometers.info/coronavirus/

These scenarios suggest a trend where the country hits the maximum number of new cases within 14 to 21 days after an initial intrusion of the virus followed by a longer decrease in the number of cases over the next three weeks. Both China and South Korea showed a slow-down of new COVID-19 cases within two months.

In this scenario, we are suggesting a relatively short (perhaps 45 – 60 days) infection period but very extensive spread of the virus. China, at its peak, showed approximately 5,000 new cases in a single day (with one day of 15,000 new cases). Given that the US has roughly 6

times the population of Hubei[7] province, and the US has been very slow to self-quarantine, social-distance and shelter-in-place[8], it is likely the number of cases in the US will be 6-8 times what we saw in China[9].

Under this scenario, we are likely to see the following:

- Unemployment rates between 22-30% by June 1, 2020
- Sustained higher unemployment rates 8 - 15% through September 1, 2020 as firms re-solidify, re-open, and re-capitalize
- New mortgage delinquencies (30 dpd) to increase to 55 - 70% of mortgages
- A drop in private establishments by 50 - 75%
- Real GDP dropping by 15 - 20% over the next two quarters (2Q2020 and 3Q2020)
- Significant rebound by 4Q2020 with a large consumer spend on entertainment and travel.

Case 2. Significant Recession with a Relapse: Waves of Uncertainty

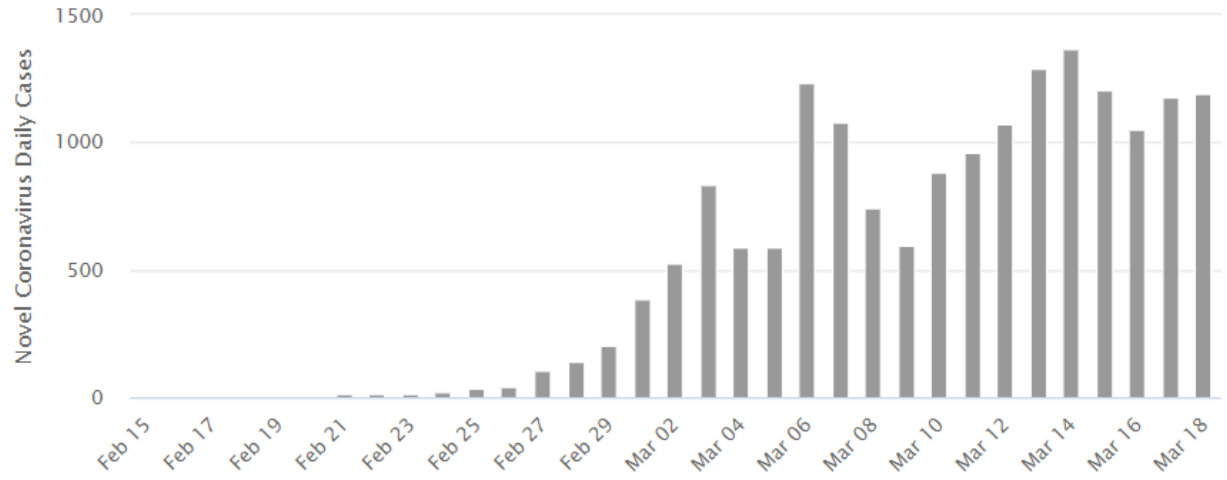
Although it appears that South Korea and China have been able to keep the trend of new cases looking similar to a 'bell curve' by engaging in significant quarantining of the population. Iran, however, has had less success with this technique and has seen a 'double-dip' or consecutive waves of new cases.

[7] https://www.forbes.com/sites/kenrapoza/2020/03/12/china-and-south-korea-models-seem-like-only-way-to-contain-covid-19/#5f99ca5c47d3

[8] San Francisco ordered a 'shelter in place' nearly two weeks after the COVID-19 took hold in Washington: https://abc7news.com/health/coronavirus-everything-you-need-to-know-about-the-bay-areas-shelter-in-place-order/6019152/

[9] As of April 5, 2020, the total cases in the US stood at approximately 300,000 with 30,000 new cases per day (https://www.worldometers.info/coronavirus/country/us/). At China's peak it saw 14,000 cases .per day

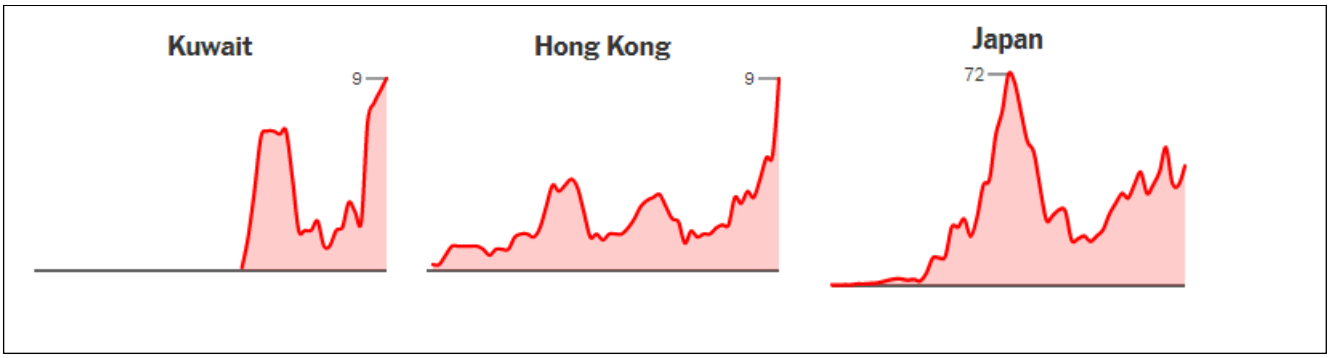
Figure 11: Number of New COVID-19 Cases - Iran



Source: https://www.worldometers.info/coronavirus/

We are seeing a similar pattern emerge in other countries as well. Kuwait, Hong Kong, and Japan have all exhibited this 'wave' pattern of new COVID-19 cases.

Figure 12: New Cases COVID-19 - Kuwait, Hong Kong, Japan



Source: https://www.nytimes.com/interactive/2020/03/19/world/coronavirus-flatten-the-curve-countries.html

Under this scenario, the US might see a spike in cases within the next two to three weeks, followed by a drop in the number of cases. If agents in the economy (consumers, businesses, and government leaders) relax social distancing, school closures and other suppressive measures, COVID-19 cases are likely to surge. In the scenario established above (see, for example, Japan) the second wave is smaller than the first wave. However, the second wave/spike could be equal in size or larger, depending on how complacent we become.

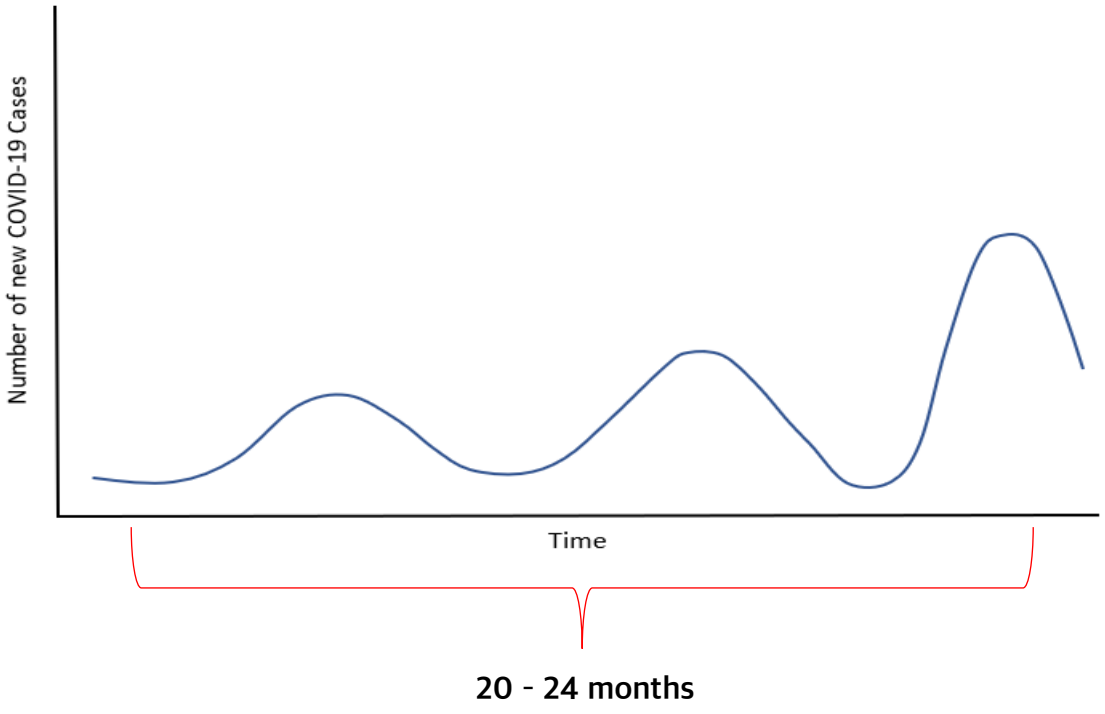
The economic conditions under this scenario are likely to be as follows:

- Unemployment rates between 45 - 70%
- Sustained higher unemployment rates 20% through January 2021
- New mortgage delinquencies (30 dpd) to increase to 65- 85% of mortgages
- Mortgage delinquencies of 60 dpd and 90 dpd to include 50 - 60% of mortgages
- A drop in private establishments by 60-85%
- Real GDP dropping by 20-30% over the next 12 months
- Slow recovery as small businesses try to recapitalize and establish new consumers

Case 3. Massive Recession with Consistent Relapses

Clearly this is a doomsday scenario that we would like to avoid. However, internal government documents (for example, U.S. Government COVID Response Plan[10]) is suggesting an 18-month pandemic with waves of new cases and extreme shortages. If this scenario plays out, we could see an extended recession lasting 20 - 24 months.

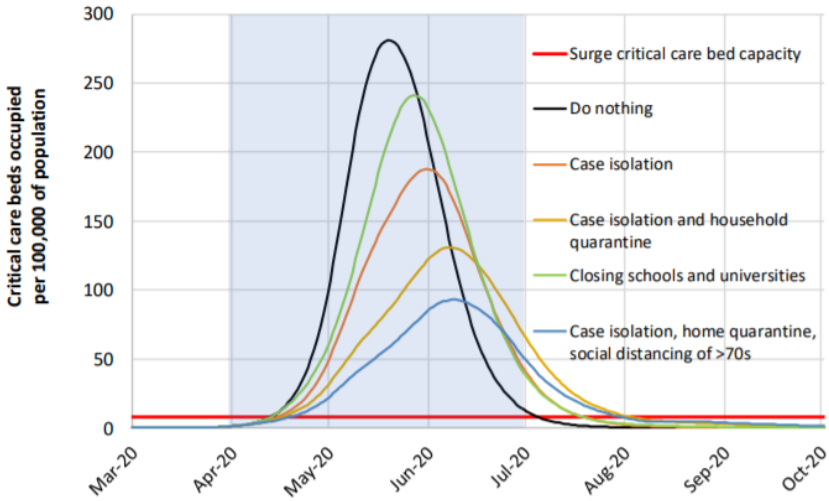
Figure 13 New COVID-19 Cases Forecast - US Extreme



[10] https://int.nyt.com/data/documenthelper/6819-covid-19-response-plan/d367f758bec47cad361f/optimized/full.pdf#page=1

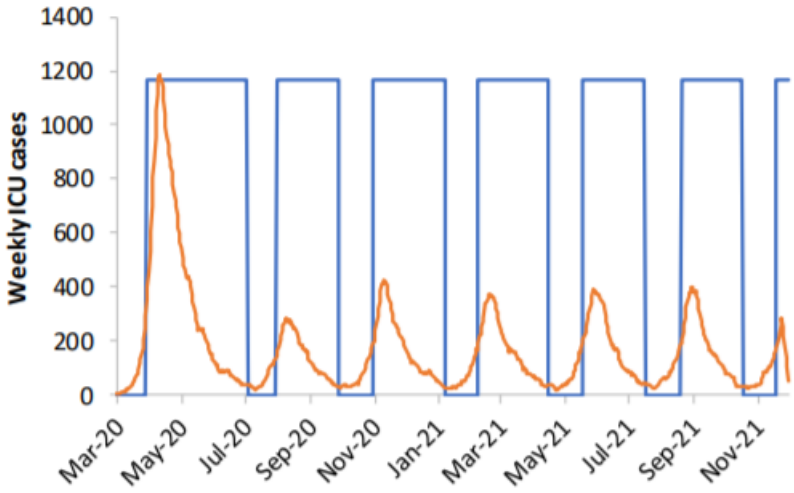
This scenario is not unlike one possible pattern of COVID-19 outbreak forecast by Neil M. Ferguson et. al[11].

Figure 14: Critical Care Beds Occupied by COVID-19 (Scenarios)



Source: https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-NPI-modelling-16-03-2020.pdf

Figure 15: Long-Run Trend of COVID-19 ICU Cases



Source: https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-NPI-modelling-16-03-2020.pdf

[11] https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-NPI-modelling-16-03-2020.pdf

The economic conditions under this scenario are likely to be as follows:

- Unemployment rates bouncing between 15 - 30% quarterly with highs above 70%
- Sustained higher unemployment rates above 10% for the next year
- New mortgage delinquencies (30 dpd) to increase to above 70% of mortgages consistently
- A drop in private establishments by 80-90%
- Real GDP dropping by 30 - 50% across the next two years

Fiscal Stimulus and Impact on the Economy

The Coronavirus Aid, Relief, and Economic Security Act (the "CARES Act") was signed into law on March 27, 2020[12]. The CARES Act[13] includes new fiscal policies as well as expansions to existing economic stabilizing programs (unemployment insurance). The act includes the following economic stimulus/emergency elements:

- Expansion to the current unemployment insurance program
    - **Federal Pandemic Unemployment Compensation ("FPUC")**: Eligible individuals will receive an extra $600 weekly benefit for all weeks of unemployment between April 5, 2020 and July 31, 2020
    - **Pandemic Unemployment Emergency Compensation ("PUEC")**: Individuals who had exhausted their unemployment benefits will receive an additional 13 weeks of unemployment insurance**;**
    - **Pandemic Unemployment Assistance ("PUA")**: individuals who are ordinarily not covered by unemployment insurance (self-employed, gig-economy workers, and employees who have not worked the minimum-eligibility hours and accumulated the minimum-eligibility earnings) are now eligible for unemployment insurance.
- Expansion to the current cadre of Small Business Administration loan programs[14]

[12] https://www.washingtonpost.com/us-policy/2020/03/27/congress-coronavirus-house-vote/

[13] https://www.congress.gov/bill/116th-congress/senate-bill/3548/text

[14] https://www.sba.gov/funding-programs/loans/coronavirus-relief-options

  - **Paycheck Protection Program:** Provides up to $100 million in loans for businesses with less than 500 workers: loan amounts worth 2.5 times average monthly payroll with forgiveness of up to 25% of the loan if funds are used to retain employees;
  - **Economic Injury Disaster Loans and Emergency Grants:** provides a $10,000 grant for immediate expenses for small businesses;
  - **Small Business Debt Relief:** The SBA will automatically pay the principal, interest, and fees of **CURRENT 7(A), 504, AND MICROLOANS** for a period of six months and will pay the principal, interest and fees of new 7(a), 504, and microloans for loans received before September 27, 2020;
  - **Emergency Bridge Loans:** allows small businesses who currently have a business relationship with an SBA Express Lender to access up to $25,000 in bridge/gap loans.
- Recovery Rebates for Individuals and Families[15]
  - **checks to individuals/families in the amounts of $1,200 for individuals and $2,400** for families. Rebate amounts are dependent on earning reported in 2018 taxes and phase our families earning more than $199,000. Individuals and families will receive additional rebates of $500 per dependent child.

These stimulus packages are likely to soften the blow to the large scale disruption. However, the impact of a Keynesian-style fiscal stimulus (money in consumer's hands) is likely to be less effective because so many businesses are now closing. If consumers have money but do not have goods and services to purchase the stimulus is not going to have any traction within the economy.

There is also concern that there is not adequate capacity for banks to process the SBA loans. SBA loans require that businesses work directly with an SBA vendor or a bank to process the loan application. The quick roll-out of this legislation and the loan provisions did not provide ample time for a coordinated effort between banks and the SBA; many banks do not have

[15] https://www.congress.gov/bill/116th-congress/senate-bill/3548/text#toc-idC62A2A4676F44E44B6A0D677C490FD17

the computer integration or person-power to process the loans and are waiting on the SBA to make the "first move"[16].

Overall Economic Impact and Long Run Trajectory

We feel that the most likely economic outcome stemming from the COVID-19 crisis is what we've outlined in Case 2 -- waves of recovery and relapse from COVID-19, accompanied by waves of economic panic and recovery. Because the current climate has shuttered large portions of the economy - restaurants, bars, and all non-essential businesses - considerable sections of the economy became/will become unemployed all at once. Even with stimulus packages - rebate checks, additional loans and industry bail-outs - the lack of goods and services to purchase will not improve the trend of the economy in any significant magnitude. When the number of new cases initially slows or ceases, consumers may 'hit the streets running', so to speak, and make large purchases at the businesses lucky enough to still be open. However, we believe that the consumers will be more "savings-oriented" if the currently accepted models regarding the re-emergence of COVID-19 are correct. (These models show that the virus will strike again and send the economy back into panic mode.) If this were to happen, we could face an even larger shock to a fragile economic state.

Macroeconomic Overview

The Unemployment, Inflation and The Federal Reserve

The unemployment rate in the US had been on a steady decline since the first quarter of 2010. Although there are occasional small upticks, the overall trend has not deviated in the last nine years. However, with COVID-19 disrupting the workforce for half of March, we saw an uptick in the official unemployment rate from 3.5% to 4.4%. This is only the start of a very dramatic change. We fully anticipate that ***the unemployment rate in April 2020 will top 15% and reach levels between 20 - 30%.*** With approximately 10 million people filing new unemployment claims the last two weeks of March, and an additional 6.6 million people

[16] https://www.nbcnews.com/business/business-news/thousands-applicants-zero-loans-trump-s-small-businesses-lending-program-n1176766

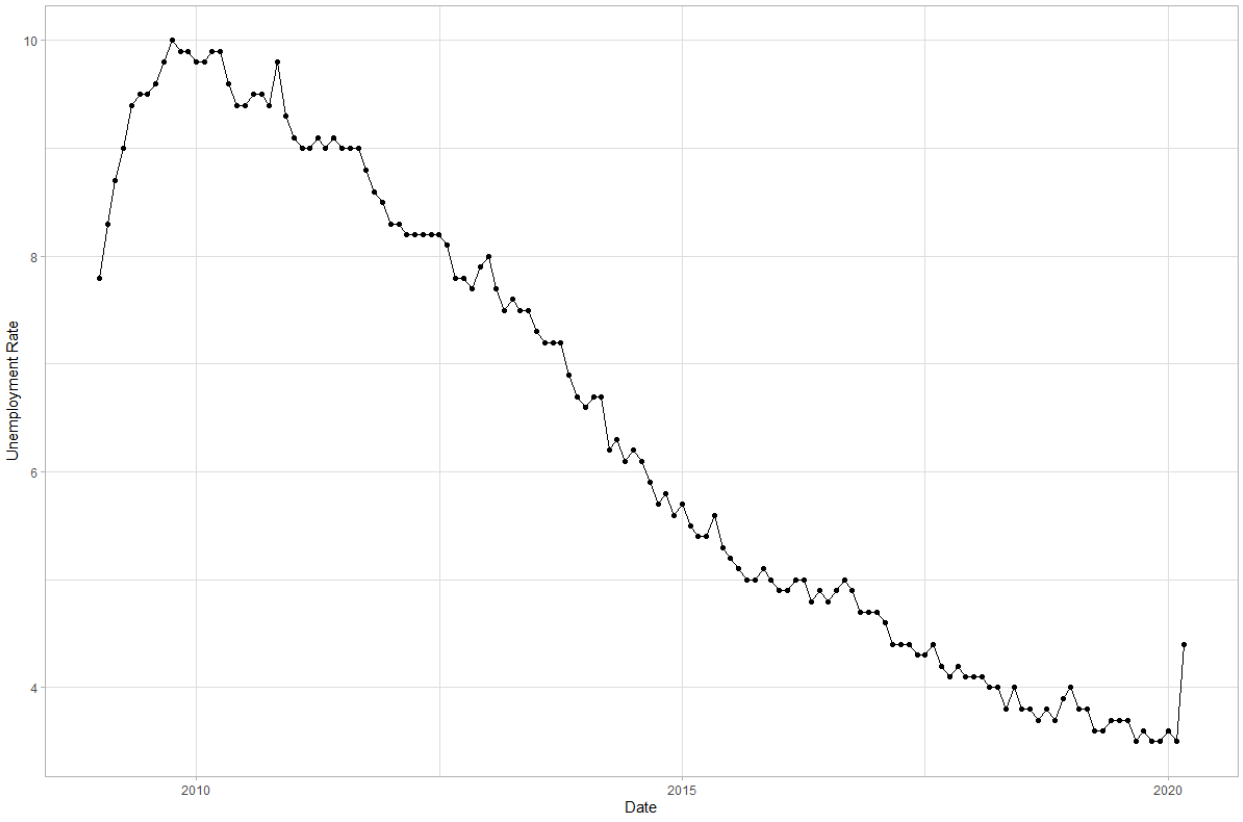
filling new unemployment claims the first Friday of April, the unemployment picture is trending towards levels unseen since the Great Depression.

Figure 16: New Initial Unemployment Claims April and May 2020

WEEK ENDING	April 4	March 28	Change	March 21	Prior Year[1]
Initial Claims (SA)	6,606,000	6,867,000	-261,000	3,307,000	203,000
Initial Claims (NSA)	6,203,359	6,015,821	+187,538	2,920,162	196,071
4-Wk Moving Average (SA)	4,265,500	2,666,750	+1,598,750	1,004,250	212,000

Source: https://www.dol.gov/ui/data.pdf

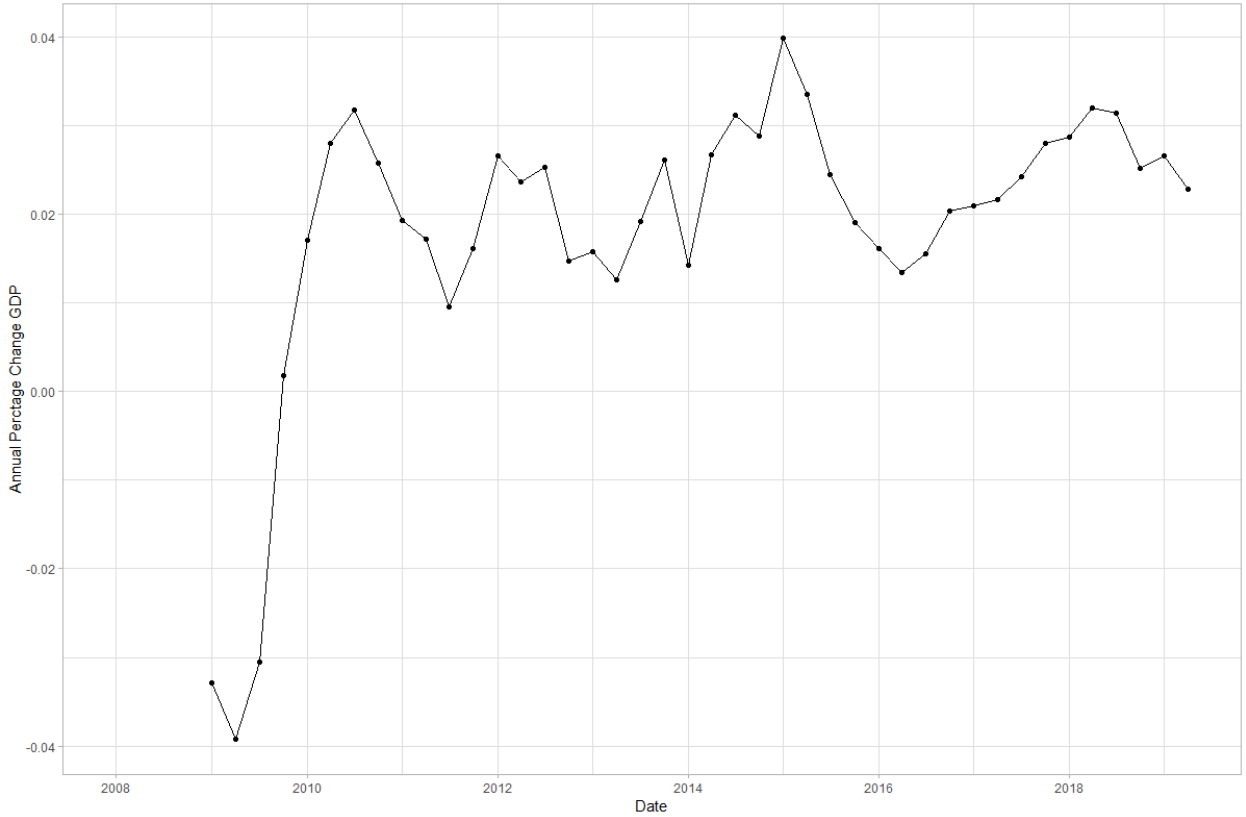
Figure 17: Unemployment Rate 2009 - 2019



source: BLS.gov, https://fred.stlouisfed.org/

The year-over-year change in real GDP has shown some variability since the last recession - with annual growth fluctuating between 1% and 3% in the last 12 quarters. Although we won't have a clear picture of the GDP for 1Q2020 and 2Q2020 for several months, ***the economy is likely to be experiencing a decrease in real GDP between 5 - 8%.***

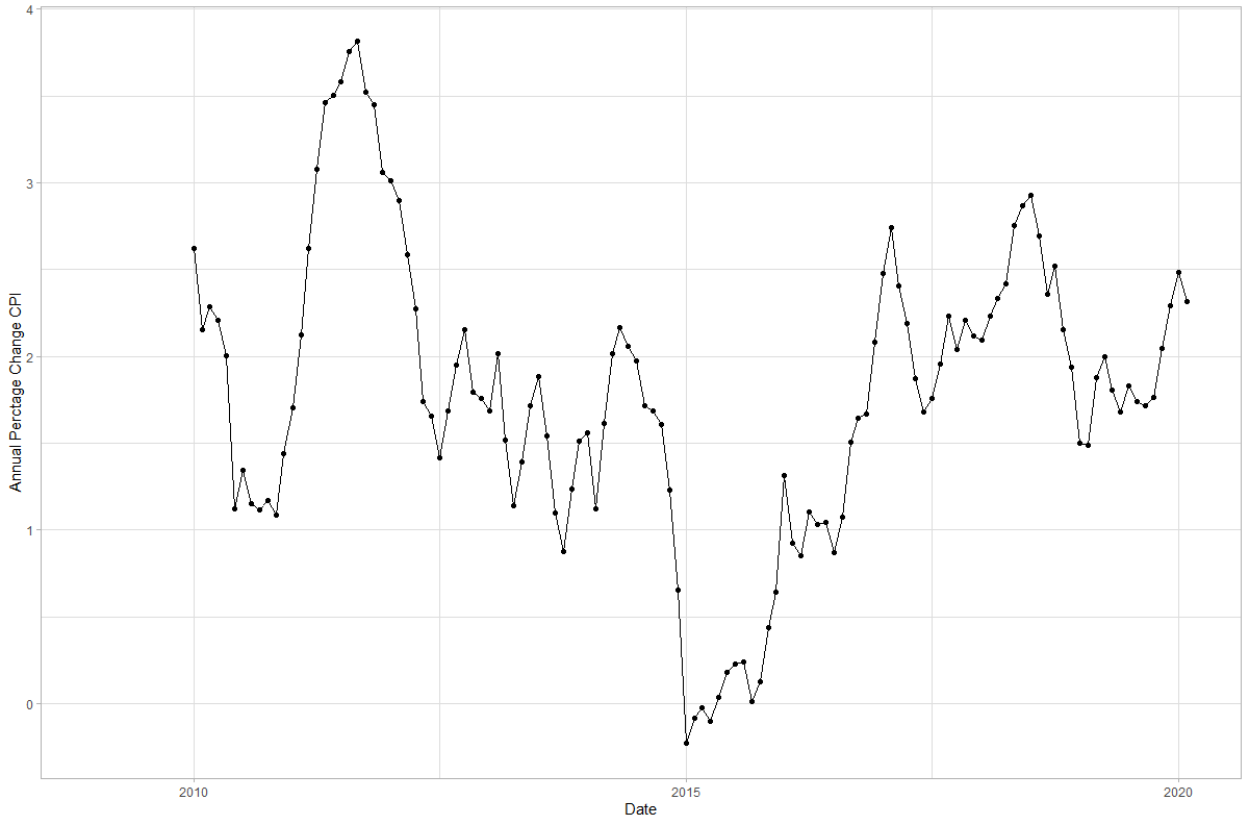
Figure 18: Year-over-Year Change in Real GDP (2009 - 2019)



Source: BLS.gov, https://fred.stlouisfed.org/series/GDPC1

Another aspect that warrants close attention is the trend of inflationary pressures. The US has been experiencing very mild inflations pressure the last 3 years, bouncing between 0% and approximately 3% annual inflation. However, we are seeing a down-tick in price levels from March 2020. Ordinarily we would evaluate this trend over the next two quarters to identify a long-run trend. However, the large drop in oil prices and closure of many non-essential businesses across the country suggests significant downward pressure in prices. ***There is a real possibility of falling into a deflationary trend throughout the economy***. If the US were to experience deflation, consumers would hold off purchases while they re-evaluate the timing and prices of goods. If prices are falling, consumers decrease current purchases in favor or future purchases. Given the current climate and lack of goods and services to purchase, any delay in consumer purchases (which comprise approximately 70% of GDP) could cause additional declines in GDP.

Figure 19: Year-Over-Year Change in CPI (2010-2020)



Source: https://fred.stlouisfed.org/series/CPIAUCSL

Table 1: Federal Funds Rate (and Changes) 2005 - 2007

Date	Increase	Decrease	Fed Funds Rate (%)	Unemployment Rate (%)
August 1, 2019	-	25	2.00	3.60
September 19, 2019	-	25	1.75	3.50
October 31, 2019	-	25	1.50	3.50
March 3, 2020	-	50	1.00	3.50
March 16, 2020	-	100	0	4.90

Source: https://www.federalreserve.gov/monetarypolicy/openmarket.htm, BLS.gov

In spite of record stock-market returns, low inflation and near-record low unemployment, The Fed' started making expansionary monetary policy moves during the Summer of 2019; specifically, the Federal Funds target rates were dropped by 25 basis-points three times during 2019. Although the Fed' left rates constant during December 2019 and January 2020,

it engaged in very bold moves creating liquidity in financial markets in early- and mid-March 2020 to drop Federal Funds target rates to zero[17]. Because mortgages are heading towards massive delinquencies, many banks are trying to liquidate other assets to reach capital requirements set by regulators. The Fed' is become the 'buyer of last resort' for many of these assets - creating markets where there are asks and no bids, and creating liquidity for banks in the over-night REPO' markets. The Fed's policies are aimed at keeping liquidity strong and preventing massive failures of banks across the country.

Ordinarily an increase in liquidity from the Federal Reserve is associated with fears of inflation. As we see in the year-over-year change in the CPI, there were some inflationary pressures prior to the Fed's dramatic actions in March 2020. The small down-tick in year-over-year CPI suggests downward pressure in prices. This movement is likely linked to the escalation of oil production between Russia and Saudi Arabia.

Figure 20: Price Per Barrel Brent Crude and West Texas Intermediate (2018 - 2020)

Source: https://fred.stlouisfed.org/series/IRNNXGOCMBD; https://www.opec.org/opec_web/en/data_graphs/40.htm

Oil prices have dropped by more than $40 per barrel since January, 2020. The oil-war between Russia and Saudi Arabia might have been resolved through a mutual agreement to cut back production by 4 million to 10 million barrels per day by both Russia and Saudi Arabia[18]. In spite of this agreement, the US oil industry has already been negatively impacted by this oil war. Bankruptcy of Whiting Petroleum[19] may be just the starting point; more than 100 US oil and gas producers might be on the verge of failure if the price per barrel stays below $40 per barrel[20].

The oil industry not only makes up 1.5% to the GDP -- it also employs millions of workers throughout the supply chain[21]. A reduction in the number and composition of US oil exploration, production and distribution companies would contribute to the downward path of unemployment and could have significantly larger effects on the southwest states in the US.

Treasury Yields

The US Treasury yield curve shows the yield of US Treasuries of different maturities. When the economy is strong, investors are willing to trade interest for maturity date - preferring higher interest for longer maturity dates. When the economy is trending towards an economic recession, investors push the market to trade interest for short-term liquidity, driving up the short-term rates relative to longer maturity rates. When short term rates fall above longer maturity rates, the yield curve inverts. This inverted yield curve is evident April 2019 (as shown in Figure 21). As we know, the inverted yield curve was forecasting the great recession, which hit the US approximately 10 months after the yield curve started inverting. An inverted yield curve appeared in early Spring 2019 and then again in February 2020. Although COVID-19 did not become a clear trigger until early March 2020, the inverted yield curve in February 2020 signals that investors were aware that the economy was on an uneven footing.

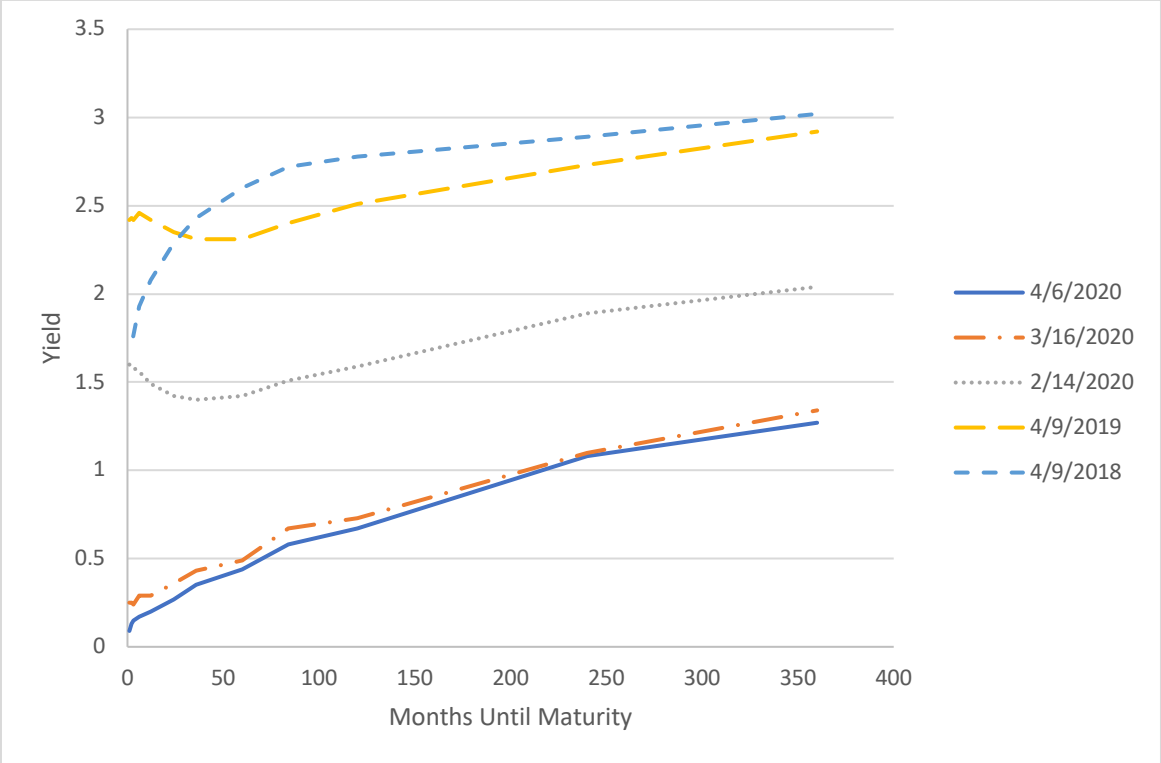
[18] https://www.axios.com/saudi-arabia-russia-opec-oil-production-deal-coronavirus-6d8e5152-4f80-4cff-9c39-868f0eae6af2.html

[19] https://www.wsj.com/articles/u-s-shale-driller-whiting-petroleum-to-file-for-bankruptcy-11585746800

[20] https://www.cnn.com/2020/04/02/business/oil-crash-bankruptcies-whiting/index.html

[2121] https://www.energyindepth.org/us-shale-industry-credited-with-driving-10-of-us-gdp-growth/

Figure 21: US Treasury Yield Curve: Comparison Between 2018, 2019, and 2020



Source: https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield

Two metrics that measure output and production are Industrial Production Index, which measures the value of produced output, and total capacity utilization, which measures the actual output of firms relative to what they can produce. The downward trend in both of these metrics over the last 10 months indicates that value of output is falling and firms are using a smaller percentage of their capital. In general, firms are exhibiting more productive capacity. The accompanying trend of an increase in inventory to sales ratio, starting in May 2018, suggests that output is sitting longer in inventory. This change is likely due to an over-production of goods influenced by optimism associated with the Tax Cut and Jobs Act. The Tax Cut and Jobs Act was signed into law at the tail end of 2017 and took effect in early 2018[22] and changed how companies and consumers were taxed. Some companies used these tax benefits to re-tool and invest[23], which may have had a positive impact on production. Companies also may have been overly optimistic regarding how the tax cut would impact wages or purchasing power by consumers. Consumer disposable income did

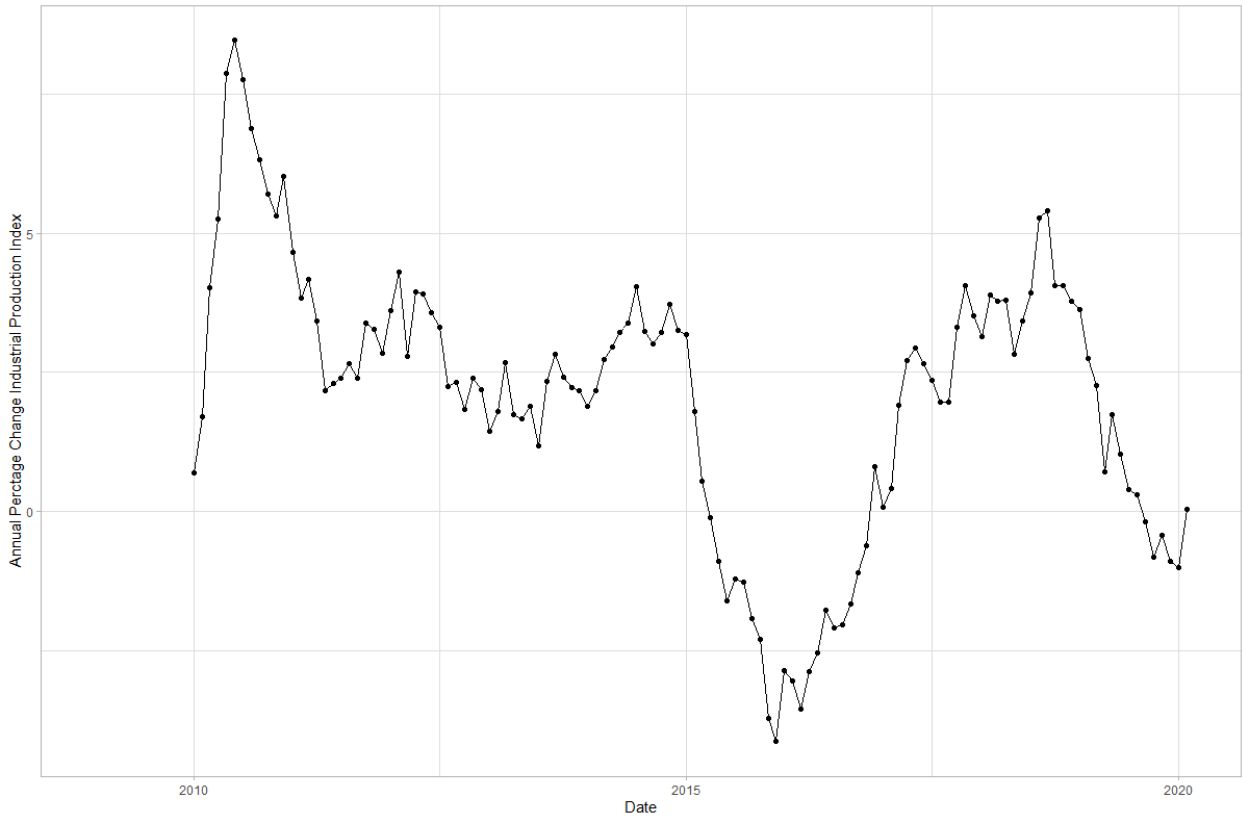
[22] https://fortune.com/2017/12/20/gop-tax-bill-cuts-start/

[23] https://www.cnbc.com/2018/06/20/now-we-know-how-major-corporations-are-spending-tax-cuts.html

grow between then end of 2017 to the beginning of 2018[24], however this growth tapered off quickly (and consumer spending actually took a bit of a downturn right at the start of 2018). A combination of company optimism and lack of consumer spending created an increase in inventory relative to sales.

A decrease in capacity utilization, a decrease in industrial production and an increase in inventories relative to sales suggests an overall slowing of production and a softening of consumer demand. The reaction of firms to lower demand is to reduce output and use a smaller percentage of their productive resources.

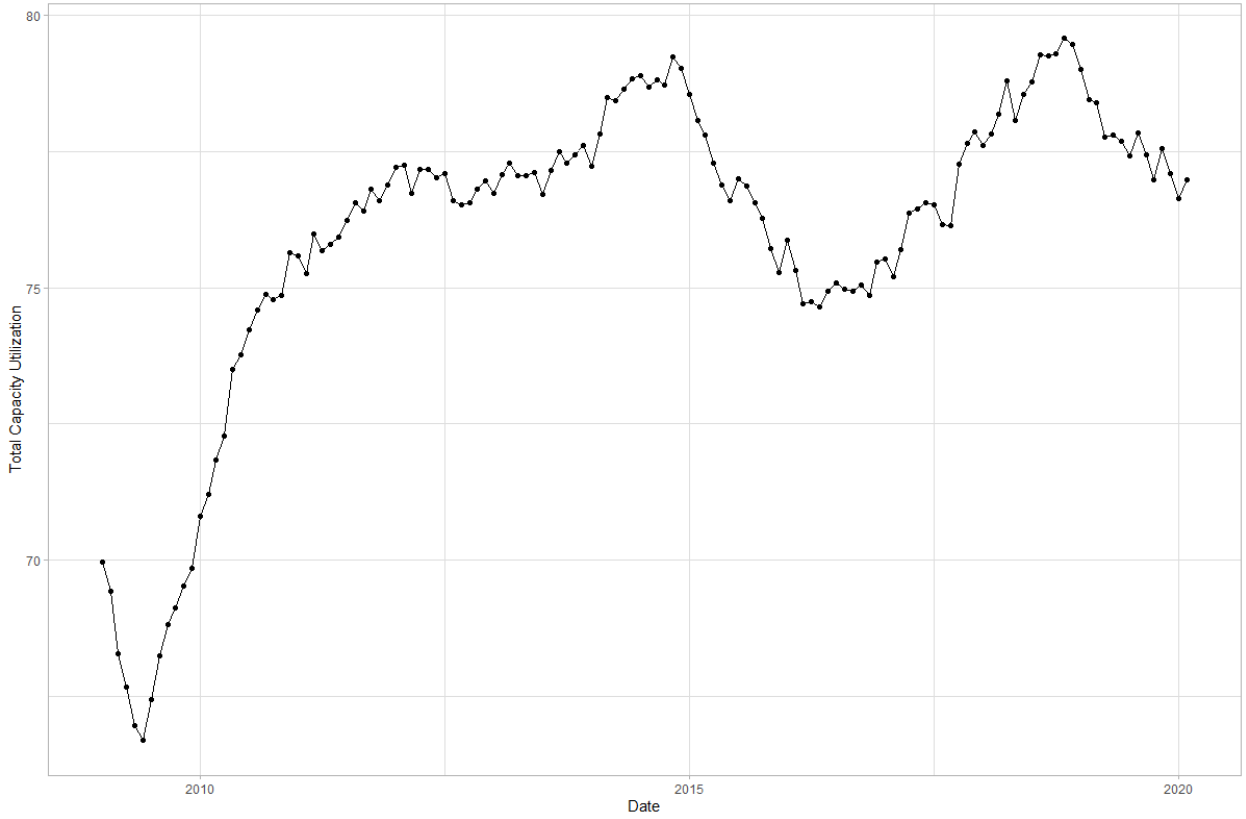
Figure 22: Year-Over-Year Change in Industrial Production Index (2007 - 2020)



Source: https://fred.stlouisfed.org/series/INDPRO

[24] https://www.wsj.com/articles/are-the-tax-cuts-working-what-to-watch-in-12-charts-1529323200

Figure 23: Total Capacity Utilization: All Industries (2009 – 2020)



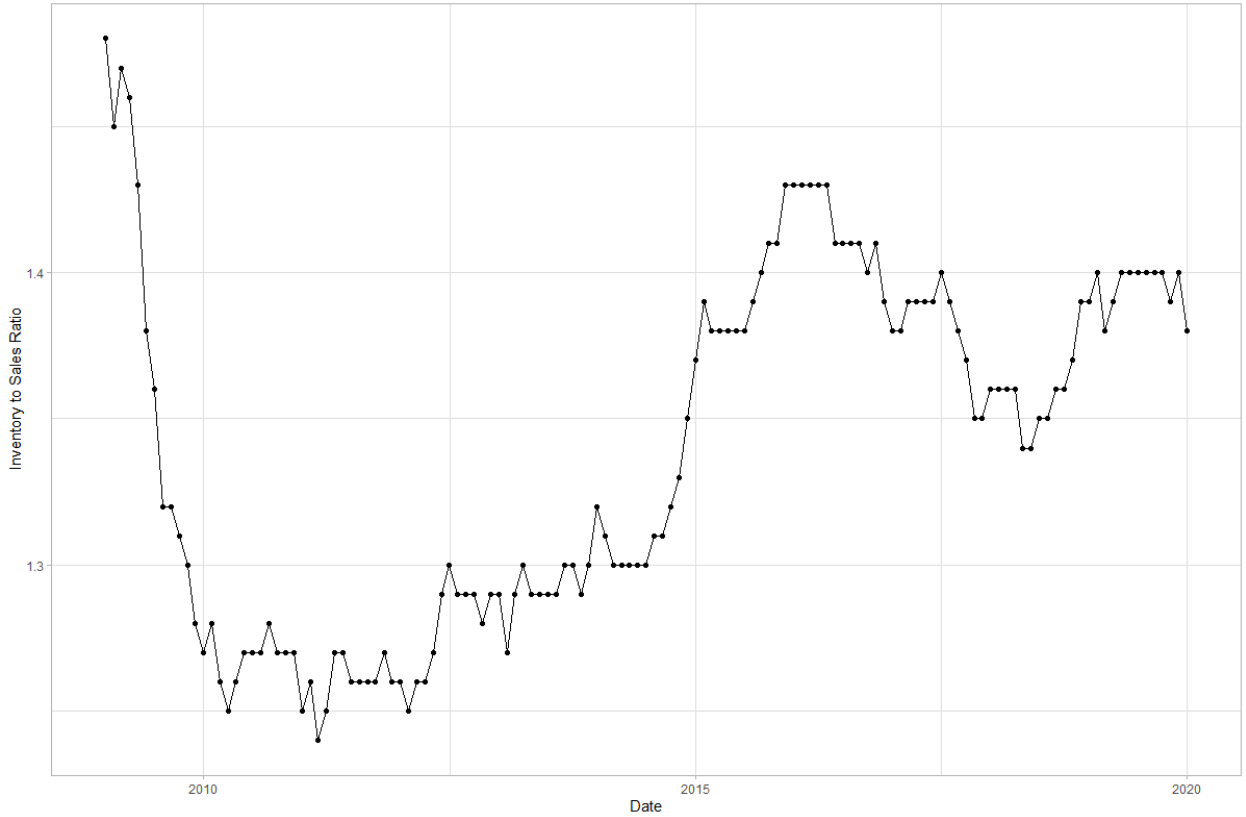
Source: https://fred.stlouisfed.org/series/TCU

Figure 24: Annual Percent Change in Total Capacity Utilization (2009 - 2020)

Source: https://fred.stlouisfed.org/series/TCU

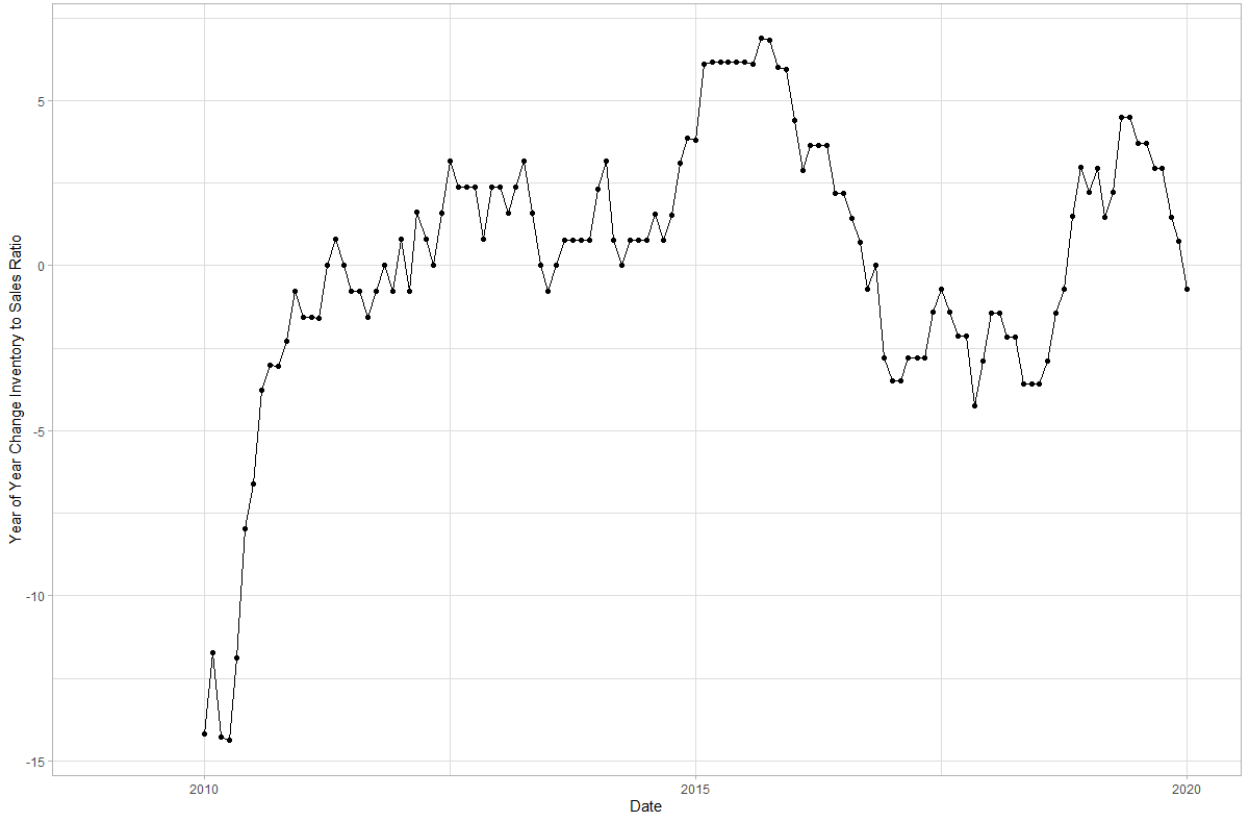
The trend in the total capacity utilization ("TCU"; see Figure 23) and year-over-year change in total capacity utilization (per Figure 24) are concerning. The TCU has been trending downwards for the last 14 months. For the last 8 months, the TCU has seen a negative year-over-year change. Not only is TCU falling, but capacity utilization for the last three quarters of 2019 were below that of the last three quarters of 2018. We anticipate that with the large number of non-essential businesses shuttering during the COVID-19 pandemic the TCU will fall drastically during Q1 and Q2 of 2020.

Figure 25: Inventory to Sales Ratio (2008-2019)



Source: https://fred.stlouisfed.org/series/ISRATIO

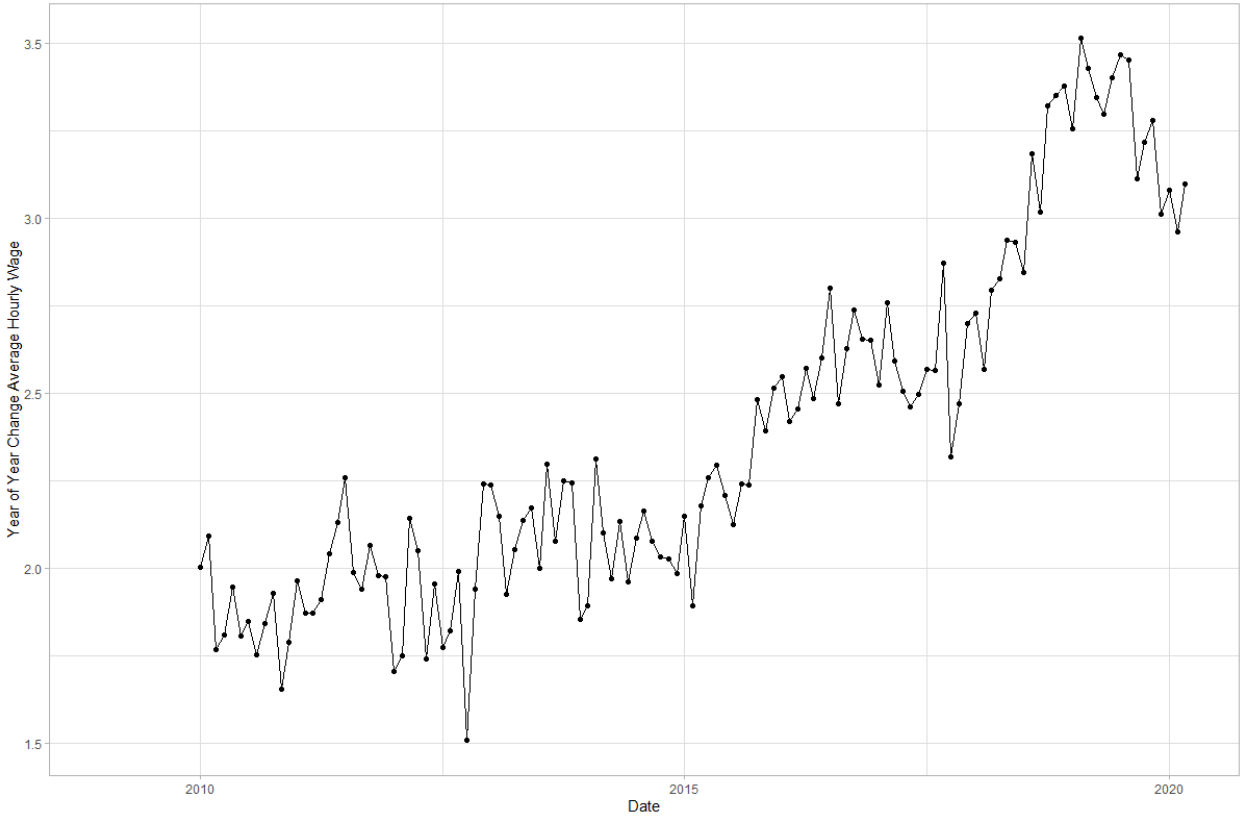
Figure 26: Year-over-Year Change in Inventory to Sales Ratio (2010 – 2019)



Source: https://fred.stlouisfed.org/series/ISRATIO

The inventory to sales ratio was increasing for much of the first half of 2019, and then plateaued in the last half of 2019. The year-over-year change in the inventory to sales ratio also showed a promise the last half of 2019. Although companies are not accumulating inventory relative to sales, the inventory adjustment always comes at a cost. Most firms, when making inventory adjustments, reduce output, decrease productivity and decrease their workforce.

Figure 27: Annual Percentage Change in Average Hourly Wage (2010 – 2020)



Source: https://fred.stlouisfed.org/series/CES0500000003

The trend in the year-over-year change in average hourly wages has been troubling the last 14 months. This trend is likely to continue as the type of employment still available to potential workers is centered around food service, grocery stores and larger box-stores. The concern with the downward trend here is that when the economy is open again, we are going to need a large infusion of consumer expenditures to jump-start the economy. This is unlikely to occur if average hourly wages are low and growth in wages are stagnant or falling.

Although the oil prices did drop to pre-December levels within a few days, an additional concern adding to the hyper-sensitivity surrounding the tension in Iran points to the general nervousness surrounding global events. A recent "near-miss" of a recession in Germany[25] had added to the pessimism about the global economy. The US will have a very difficult time staying out of a recession if the global economy weakens and becomes less predictable.

[25] https://www.bbc.com/news/business-50419127

Short and Long-Run Expectations

Every economic recession occurs as a result of an economic shock. The following table identifies a chronology of the last six recessions, their peak and trough months and the corresponding economic shocks. The recessions of 1975 and 1980 were motivated by energy policies and oil prices. The recession in 1991 was caused by consumer pessimism surrounding the Iraq war and massive failures within the savings and loan industry. The 2001 recession was caused by a burst of the dot.com bubble and the loss in consumer confidence caused by failures by Enron, WorldCom and the 9/11 terrorist strikes to the US. The Great Recession in 2008 was caused by a collapse of the housing market and the sub-prime loan market. The last four recessions were the result of decreases of consumer spending.

The movement of several economic indicators suggest that we are currently in a consumer driven economic recession. ***The COVID-19 Recession, or perhaps the "COVIDepression", is an economic recession brought on by massive closures of all non-essential businesses, the corresponding huge upswing in unemployment rates and the looming debt crisis brought on by missed consumer and commercial loan payments.***

Table 2: Recession Chronology and Corresponding Shocks

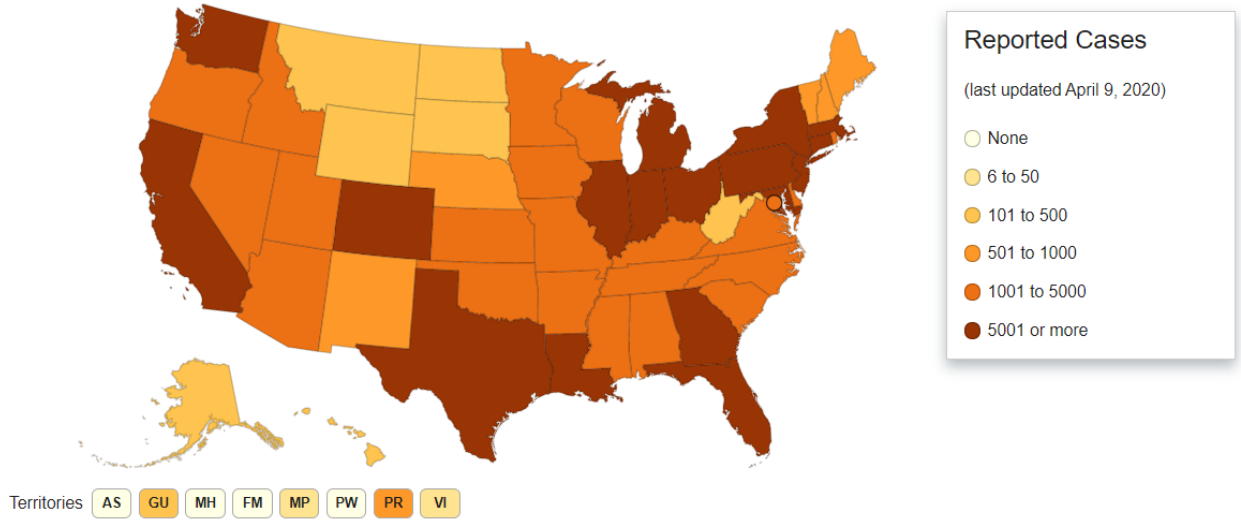
Peak Month	Trough Month	Economic Shock
November 1973	March 1975	Oil Embargo
January 1980	July 1980	Fall of the Shah of Iran/Energy Crisis/Volker Interest Rates
July 1981	November 1982	Volker Interest Rate Hike
July 1990	March 1991	Iraq War/ Savings and Loan Crisis
March 2001	November 2001	Dot.com Bubble/ Enron & WorldCom/ 9/11 Terrorist Strike
December 2007	June 2009	Housing Crisis
March 2020	TBD	**COVID-19 Pandemic**

Source: NBER.org

Impact on Election: COVID-19 Exposure

During our discussion of COVID-19 trends, we suggested that the economy might experience waves of reinfection and economic uncertainty. Figure 15, specifically, shows peaks and valleys of COVID-19 cases that also correspond to increases and decreases of economic activity. The likelihood of this outcome is quite dependent on the November 2020 election. We're also certain that the outcome of the election is dependent on the current state of the economy and the current state of COVID-19 infections.

Figure 28: COVID-19 Cases By State (April 9, 2020)



Source: Center for Disease Control

We are seeing increasing in COVID-19 cases in the Northeast and Midwest regions of the US as well as selected states in the South and Southwest. The Initial unemployment claims are also highest in the states experiencing the highest reported cases of COVID-19. The high infection rates of COVID-19, and corresponding high initial unemployment claims, might be a significant hurdle to Donald Trump in his re-election bid. Since 1960, there we've seen a downward relationship between the election margin of the incumbent President (and President's party) and the unemployment rate. We show the relationship between these two variables for elections between 1960 and 2016 and for elections between 1988 and 2016.

Using the most recent elections, we could forecast that the Republican margin for reelection in November would be the following under different prevailing unemployment rates:

Table 3: Incumbent Reelection Margin and Prevailing Unemployment Rate

Incumbent General Election Margin	Unemployment Rate
2.885	5
1.378	6
-0.129	7
-1.636	8
-3.143	9
-4.65	10
-6.157	11
-12.185	15
-19.72	20
-42.325	35
-64.93	50

Under this model, President Trump might be able to win re-election with an electoral college victory if the unemployment rate falls between 6 and 7 percent. However, prevailing unemployment rates above 8 percent would almost certainly push the general election and electoral college margin towards Vice-President Biden. We are forecasting unemployment rates between 25 - 45% for the immediate term (2Q2020 & 3Q2020). Even if the economy rebounds quickly, it is likely the unemployment rate will still be above 10% in November 2020.

If Vice-President Biden becomes the Presumptive President in November 2020, he is likely to take the same approach towards COVID-19 policy that (then Presumptive) President Obama did in 2008. Shortly after the 2008 election, Obama started putting together a team and identifying potential policies for what would ultimately become the American Recovery and Reinvestment Act[26]. Vice President Biden does have a history of long-run planning and big-picture policy initiatives; Biden's Cancer Moonshot[27], driven in part by losing his son to cancer[28], was aimed at creating awareness and additional funding in the same vein as President Kennedy's space race[29] in the early 1960s. If Biden were to follow this path, we

[26] https://abcnews.go.com/Business/story?id=6194803

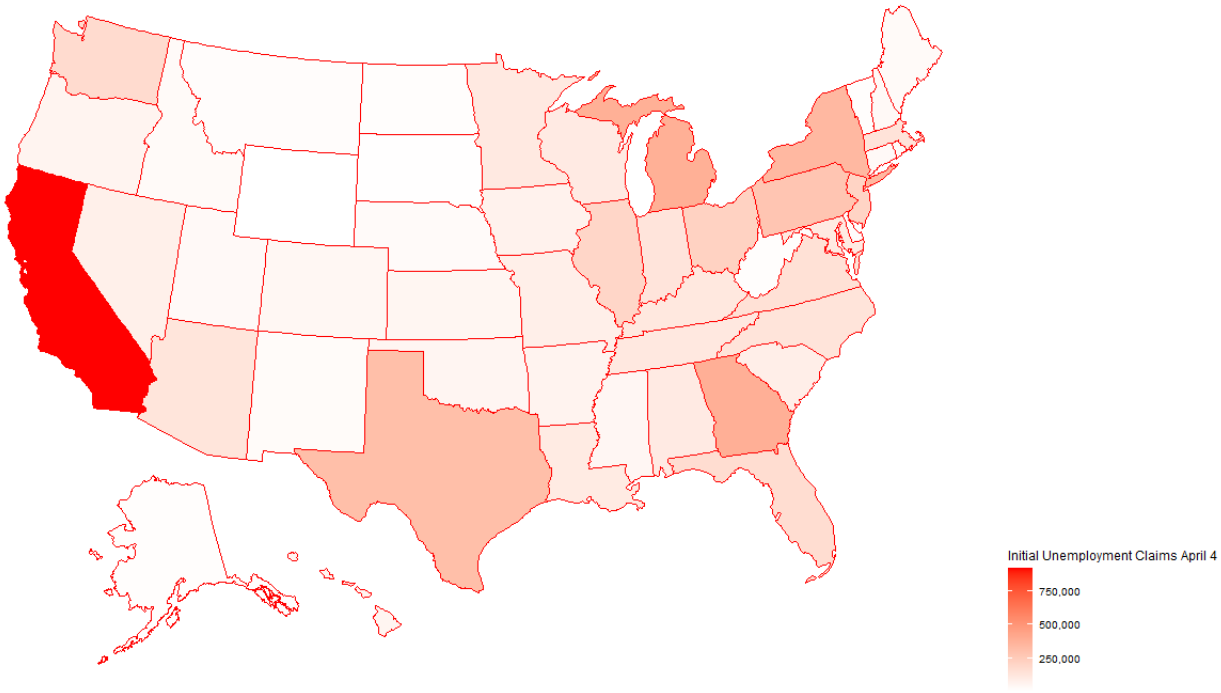
[27] https://obamawhitehouse.archives.gov/cancermoonshot

[28] https://www.nytimes.com/2015/05/31/us/politics/joseph-r-biden-iii-vice-presidents-son-beau-dies-at-46.html

[29] https://www.jfklibrary.org/learn/about-jfk/jfk-in-history/space-program

could see a more national response to COVID-19 testing, quarantining, or additional planning for future pandemics. It certainly is not a huge leap to suggest that Biden would take a similar position as President Obama did in 2014 regarding pandemics and pandemic responses[30].

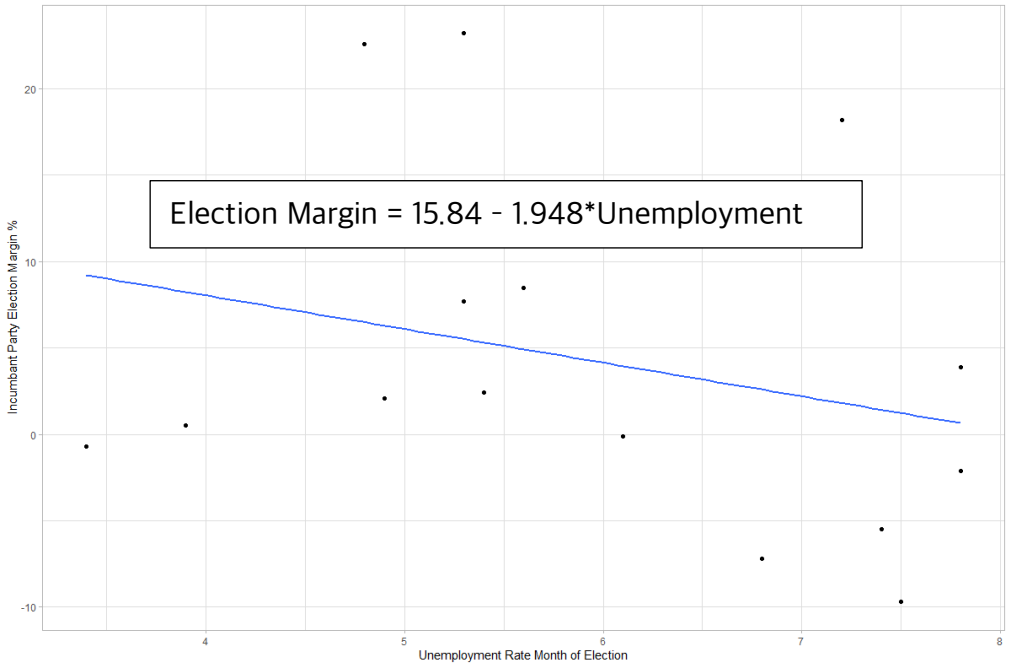
Figure 29: Initial Unemployment Claims by State (April 4, 2020)



Source: https://www.dol.gov/ui/data.pdf

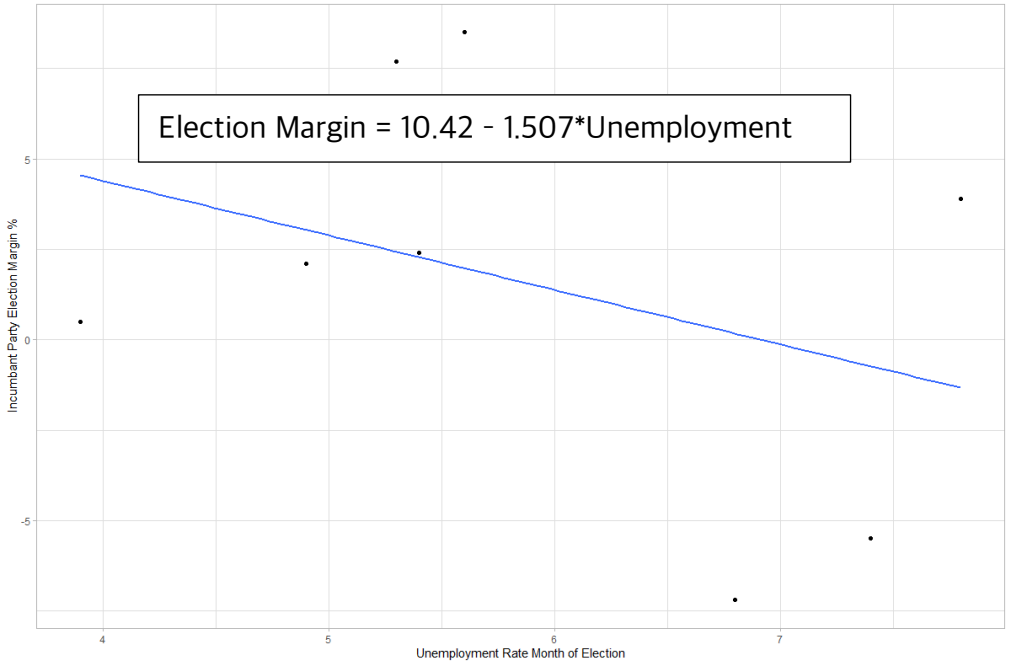
[30] https://www.cnn.com/videos/politics/2020/04/10/barack-obama-2014-pandemic-comments-sot-ctn-vpx.cnn/video/playlists/this-week-in-politics/

Figure 30: Linear Relationship Between Unemployment Rate and Election Margin (Incumbent Party, 1960 - 2016)



Source: Author's calculation

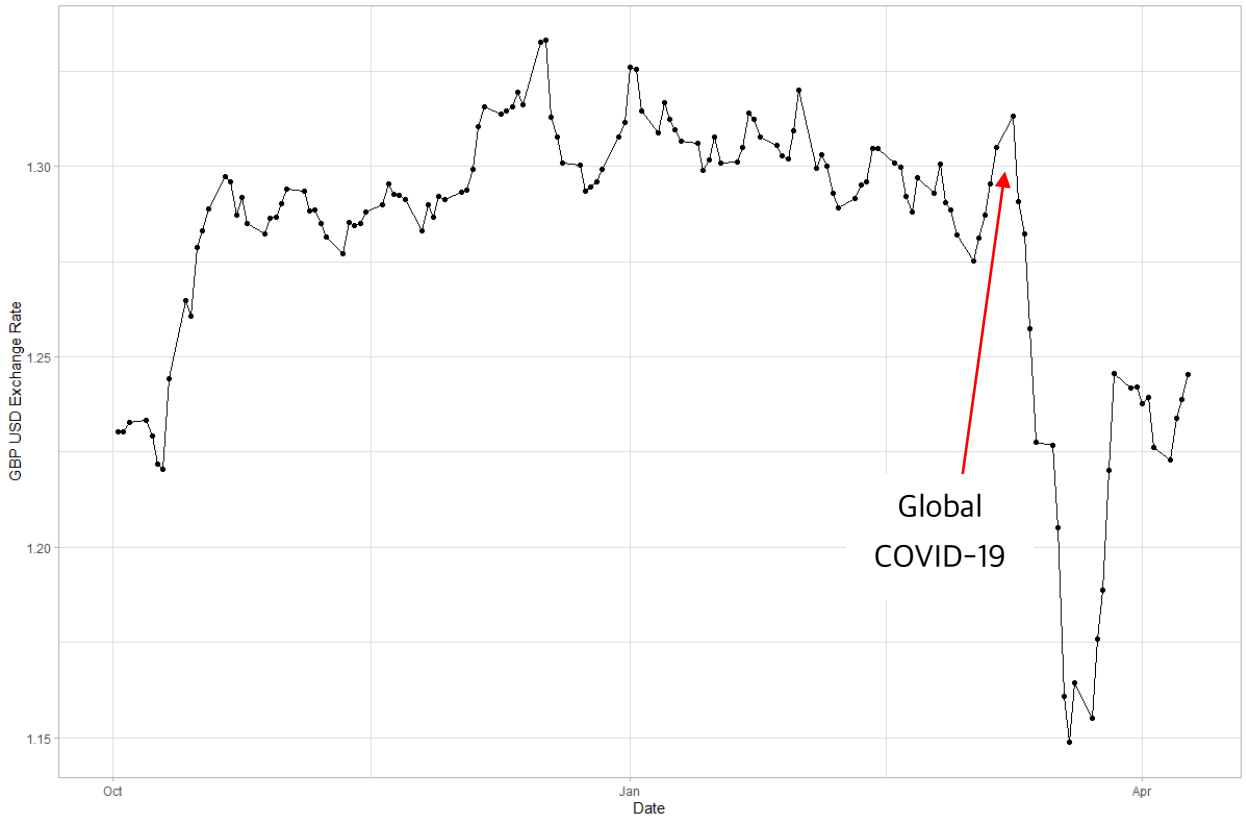
Figure 31: Linear Relationship Between Unemployment Rate and Election Margin (Incumbent, 1988 - 2016)



Source: Author's calculation

Brexit, Exchange Rates and International Trade

Figure 32: Dollar Price of GB Pound (Oct 2019 - April 2020)

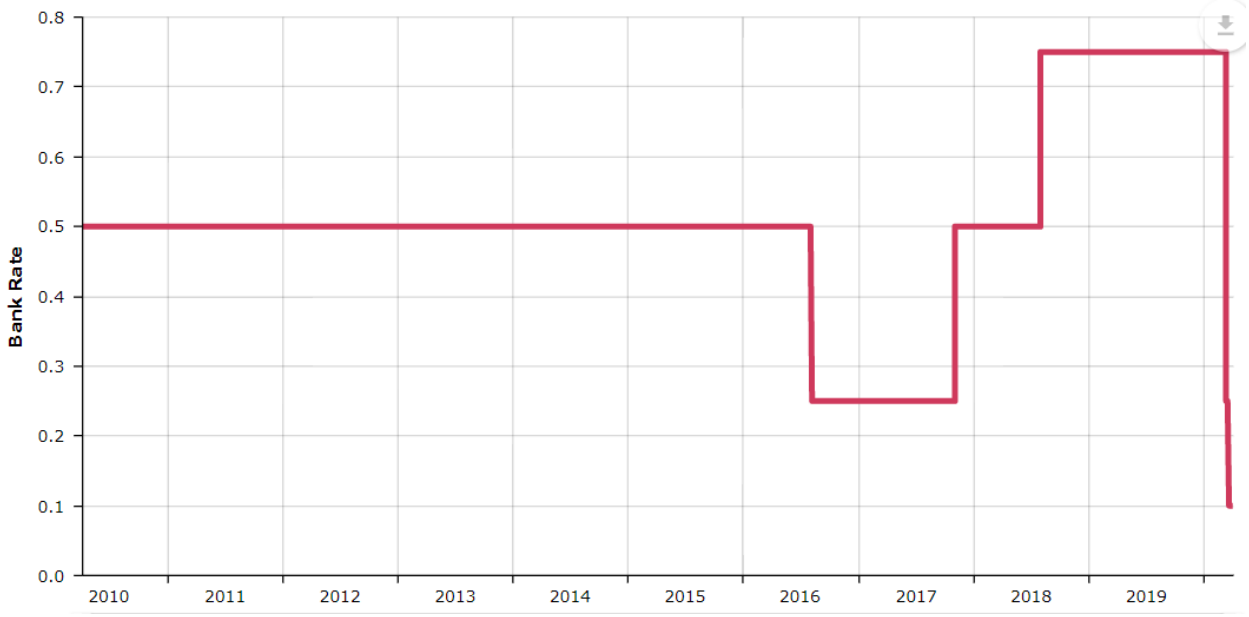


Source: https://www.investing.com/currencies/gbp-usd-historical-data

Although we have been concentrating the impact of Brexit on the BGP-US Dollar exchange rate, the re-election of Boris Johnson[31] pushed up the dollar-price of the pound in mid-December 2019 and re-established the dominance of the pound against the dollar. With the global pandemic in March 2020, the value of the pound decreased significantly against the dollar. The pound has rebounded slightly in early April, but it is very likely the dollar-pound exchange rate will settle at $1.34 per pound.

[31] https://www.bbc.com/news/election-2019-50765773

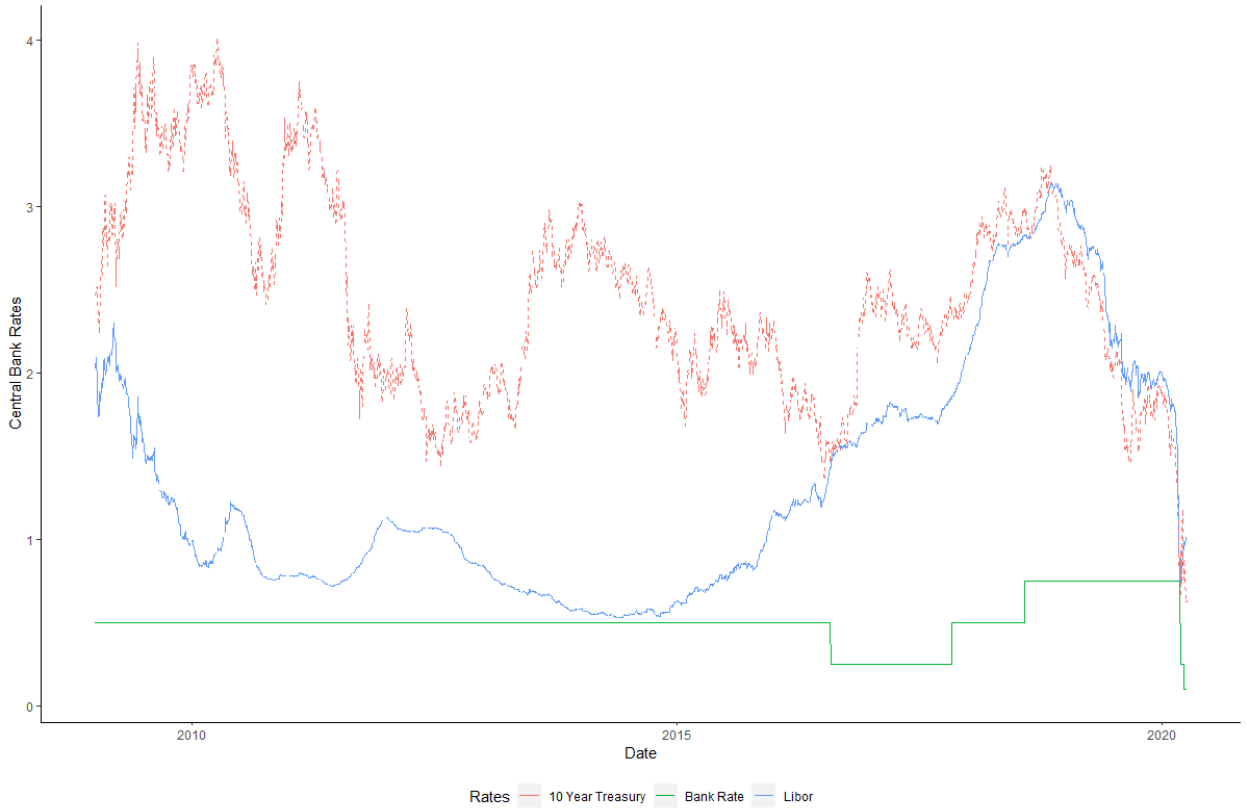
Figure 34: Bank Rate Set by Bank of England (2010 - 2020)



Source: https://www.bankofengland.co.uk/monetary-policy/the-interest-rate-bank-rate

Although Britain has been going through the Brexit crisis for more than two years, the Bank of England has been fairly stable with its monetary policy until this past month. The Bank of England acts in a similar fashion to the Central Bank of the US, setting the foundation interest rate upon which other interest rates are stacked. The Bank of England dropped the Bank Rate by 25 basis points approximately 1 month after the Brexit vote in 2016 and then increased the rates at the end of August 2017, and again in 2018. The Bank of England's policy have been mirrored by changes in the LIBOR starting in mid-2016. The 10-year US Treasury rate has moved in concert with the LIBOR since mid-2016. However, with the dramatic changes surrounding COVID-19, the Bank of England dropped the Bank Rate to a 10-year low 0.10% on March 26, 2020.

Figure 21: Bank Rate, LIBOR and 10-Year Treasury Rates (2009 - 2020)



Source: https://fred.stlouisfed.org/series/USD12MD156N#0; https://www.bankofengland.co.uk/monetary-policy/the-interest-rate-bank-rate

The LIBOR represents the average rate at which banks in England lend to each other and has been moving in steps similar to the rates established by the Bank of England. The 10-year US Treasury yield is dependent on neither the LIBOR nor the Bank Rate; rather, it is determined by the market for mid-term risk-free assets. Government securities in both of these countries are considered risk-free and any differences in the rates between these assets will be off-set by exchange rates and transaction costs. As such, differences in the prevailing interest rates in these two countries highlight the alternative risk aversion of consumers within those native markets. Between 2016 and mid-2018, investors in the US and Britain moved towards the equities market and moved away from fixed income. However, as the certainty of Brexit takes hold (particularly with the re-election of Boris Johnson), risk-averse investors are moving towards fixed income. We have seen a significant decrease in all three of these rates during the last month. The expansionary monetary policy of the US and the Bank of England is directed towards creating liquidity in the markets of the US and the UK.

Data Analysis

As part of the Dodd-Frank Act, larger banking institutions in the United States are required to use government specified variables, and approved proprietary processes, to determine if they are adequately prepared for unexpected "systemic failures". Some banking institutions are also incorporating portions or components of their forecasting processes to estimate future profitability; in order to do so, however, realistic forecasts (as opposed to extremes) are required.

While arguments could be made about the variables included in this study, as stated in Jiang, et al., "… a conclusion that can be made for … US data is that there is little to no improvement in forecast accuracy when the number of predictors is expanded beyond 20-40 variables."

Capitalytics provides the results of a rigorous analysis of every variable that is included in our quarterly macroeconomic study. These variables include the following[32]:

1. Real GDP growth
2. Nominal GDP growth
3. Real disposable income growth
4. Nominal disposable income growth
5. Unemployment rate
6. CPI inflation rate
7. 1-month Treasury yield
8. 3-month Treasury yield
9. 6-month Treasury yield
10. 1-year Treasury yield
11. 3-year Treasury yield
12. 5-year Treasury yield
13. 7-year Treasury yield

[32] This study is motivated by the Federal Reserve Board's Dodd-Frank Act, which includes requirements to consider various international factors; however, those factors will not be discussed extensively in this particular report based on the target use and audience of this report.

14. 10-year Treasury yield
15. 20-year Treasury yield
16. 30-year Treasury yield
17. BBB corporate yield
18. Mortgage rate
19. Prime rate
20. US Average Retail Gasoline Price ($/gal; all grades, all formulations)
21. S&P 500 Stock Price Index
22. Cost of Federal Funds (Primary Credit Rate)
23. Moody's AAA Rate
24. Moody's BAA Rate
25. Dow Jones Total Stock Market Index
26. House Price Index
27. Commercial Real Estate Price Index
28. Market Volatility Index (VIX)

Our procedure is as follows:

1. Data is collected per the information in Appendix A, "Data sources".

2. Correlations between variables are identified to determine which variables are may be considered as "dependent" (upon other variables, i.e., highly correlated with other variables as part of their nature).

3. Multiple forecast analyses are performed per the procedure in Section I of Appendix B for all variables, with the results of corresponding forecasts aggregated.

4. Regressions are performed per the procedure in Section III of Appendix B for all variables.

5. The rationale for these analyses, modifications, and the conclusions thereto are documented in the following section of this report, "Data Series Conclusions".

Correlations

Part of Capitalytics' analysis of macro-economic variables entails computing the correlation between variables, in order to establish the existence and level of interdependence of variables.

In Appendix C of this document, we document the 139 pairs of variables that showed absolute correlation values greater than or equal to 0.6. As part of this portion of the study, Capitalytics identified the following sets of strong dependencies (correlations with magnitudes greater than 0.95) between variables that were subsequently validated as significant, long-term, recurring correlations as part of the nature of the variables; these pairings of variables are viewed as extremely significant based on the respective definitions of the variables and will be leveraged as discussed in Section I of Appendix B.

Table 4: Variable Dependencies

Regression (Dependent) Variable		**Independent Variable**[33]
6-month Treasury yield		3-year Treasury yield*
Prime rate		3-month Treasury yield
1-month Treasury yield		1-year Treasury yield
3-year Treasury yield		1-year Treasury yield
7-year Treasury yield		3-year Treasury yield*
10-year Treasury yield	**⋯ depends on ⋯**	5-year Treasury yield
20-year Treasury yield		7-year Treasury yield*
30-year Mortgage rate		5-year Treasury yield*
30-year Treasury yield		20-year Treasury yield*
S&P 500 Stock Price Index		Dow-Jones Total Index
US Residential Home Price Index		Commercial Real Estate Price index
Primary Credit rate		3-year Treasury yield*

[33] It should be immediately apparent that some of the variables that are listed as "independent" are, in fact, dependent on other variables; these "independent" variables that actually have dependencies are noted by a trailing "*".

Analysis of Variables

Real & Nominal GDP Growth, Real & Nominal Disposable Income Growth, and CPI Inflation Rate

Analysis

Our quantitative algorithm indicated that real GDP growth was to remain between 2.1% and 2.45% through 2024, and nominal GDP growth to fluctuate between 4.1% and 4.7% during the same period. Historically, real disposable income has traditionally dropped by as much as 1.5% during second quarters within any given year, and given that it dropped to just over 2% during 4Q2019, it was expected to remain between 2.1% and 2.75% for the next several years. Finally, the nominal disposable income (which is affected by the inflation rate) was expected to remain between 4.5% and 5% through 2024, with values peaking during first quarters.

While the Fed' attempts to drive inflation to a target of 2% by adjusting interest rates on Treasury bonds, rates for 1Q2019 were below 1%, with rates during the rest of 2019 ranging from 1.8% to 2.9%. Our current analysis based on the Fed's data through 4Q2020 anticipates an extremely stable inflation rate, holding between 2.25% and 2.6% through 2024. However, this outcome seems extremely unlikely at this time.

Ordinarily, GDP is driven by several factors:

- Personal consumption;
- Retail sales;
- Government spending;
- Net trade; and
- Mortgage rates.

As we have mentioned, the current Corona-virus emergency (COVID-19) is expected to significantly hamper domestic output in the near term, starting with international travel, imports & exports, and related industries. Given the unemployment filings that we have already witnessed after a few weeks of widespread isolation, and a few months since the first US impact, personal consumption and retail sales are expected to have plummeted;

many states have imposed ordinances that office supplies, home repair, food & medical services are the only offline retail services available to end consumers. Some online retail services are still available to consumers with fulfillment provided by delivery services (USPS, UPS, Fedex, etc.), but the vast majority of outlets for purchasing goods have been closed by local regulations.

Additionally, spending patterns by consumers who are still working have shifted in light of the changes in the culture. With reliance on online infrastructure from an in-home workspace, consumers are needing (in the short term) computing & office supplies; however, these purchases are expected be unusual events that will not perpetuate. Other needs for, e.g., professional shirts (and similar items) have been noticed given businesses' reliance on laptop-based video-conferences.

As a result the main thrust of purchases and exports for the near future (i.e., until this crisis is resolved) will likely be food products, and services. The modern-day consumer's mindset has already been shown to be one that, when stressed and/or uninformed about a crisis' duration or other guiding details, the consumer will purchase and stockpile poorly considered and unnecessary quantities of items, and then capital will be conserved by both individuals and businesses. (The current-day examples of this phenomena are toilet paper, sanitizer, and other hygiene products.) Hence, while ***government spending will likely stay level or slightly increase*** given the emergency, we expect ***personal consumption and retail sales will drop precipitously***.

Finally, we ***expect net trade to increase*** given the demand for American food supplies globally. In contrast, ***mortgage rates have fallen off significantly***, given the Fed's support of the economy in this time of crisis (to be discussed later in this report). Given this mixture of factors, we expect that the ***nominal GDP growth rate will be around -10.0%, inflation will rise at a rate of as much as 3.0%***, and the ***real GDP growth rate will be between -5.0% and -8.0% for 1Q2020***. Disposable income and capital investment will shrink severely. We believe that inflation could average at or above 4.0% for 2020, and stay above 3.0% through 2021, despite the Federal Funds rate remaining below 0.5% for the duration (again, to be discussed later in this report). Inflation is a very difficult measure to predict given the short term drops anticipated for energy costs, but the shakiness of current-day supply chains and healthcare costs, we believe that they will likely rise sharply.

Other Commentary

- The Economist headlines "Economists' Forecasts for GDP Growth in 2020 Vary Widely", and charts that experts on the US economy see its Y/Y change in GDP ranging from 0% to -7%. (see https://www.economist.com/finance-and-economics/2020/04/03/economists-forecasts-for-gdp-growth-in-2020-vary-widely; Apr 4, 2020)
- "Factories across Asia and Europe cut output and jobs at the fastest pace since the global financial crisis, a sign the global economy has entered a deep freeze as governments lockdown their populations in an effort to contain the novel coronavirus and minimize mortality." (see https://www.wsj.com/articles/factories-cut-output-jobs-as-coronavirus-lockdown-bites-11585736047; Apr 1, 2020)
- Kiplinger "[expects] the inflation rate to fall to 1.8% by the end of the year, down from last year's 2.3%." (see https://www.kiplinger.com/article/business/T019-C000-S010-inflation-rate-forecast.html; Mar 11, 2020)

Unemployment Rate

Analysis

Pre-coronavirus, unemployment showed no sign of breaking from its historic sub-4% low levels in the foreseeable future (currently reported as 3.5%). However, the Corona-virus emergency has had a significant impact on product demand and distribution. A significant number of small businesses have had to shutter (and larger businesses have had to impose furloughs), and unemployment claims after mid-March climbed to almost 3.3 million. April, and even May, are expected to follow comparably as business owners find themselves tapped of cash reserves and consumers unavailable (and unwilling) to spend money.

The unemployment rate is driven by the size of the employable labor force; the monetary policy of the Federal Reserve (which drives the Federal Funds Rate); and, the fiscal policy of the US (which impacts government spending). After the crisis in 2008, we saw a substantial number of workers leave the labor pool due to the unavailability of acceptable work (and they did not return due to their skills & interest in working eroding); if the current crisis

continues for a significant period (i.e., to the end of 2020), we will likely see another round of "self-selection" out of the labor pool. This outcome could apply pressure to artificially reduce the perceived unemployment rate (by reducing the number of workers that are considered eligible to work, despite their potential interest in an ideal opportunity).

If this outcome occurs, we expect that these individuals (who choose to not work) will eventually end up relying on a spouse (or other family members) for long-term support and/or working as part of the emerging tech-fueled "gig economy" (independent subcontractors who are paid exclusively on an hourly or per-task basis) in urban areas. Based on our previous discussion, and using Hurricane Katrina as a basis, we have estimated that ***unemployment will settle above 15%, and possibly as high as 35%*** by YE2021. Regions that rely on the hospitality industry (e.g., Hawaii, Florida, Nevada, etc.), energy (e.g., Texas, Louisiana, Missouri, etc.), commercial & residential real estate (i.e., 12 major metro areas, e.g., Miami, San Francisco, etc.), and entertainment (e.g., Nevada, California, etc.) are expected to be the hardest hit; agriculture and conservative markets will be the most resilient, but will still feel the effects of the phenomena. Similarly, the Brookings Institute purports that the smallest and youngest businesses are the most vulnerable at this time, with ***extremely young/small retail and construction firms reducing their staff by over 30%***; also, the area bounded by Washington, DC; New York City; Chicago; and the southern-most tip of Illinois was the hardest hit.[34]

Other Commentary

- "[The employment report due on April 3rd] is "not going to really capture the significant damage out there that occurred," said Joseph Brusuelas, chief economist at RSM US LLC. ⋯ If the shutdowns continue for a few more weeks, the April jobs report, scheduled for release May 8, could show the greatest one-month deterioration of the labor market on record." (per https://www.wsj.com/articles/march-jobs-report-unlikely-to-show-full-impact-of-the-coronavirus-crisis-11585490400; Mar. 30, 2020)

[34] See https://www.brookings.edu/blog/the-avenue/2020/03/25/what-the-great-recession-can-tell-us-about-the-covid-19-small-business-crisis/

- "A record 3.28 million Americans filed for unemployment benefits last week as the coronavirus pandemic shut down much of the country. The Labor Department's report for the week ended March 21 was one of the first official indicators of how many people have suddenly been forced out of work nationally." (per https://www.npr.org/2020/03/26/821580191/unemployment-claims-expected-to-shatter-records; Mar. 26, 2020)

Treasury Yields (1, 3, & 6-month; 1, 3, 5, 7, 10, 20, & 30-year series)

Analysis

For the past several months, an inversion of the US treasury yield curve, along with the global indicators of a recession, has been the greatest concern for the US economy. More recently, however, the 10-year Treasury yield has found its way into record low territory -- closing well below 1% during early March (prior to the emergence of the COVID-19 emergency).

Prior to the COVID-19 emergency, Capitalytics' analysis showed the 3-month Treasury yield falling in line with its reported value of 1.6%, and, without accounting for the most recent transient issues, it was expected to remain at approximately 1.6%-1.7% for the near term (through 2024). That rate has already been affected by global medical issues (with the Federal Reserve and other central banks responding to proactively support economies), and is expected to be affected by political concerns.

At this point, however, the US Federal Reserve is not only trying to "get in front of" the economic effects of the COVID-19 emergency, but also get out from being under a yield curve inversion (that has signaled a pending recession for several quarters) and rebound from an unprecedented bull market that turned bear-ish in a matter of less than a month.

Short-term Treasury Yields

Looking first at "short-term Treasury yields" (bonds with a maturity period of 5 years or less), rates are generally driven by inflation, the Federal Funds Rate, and investor confidence (which is strongly affected by confidence in the US President and Congress). We have

previously discussed that ***inflation will rise at a rate of at least 3.0% in 1Q2020, and will average above 4.0% through 2020, and above 3.0% through 2021***. We have also alluded to our conclusion that ***the Federal Funds Rate will stay below 0.5% through at least 2021,*** and will only grow slowly at the end of the crisis.

We will use the "Presidential Job Approval" rating from The American Presidency Project[35] as a proxy for "investor confidence". President Trump's approval rating has grown very gradually from 37% to 44% over the past two years, with a spread of approximately +/-7 points (roughly a 20% improvement)[36].

As a result, we are left with a few key points to consider: there will be extremely "cheap" money (from the Federal Reserve), and a "pro-business" President through the end of 2020. Inflation will be comparatively high through 2021; the "dampening" of that inflation rate will be driven by (a) the fiscal policies that can be agreed upon by the US President and the Congress in the form of budgetary government spending, and (b) the monetary policy of the Federal Reserve and the FOMC that may be adjusted to address near-term issues in the economy.[37]

All of this is to say that there are a limited set of tactics that the President (and Congress) can employ to affect the inflation rate: one is by collecting taxes to accommodate the annual budget; this approach will likely be exploited of in the case that President Trump is not re-elected in 2020. In other words, based on past history, we expect that ***the general tax rate on businesses and individuals will likely increase in 2021 under a Biden administration*** and spending to increase as part of the 2022 budget. On the other hand, ***we expect Trump's approach would be to pressure the FOMC to hold interest rates*** as much and as

[35] See https://www.presidency.ucsb.edu/statistics/data/presidential-job-approval

[36] We would even hazard to say that, within the context of this discussion, Trump's approval rating would be somewhat higher than this, given his "business friendly" attitudes.

[37] While the President can (for "cause") fire and nominate a candidate for any of the positions of the Board of Governors of the Federal Reserve System (from which the FOMC is constituted), these nominations can be long and tedious chores that require confirmation by the US Senate. On the other side, the President and the Senate play no role in picking the presidents of the 12 regional Fed banks; those presidents are appointed by their private sector boards of directors, subject to the approval of the Fed Board in Washington.

long as possible - with the distinct possibility of a lesser increase in taxes to support spending in 2021 – in order to combat continued, excessive inflation.

Getting back to "Short-term Treasury Yields", we will specifically look at 1-year yields, and then rely on the high correlations that exist between that yield rate and others that are 5-year terms and less. The 1-year yield went from 1.8% to 2.57% during 2018, and then consistently fell to 1.55% during 2019. It then plummeted from 1.49% on Feb 10, 2020 to 0.11% on March 23rd. Due to the extenuating circumstances, ***forecasts based on immediate past history will not be helpful***.

However, we did see this yield at 0.5% at YE2008, and ***it floundered at approximately this same level for six years*** until Thanksgiving 2014 (at which point it began a four-year run up). Coincidentally, New York's 104-story One World Trade Center officially opened on November 3, 2014.

Long-term Treasury Yields

Turning to "long-term Treasury yields" (bonds with a maturity period of more than 5 years), rates are generally driven by inflation, government spending, wages, and industrial capacity & utilization. Again, we have previously discussed that ***inflation would likely rise at a rate of at least 3.0% in 1Q2020, will average above 4.0% through 2020, and above 3.0% through 2021***.

Currently, federal and state spending is $4.79T in FY2020. While it cannot be said exactly what spending will be in FY2021, we can look to a past recessionary period to have a sense of how spending has previously evolved. Specifically, government spending in FY2007 was $2.73T, $2.983T in FY2008 (a 9.27% Y/Y increase), $3.518T in FY2009 (a 17.93% Y/Y increase), and $3.456T in FY2010 (a 1.76% Y/Y decrease)[38]. Based on these numbers, ***a 10% Y/Y increase is a reasonable estimate for the rate of change of government spending in a recessionary period***.

[38] Per https://www.thebalance.com/current-u-s-federal-government-spending-3305763

Looking at wages[39], we see that the national wage index reported by the Social Security Administration for the latest year reported (2018) being 3.62% higher than the previous year (2017, compared to an inflation rate of 2.4%). From 2017 to 2016, the national wage index increased by 3.45% (versus an inflation rate of 2.1%), and, from 2016 to 2015, the index increased by 1.13% (versus an inflation rate of 1.3%). Now, moving to a recessionary period, wages over 2007 changed by 4.54% (versus an inflation rate of 2.8%, a net of 1.74%), wages in 2008, they changed by 2.30% (versus an inflation rate of 3.8%, a net of 1.5%), and, in 2009, they changed by -1.51% (versus an inflation rate of -0.4%, a net of 1.11%). Looking farther across the years, the average wages growth rate over the past 20 years is 3.01%, and the average wage growth rate over the past 40 years is 3.98%. Therefore, while we see a certain amount of volatility, ***wages appear to be consistently growing at about 3% per year***. However, these figures assumed a relatively constant labor force; today, however, we must assume that the US will experience a dramatic increase in its unemployment (16M+ unemployment claims in only the first three weeks of sheltering during this emergency), meaning that ***the aggregate wages earned by the population will significantly decrease***.

Regarding industrial capacity & utilization, we discussed previously that there is a downward trend in both of these metrics over the last year indicates that value of output is falling, and firms are using a smaller percentage of their capital.

As a result, we are seeing rapidly increasing inflation, steadily increasing government spending, (at best) slowly growing per-worker wages, dramatically increased unemployment, and dropping, industrial capacity & utilization, which ***we expect to significantly reduce the long-term Treasury yields***.

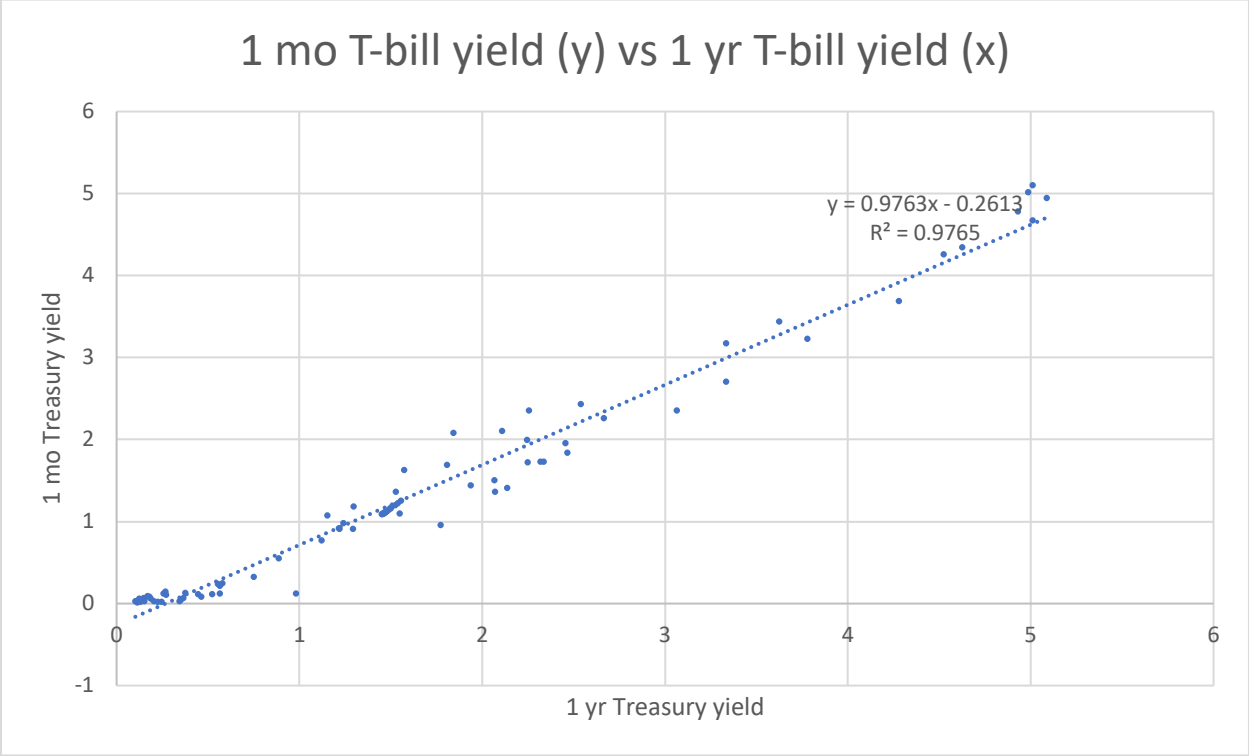
Other Commentary

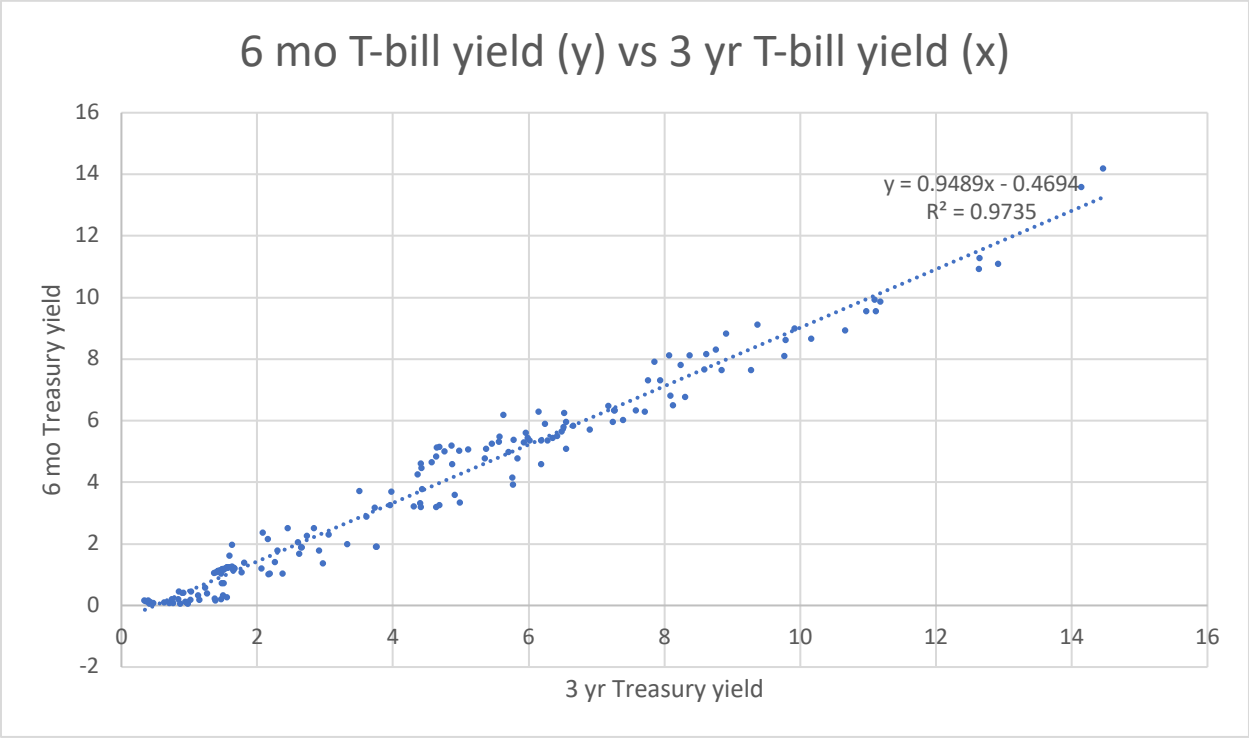
- "The Federal Reserve made another emergency cut to interest rates on Sunday, slashing the federal funds rate by 1.00 percent to a range of 0-0.25 percent. ⋯ The latest rate cut is an urgent measure that underscores the Fed's commitment to mitigating disruption to the economy, as the virus and the aggressive response to it cause an economic slowdown to percolate through the global economy. It was just

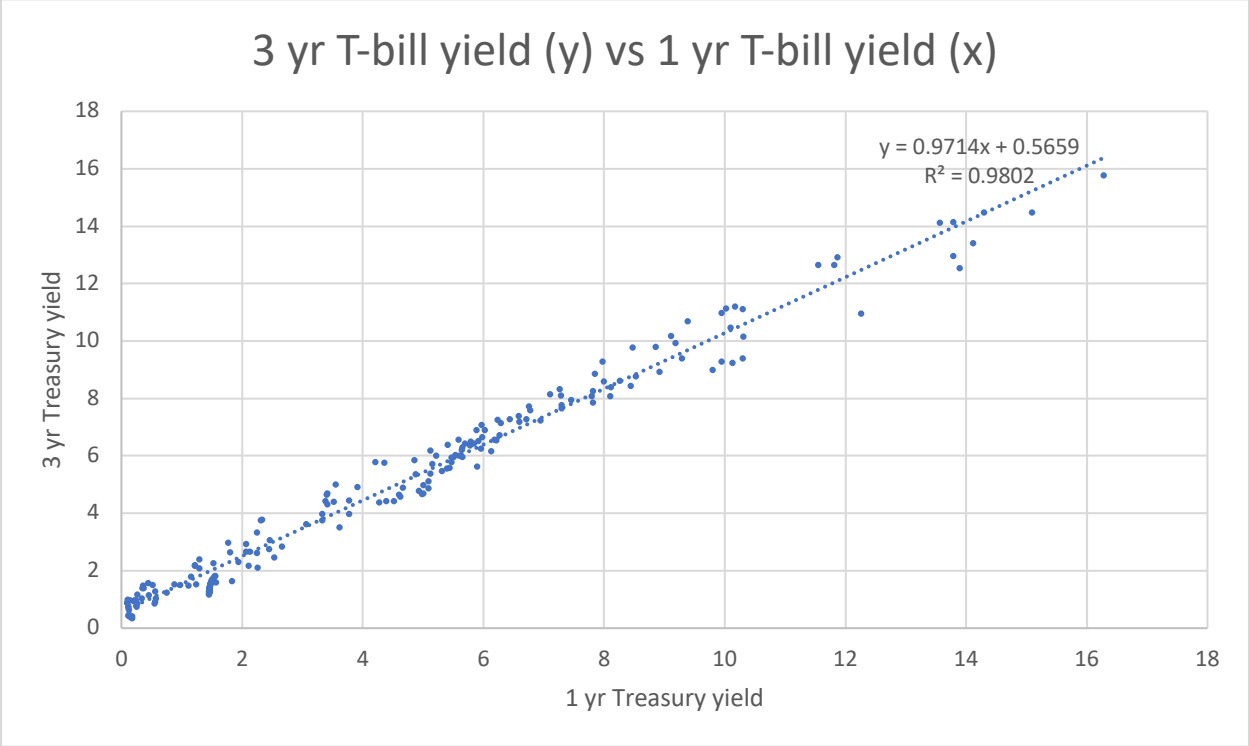
[39] See https://www.ssa.gov/oact/cola/awiseries.html

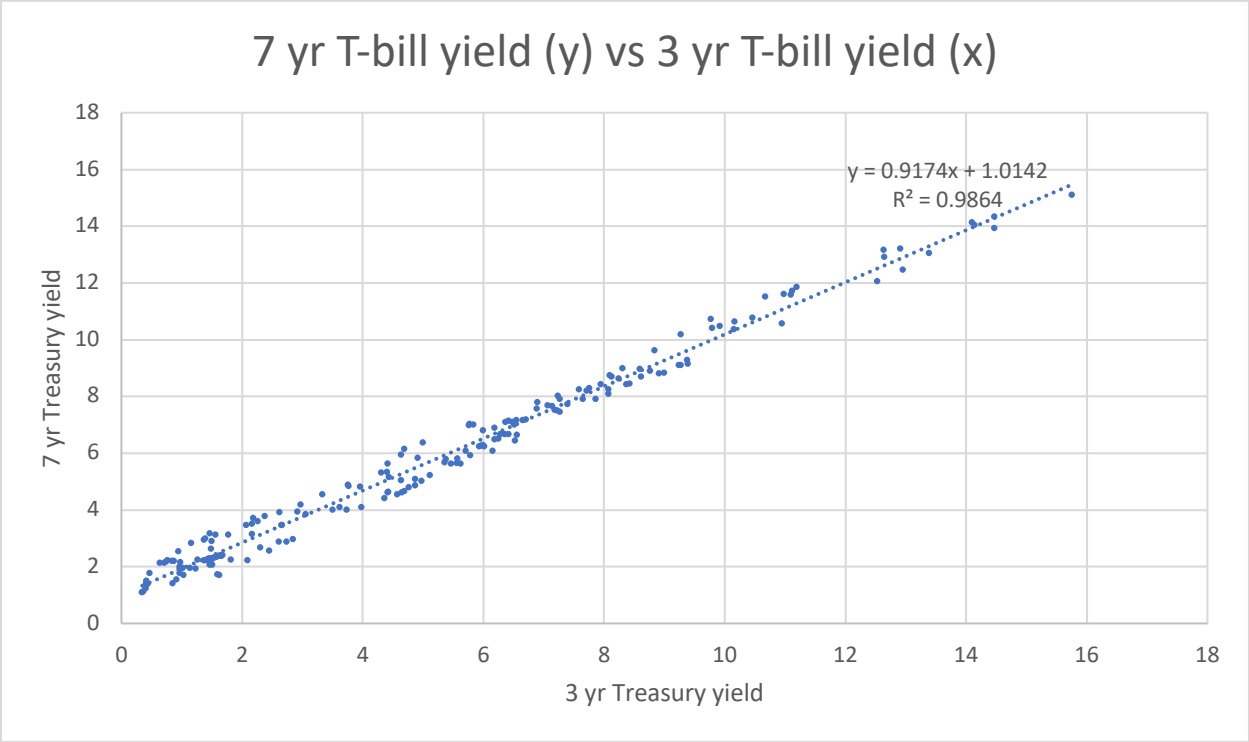
two weeks ago that the Fed made an emergency cut of 0.5 percent." (see https://www.bankrate.com/banking/federal-reserve/interest-rate-decrease-winners-losers/; Mar. 15, 2020)

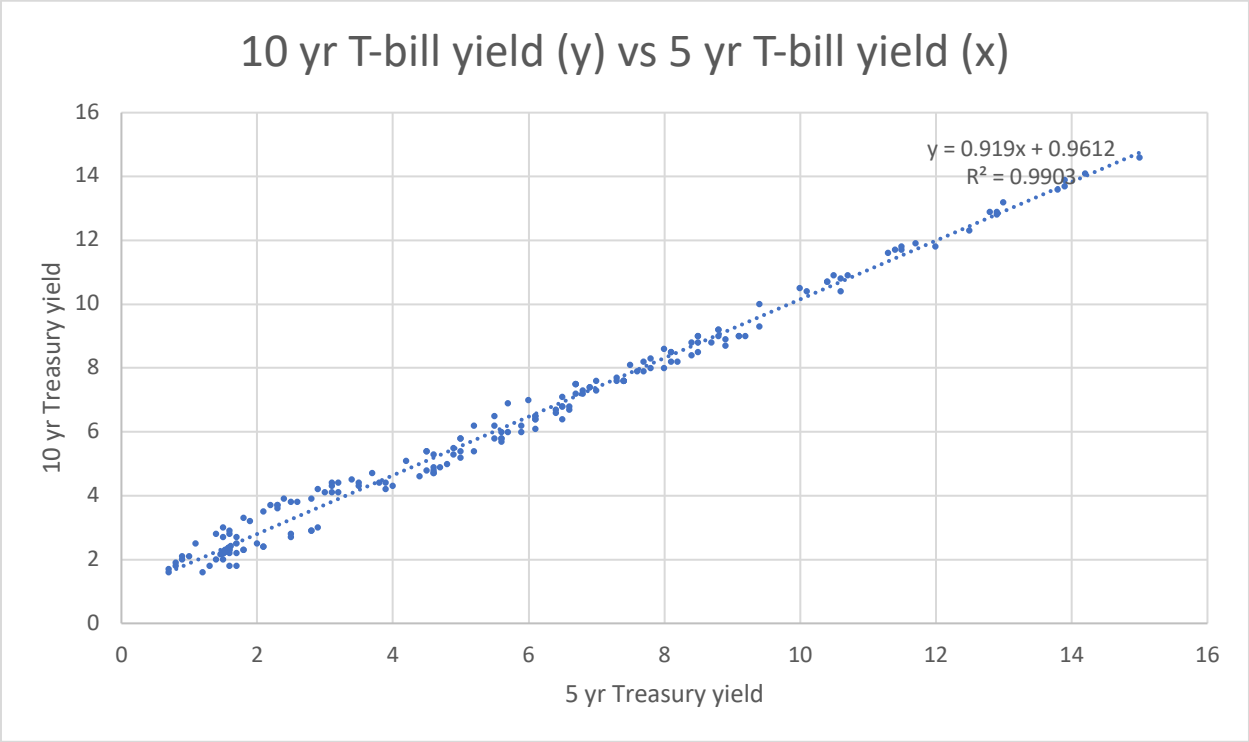
- "… on March 3rd, [the Federal Reserve cut rates between FOMC meetings] … because of the 'evolving risks to economic activity' from the coronavirus. … The decision to drop rates by half a point to 1-1.25% was a bold move, but it failed to reassure investors. American stock markets remained jittery, particularly in light of comments made by Jerome Powell, the Fed's chairman, at a press conference. 'We do recognize that a rate cut won't reduce the rate of infection,' he said. 'It won't fix a broken supply chain. We get that. We don't think we have all the answers. But we do believe our action will provide a meaningful boost [for] the economy.' " (per https://www.economist.com/finance-and-economics/2020/03/02/americas-central-bank-acts-to-offset-the-impact-of-covid-19; Mar. 2, 2020)

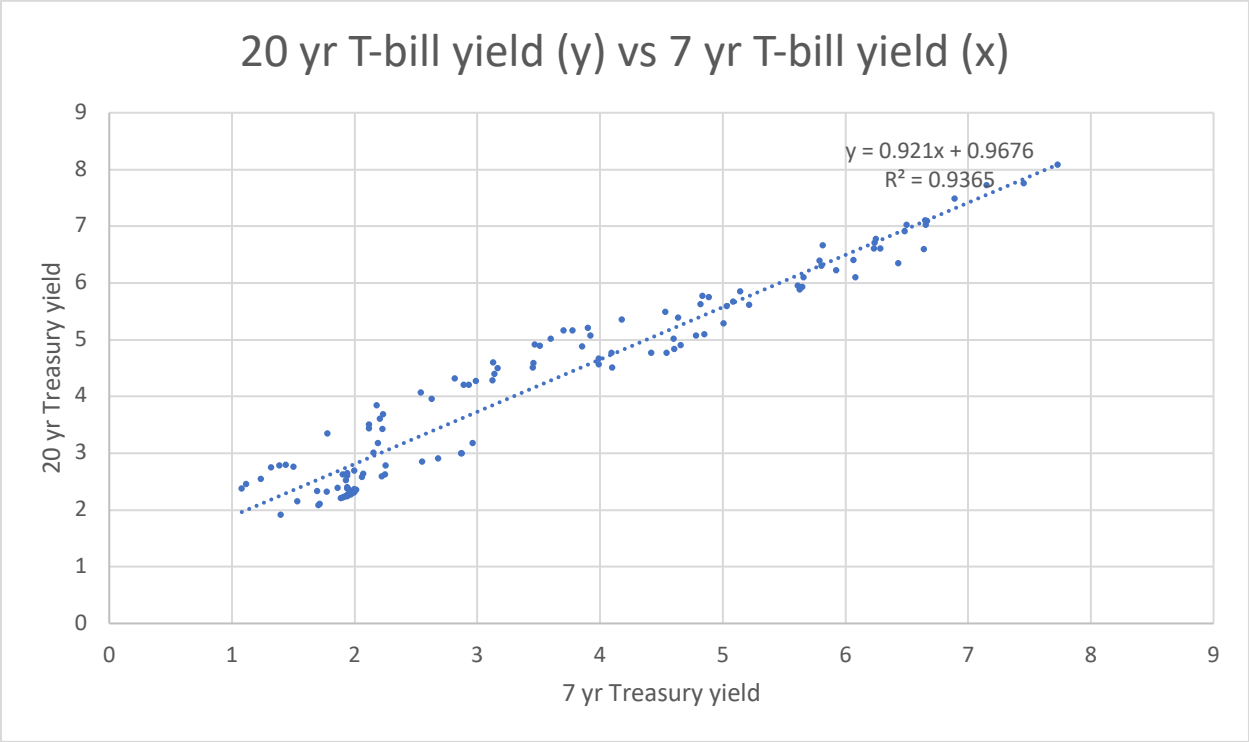


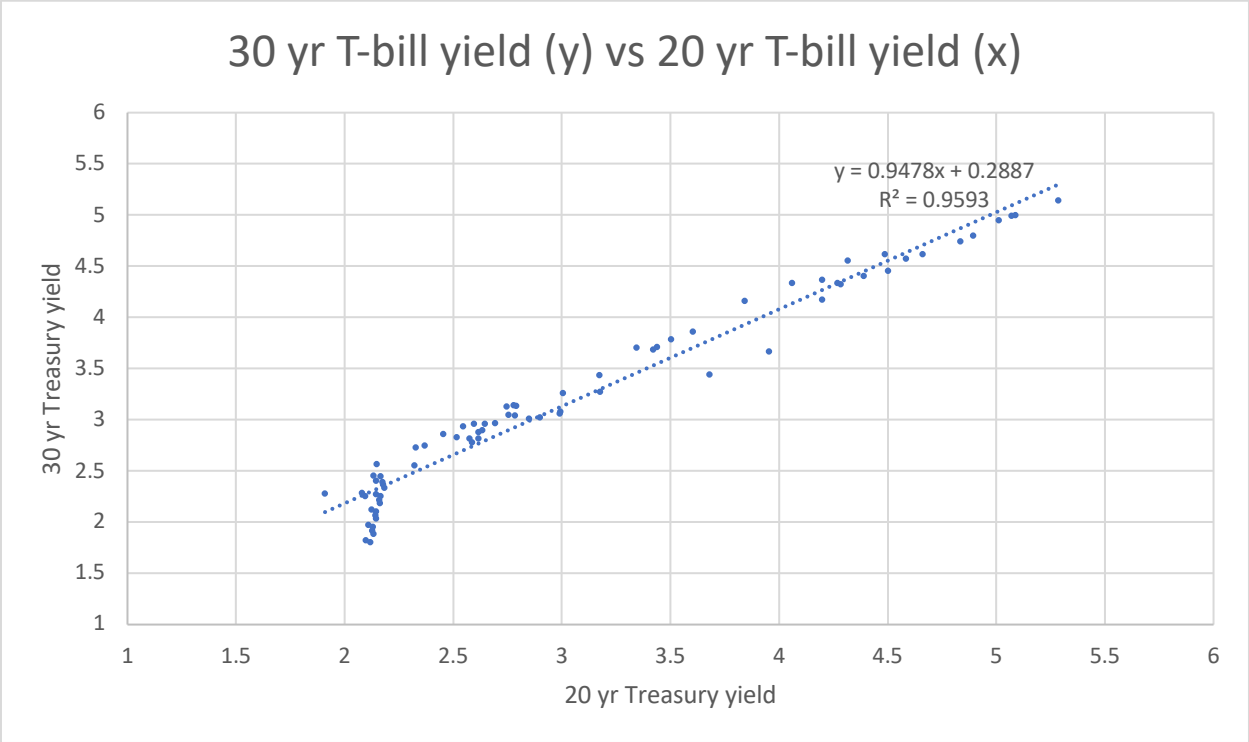












30-year Mortgage Rate

Analysis

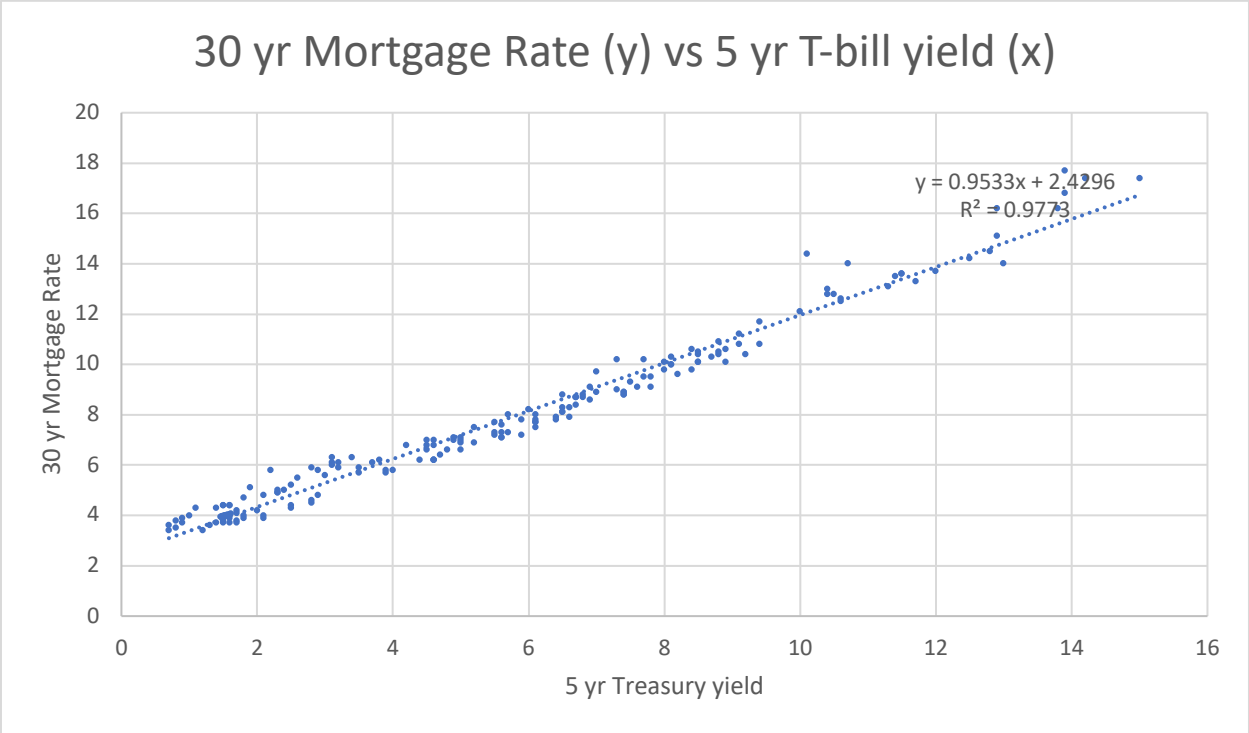
Over the past year, an anticipated economic slowdown and reduction in the housing market has been continuously rumored as being "right around the corner". Prior to the COVID-19 emergency, our models reflected the 30-year fixed mortgage rate stabilizing between 3.8% and 3.9% for the foreseeable future. Further, our quantitative analysis indicated that there is a strong connection between mortgage rates and the 5-year T-bill.

However, as the Federal Reserve has lowered interest rates on longer maturity notes (e.g., 10-year notes) in order to stimulate spending, this has also lowered mortgage rates. Mortgage rates have historically remained 1.5%-2% higher than 10-year T-bill rates, but due to the dramatic actions of the Federal Reserve, there has been a massive demand for refinancing which has held mortgage rates at a higher level over the current 0.6% Treasury note yield.

Looking forward, though, as unemployment stabilizes at the higher levels that we have quoted earlier, we expect for the frothiness of the retail market to settle and ***expect 30-year fixed rate mortgages to be offered as low as 1.5%-2% within the next 12 months*** before they rebound. When rates do start to recover, we expect them to recover extremely slowly, much as we saw in 2014.

Other Commentary

- Kiplinger expects that "Low mortgage rates should contribute to a good housing market this spring by making mortgages easier to afford." (https://www.kiplinger.com/article/business/T019-C000-S010-interest-rate-forecast.html; Mar. 13, 2020)



Moody's AAA & BAA Rates; BofA BBB Corporate Yield; and the Market Volatility Index (VIX)

Analysis

Moody's AAA bond rates tend to track in conjunction with mid-duration T-bill. Moody's BAA rates tend to be higher yield (corresponding to higher risk), and more volatile, than AAA rates. Both were also dependent on consumer/investor confidence in the organizations that were reflected in the securities. The BBB Corporate Yield is generally tied to Moody's indices (particularly the Moody's BAA bond yield), CPI, and the 30-year Mortgage Rate, even though these bonds are generally 10 years in duration. Capitalytics' analysis showed that the VIX was usually tightly coupled to the BBB corporate yield. Over the past few years, the volume of bonds that are rated generally in the BBB range has grown dramatically, to take up a significant portion of the investment grade market.

Capitalytics' (original) quantitative models saw AAA rates gradually dropping over the next several years (through 2024) from 3.06% (to 3.0% by YE2020) to 2.9% by 2024. These

figures continued to show reductions from our previous models. BAA rates were expected to drop from 4.0% to 3.85% over the next 5 years.

At this point, however, there are very few sectors of the US Economy that remain unaffected by the COVID-19 emergency. The most likely significant portion of the market to be affected by this emergency are real estate-heavy operations that are dependent on lease payments (consider CBRE, Simon, and GPG) - and those organizations that lease substantial amounts of real estate (large distributed organizations such as IBM are sure to write down noteworthy losses to break leases -- where possible - as their employees adapt to working from their residences).

We expect the weakest of this group to be able to ride out the situation for 12-18 months, but substantially hindered. While they were dropping very slowly from about 3.0% (as their security was increasingly expected), ***we expect these yields to now be forced up to 5.0% (and higher) by the end of 2020***. Unfortunately, we also expect a significant number of defaults of bonds that are currently held at *every* risk grade to occur within the next two years as a global slowdown sets in. Along those lines, we now expect ***a plethora of these bonds to drop in grade to or below "junk" status, and a significant number of these companies will be pulled into bankruptcy before YE2021***. This change in the landscape will affect otherwise highly rated bonds as markets potentially start to dry, and ***we advise the preservation of any liquidity possible in order to weather the next 24 months***.

Capitalytics has previously forecasted that the Market Volatility Index would fluctuate between 14 and 16 over the next five years; however, again, the COVID-19 outbreak has upended many of our short-term forecasts. Market instability due to concerns about the COVID-19 issues and the likelihood of no inoculation for a 12- to 18-month period (and the steps that companies will take to maintain their productivity in the interim) means that the VIX will remain at a heightened level for the near term, and trading policies based on the VIX will continue to be fueled.

To wit, per https://qz.com/1819360/wall-streets-vix-fear-gauge-is-almost-back-to-its-2008-level/, "On Monday, the Cboe Volatility Index ⋯ jumped to 77.7, hovering around the highest levels since November 2008, …" (The VIX tracks market volatility as a function of out-of-the-money options prices.). Similarly, "Part of the reason for this level of volatility is

because there's so much uncertainty around the length of the outbreak and its economic impact, according to Bill Miller, founder of Miller Value Partners."[40]

We agree with Mr. Miller's assessment: until some degree of certainty about the duration of the emergency is found, the VIX will have an extremely elevated level. ***The next most likely milestone that will assuage the market's volatility is understanding if a major US metropolitan area can truly control its outbreak.*** Rumors are currently swirling that NYC and other cities will see a peak by the end of April 2020, which, if accurate, will likely send that message. After that point, economists will have a better sense how the uncoordinated control that multiple cities will exert over their own outbreaks will turn out, and how those controls will impact distributed organizations and the economic markets. ***Similarly, news of successful preventative measures and/or cures will be an undeniably major step to settling the market; currently, this objective is expected in 12 to 18 months.***

Other Commentary

- ""It reflects the uncertainty and potential impact of that range of outcomes," [Bill Miller, founder of Miller Value Partners] said in a note Monday. 'When the market thinks the authorities don't get it … the market reflects that immediately. When it believes proactive measures are being taken — Trump's remarks [Friday] — that is quickly evident in the market's reaction.'" (see https://www.cnbc.com/2020/03/16/wall-streets-fear-gauge-hits-highest-level-ever.html)
- "Many kinds of businesses, from airlines to restaurants, are staring into an abyss as commerce comes to standstill. The US Federal Reserve yesterday announced its most aggressive measures to date, aiming to prevent a credit crunch by slashing interest rates and giving banks the green light to support clients even if it eats into their capital holdings. The Fed's efforts could buy time and reduce defaults until other measures are activated to stem the crisis." (per https://qz.com/1819360/wall-streets-vix-fear-gauge-is-almost-back-to-its-2008-level/, March 16, 2020)
- "Start with the first, volatility. Equity-market instability might feed on itself. The VIX, which measures the expected volatility implied by the price of options on the S&P

[40] See https://www.cnbc.com/2020/03/16/wall-streets-fear-gauge-hits-highest-level-ever.html

500 index, vaulted from around 15 to above 27 in a matter of days … Some investment strategies are particularly sensitive to it. For example, when volatility is low, they allow for a bigger weighting of equities in portfolios. But when it rises and stays high, some investors are forced to unload some of their holdings—creating yet more volatility. Some exchange-traded funds whose value is linked to the VIX saw outflows. It is likely that at least some investors have been betting on continued near-dormant volatility. The resilience of such strategies could be tested." (per https://www.economist.com/finance-and-economics/2020/02/27/markets-wake-up-with-a-jolt-to-the-implications-of-covid-19; Feb. 27, 2020)

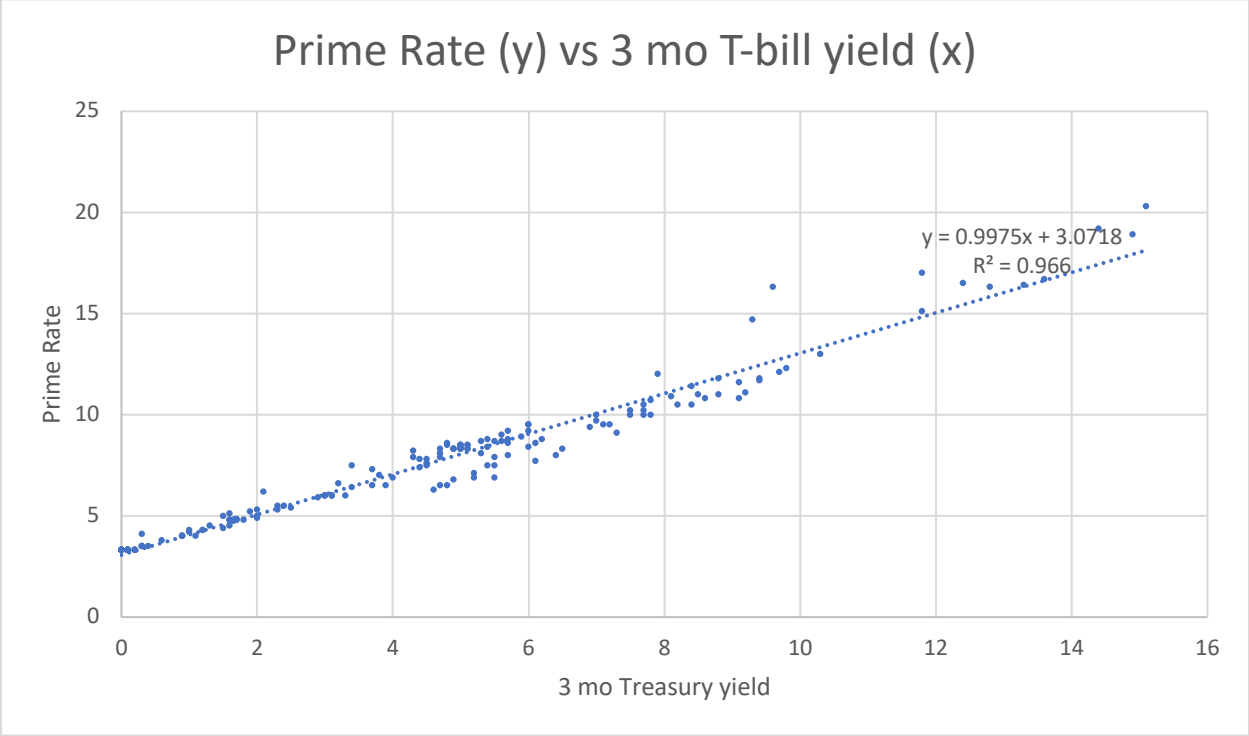
- "A surprise rally in riskier corporate bonds is providing much-needed help to some energy companies with lower credit ratings, allowing them to issue new bonds to push back looming repayment dates." (see https://www.wsj.com/articles/energy-companies-seize-the-day-with-bond-refinancings-11579006807; Jan. 14, 2020)
- "Investors have either made peace with the risk of mass downgrades when the credit cycle turns, or they've just decided to ignore it and reach for yield when the Federal Reserve is cutting interest rates. Neither seems to be sustainable. … But perhaps the most telltale sign of just how little investors seem to mind the 'ratings cliff' between investment- and speculative-grade is how they're gobbling up double-B bonds just as voraciously as triple-Bs. In fact, on Oct. 28, the spread between the two dropped to 43 basis points, a new low, according to Bloomberg Barclays data. At the start of 2019, it was as high as 172 basis points. Even though triple-B corporate bonds are having their best year in a decade, double-B debt isn't far behind." (see https://www.bloomberg.com/opinion/articles/2019-11-04/alarms-still-blare-on-triple-b-bonds-but-no-one-cares; Nov. 4, 2019)

Prime Rate

Analysis

The Prime Rate is historically very tightly coupled to very short-term Treasury Bills (specifically, 3-month yields). Capitalytics models anticipated the Prime Rate remaining very close its current level of 4.8% for the foreseeable future (through 2024). However, given the trajectory of short-term T-bills, ***we anticipate the Prime Rate will only be buoyed by competition, and will remain at or below 3.5% through mid-2021***.

The accompanying chart shows the tight relationship that has existed historically between the Prime Rate and the 3-month T-bill yield.



US Average Retail Gasoline Price

Analysis

Capitalytics' quantitative analysis showed that Gasoline prices are expected to remain relatively stable over the next several years, with typically expected fluctuations occurring during the summer and winter months (between $2.70 and $2.85 per gallon through 2024). Based on the geo-political stability of the Middle East and other OPEC nations, gasoline prices were expected to rise very slightly on an annual basis. However, those results were based on data from before the Russia-Saudi Arabia conflict, and the impact of the COVID-19 crisis.

Over the latter half of February and beginning of March 2020, numerous companies (including the European Central Bank) have taken formal positions of reducing or eliminating travel for employees in order to reduce the risk of (and liability from) exposure to the COVID-19 virus. International (and domestic - at least in the US) travel has been significantly curtailed by numerous organizations, which is significantly reducing the demand for fuel and, after only a few weeks, a glut of oil is forming in international markets. This glut has subsequently affected (i.e., put downward pressure on) prices.

In early March, after prices of unrefined crude oil had already dropped by over 20% since year-end 2019, Saudi Arabia responded to Russia's proposal (to OPEC) and discussion of oil production cuts by offering additional cuts in oil prices (now at over 60% of year-end values). This price drops not only affects Saudi revenue, but the global value of oil, and currency values. Since that time, Saudi Arabia, Russia, and the US (among others) have all reduced their oil production targets, and the price has been attributed to impacting stock exchanges globally and bankrupting at least one producers[41].

While rumblings of a peace between Russia and Saudi Arabia is beginning, the effects of the Coronavirus on travel have already entrenched themselves. While the Saudi discounts can be removed from the prices of oil, demand has been substantially altered based on fleets of airlines being "mothballed" in deserts for long-term storage, and are not expected to return to service in the near future. (The success of "virtual presence" services such as Zoom and Google Meet have taken the opportunity to spread their offerings.) Over-the-road distribution has also been significantly affected, and may have issues rebounding after a weaker firms close.

Retail gasoline has dropped by more than 30 cents/gallon across all grades over a six month window, equating to 15% of retail prices[42]. (Per https://www.thebalance.com/u-s-retail-sales-statistics-and-trends-3305717, "Oil prices drive 60% of gas prices.") As we have already discussed, crude oil has dropped from $60 per barrel to about $20 per barrel. There was a similar drop in crude oil prices during the second half of 2008, during which the price of a barrel of crude plummeted from $140 to about $40. While ***there was a rapid rebound***

[41]See "Shale group Whiting files for Chapter 11" at https://www.ft.com/content/116fe93a-6fe7-400a-aedf-840ba9738743

[42] See https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_m.htm

for about 20% of the lost value during the first six months of oil's recovery, it took another five years to recover another 45% of the lost value[43]. We feel that the US will experience a similar rebound once the COVID-19 emergency begins to truly pass.

Other Commentary

- "Delta, an American carrier, says it may have to trim international schedules by 40%, up from a 25% reduction before the ban. Lufthansa, Europe's biggest carrier, had already cut flights in half for April. As more countries impose travel restrictions, the German airline may need to thin schedules by 90%, reckon analysts at Bernstein, a research firm." (per https://www.economist.com/business/2020/03/15/coronavirus-is-grounding-the-worlds-airlines; Mar 15, 2020)
- "Oil prices slid the most since the Gulf War in January 1991 following Saudi Arabia's decision over the weekend to instigate a price war as it escalated a clash with Russia. Crude prices, along with U.S. government bond yields, are typically viewed as key barometers of economic health and confidence, said Gregory Perdon, co-chief investment officer at private bankers Arbuthnot Latham." (see https://www.wsj.com/articles/asian-stock-markets-in-early-monday-sell-off-after-saudi-arabias-decision-to-cut-most-of-its-oil-prices-11583713399; Mar. 9, 2020)

Federal Funds (Primary Credit) Rate

Analysis

When a depository institution has a shortfall and need for liquidity, it may borrow funds on a short-term basis from the Federal Reserve. The "discount rate" is the interest rate charged to commercial banks and other depository institutions on loans they receive from their regional Federal Reserve Bank's "discount window". The Federal Reserve Banks offer three discount window programs to depository institutions: Primary Credit, Secondary Credit, and Seasonal Credit, each with its own interest rate. Under the Primary Credit program, loans are extended for a very short term (usually overnight) to depository institutions in generally sound financial condition. (Secondary Credit & Seasonal Credit may be available to institutions that do not meet the "sound financial condition" criteria.) The discount rate

[43] Per https://tradingeconomics.com/commodity/crude-oil

charged for primary credit (the primary credit rate) is set above the usual level of short-term market interest rates.

Historically, we have seen a tight connection between the Primary Credit rate and the 3-month T-bill; the accompanying chart illustrates that relationship. Prior to the COVID-19 outbreak, the Primary Credit rate for 4Q2019 was 1.65%, and Capitalytics was projecting it to drop dramatically during 2020. We anticipated the cost of funds to fall below 1% by 3Q2020, and below that point thereafter. As has been mentioned, the FOMC made two unscheduled cuts (totaling 1.5%) to the cost of money.

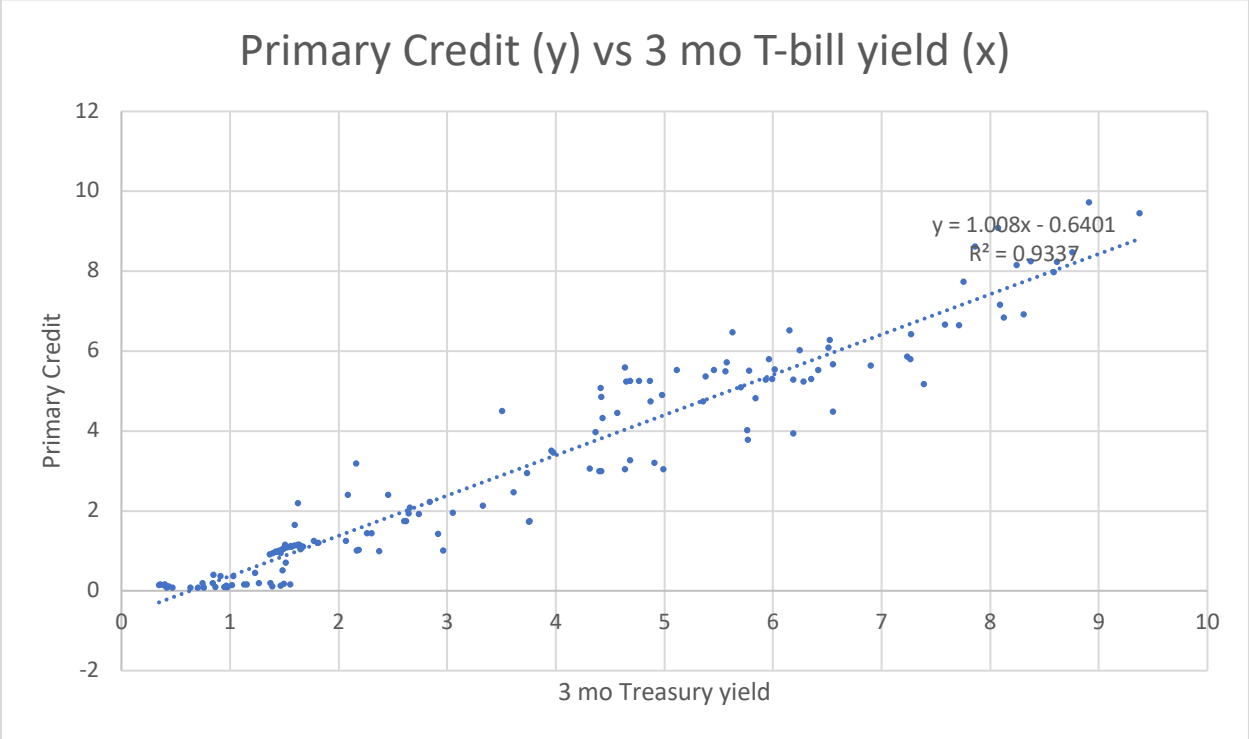
Looking at history, the Federal Funds rate has generally been quick to fall due to recessions, and slow to recover. During the 2001 recession, the rate went from 5.5% to 1.6%, and in the recession of 2008, the rate went from 4.66% to 0.1%. But it took 2 full years (mid-2004 to mid-2006) for the rate to be raised from 1.00% to 5.25%, and it took 2 more years (Oct 2016 to Dec 2018) for the rate to go from 0.4% to 2.4%.

While the duration of the Coronavirus epidemic isn't know, speculation in medical circles is that the world is still 12- to 18-months from a cure being widely available. Based on those numbers, ***we expect the Federal Funds Rate to remain at essentially zero for at least 24 months***. Assuming that the recovery of the US economy behaves as it has previously, we expect the rate to slowly recover. While the White House could attempt to intervene in the economy's recovery by trying to accelerate distribution to the public, the lack of outlets for spending and the impact of inflation will likely fail.

Other Commentary

- "Compared to a world war, the COVID-19 epidemic is a fairly manageable problem, provided that the U.S. government can rise to the challenge. But without a mass mobilization to secure critical supplies and prevent a panic, the crisis could easily spin out of control." (see https://www.marketwatch.com/story/this-is-how-america-will-beat-covid-19-2020-03-05)
- "The Fed has been adding large amounts of short-term liquidity to financial markets since September, when short-term interest rates surged unexpectedly. Then, big banks that normally lend cash short term to other financial companies pulled back, causing money-market rates to go up. Most notably, the federal-funds rate, a key

focus of central-bank policy, moved above its range." (see https://www.wsj.com/articles/new-york-fed-adds-60-7-billion-to-financial-markets-11578929190; Jan. 13, 2020)



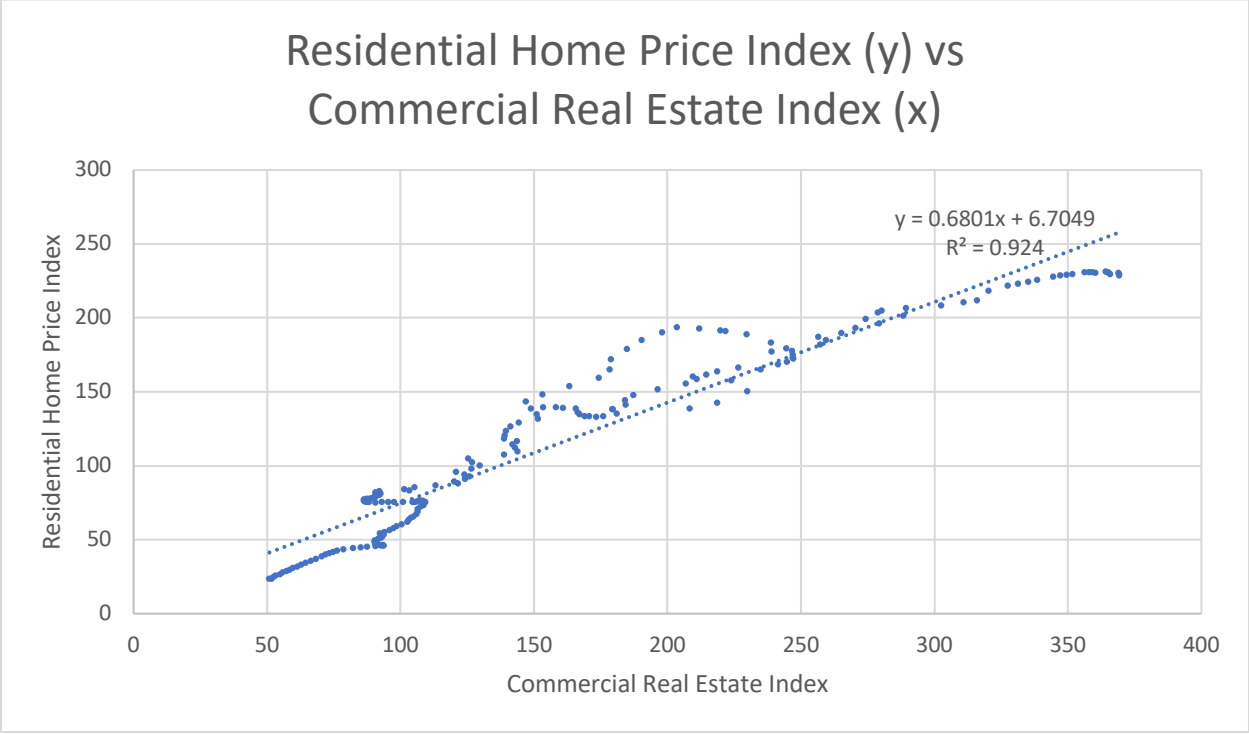
House and Commercial Real Estate Price Indexes

Analysis

New home-construction and home sales (both new- and existing-home sales) have dropped dramatically since the end of 2018. These trends will be reflected in the Home Real Estate Price Index as it was to have grown by as much as 1% per quarter nationally over the next several quarters (from 211.5 in 4Q2019, to 220 at YE2020, to 227 at YE2022), while still being driven by the aforementioned trends. However, growth that was already slowing is now expected to slow even further; while mortgage rates will bottom out during 2020 and stay through 2021, ***mortgage originators will be very selective of new mortgagees and their employment stability***. Additionally, we expect employee transfers within

corporations (that will be conserving capital) will be minimized, further hindering sales and leaving an already significant amount of inventory on the market.

The Commercial Real Estate Price index was projected to grow at between 0.4% and 1% per quarter, and then grow approximately 1%-2% per quarter over the next 60 months (from 316 in 4Q2019, to 335 at YE2020, to 365 at YE2023). However, the same concerns that will minimize relocations of employees will press corporations that survive this crisis to carefully manage their capital. Retail enterprises' issues (vis a vis competition with online-based companies) will only increase as customers rely more on services such as Amazon, and big box vendors with the strongest supply chains (e.g., Walmart, Target, Home Depot, etc.). When considered on top of the real estate that will become newly available, and the previously hot development space, ***we expect that this index will start to falter, growing by no more than 0.2% this year and then dropping as investors look to repurpose assets*** to more stable purposes.



Other Commentary

- "Listings failed to keep up with sales in December, with the inventory-to-sales ratio for single-family homes declining to 3.0 months. On a year-over-year basis, total inventory was down 8.5% …" (see https://www.kiplinger.com/article/business/T019-C000-S003-housing-market-forecast-housing-starts-home-sales.html; Jan. 30, 2020)
- Per the National Association of Realtors, "… numerous experts have lowered their housing market predictions for the next 5 years for home prices and appreciation rates. According to Zillow's Home Price Expectations Survey (which surveyed a panel of over 100 real estate and economic experts), experts forecast that home prices will rise only 2.8% in 2020 nationally." (see https://www.mashvisor.com/blog/us-housing-market-predictions-2020/; Sept 7, 2019)

Dow Jones Total Stock Market Index (end-of-quarter) and S&P 500 (quarterly average)

Analysis

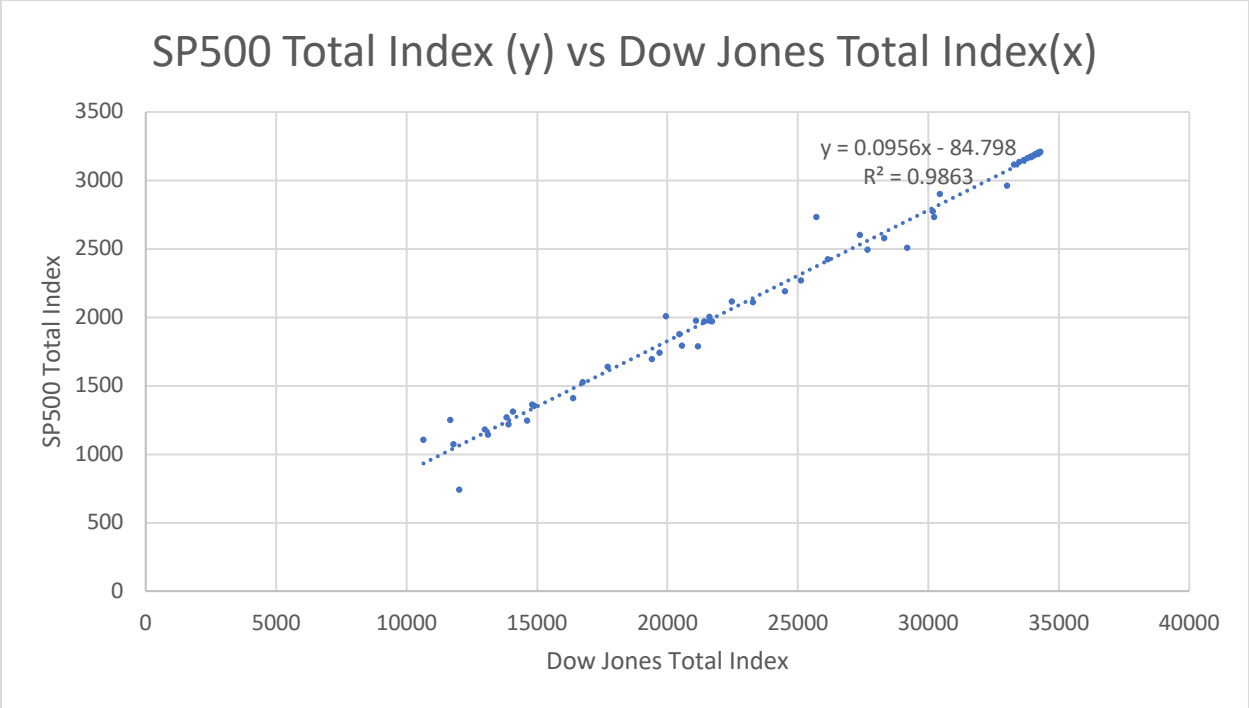
Given the business- and investor-friendly administration that is currently installed in the United States, we expected steady growth during 2020. This trend, however, has been hampered by the COVID-19 crisis. The Dow-Jones index jumped to over 33,000 at YE2019, and then went to 34,600 in mid-Feb. 2020; it was below 22,500 in late March 2020[44]. Similarly, the S&P 500 peaked at almost 3,400 in mid-February, but plummeted to under 2,300 within 30 days (a drop of over 33%)[45].

Given the lack of stability in the market today, we expect growth the be very slow once the economy re-emerges. We believe that, with the different regions that have different infection dates and degrees of infection, recovery will be staged geographically; there is a strong likelihood that aggressive relaxing of quarantine requirements will result in relapses

[44] See https://us.spindices.com/indices/equity/dow-jones-us-total-stock-market-index; the index has recovered between 2500 and 4000 points at of this writing

[45] See https://us.spindices.com/indices/equity/sp-500; the index has recovered by about 400 points at of this writing.

across the county. Hence, the recovery will be "inconsistent and/or erratic", and it will likely not be monotonically improving across the entire nation. The lack of a constantly improving perception will likely cause the markets to remain unstable until the end of the crisis, which will be indicated with the widespread release of a cure and/or inoculation, which is currently projected as being during the Summer of 2021. As such, ***we expect to see a continuation of the volatility that has been observed over the past 30 days for at least the next year.*** Further, ***it is too soon to determine the trend of the markets during this crisis*** given the volatility that we have seen.



Other Commentary

- "The S&P 500 suffered its fastest-ever 10% decline from an all-time high. The Dow Jones Industrial Average just had its worst week since the start of the 2008 global financial crisis. Shares of manufacturers, banks and utilities alike have dropped by double digits." (per https://www.wsj.com/articles/the-week-that-wiped-3-4-trillion-off-the-stock-market-11582891223; Feb. 29, 2020)
- "Investors have grown increasingly pessimistic that efforts to stop the spread of the virus will prevent significant damage to the global economy. Some U.S. companies

say they could lose as much as half their annual revenue from China if the coronavirus epidemic extends through the summer. American businesses will generate no earnings growth in 2020 if the virus becomes widespread, Goldman Sachs Group's equity analysts warned on Thursday." (from https://www.wsj.com/articles/global-stocks-extend-declines-as-coronavirus-concerns-mount-11582784087; Feb. 27, 2020)

Regression Analyses

The following section document the linear regression coefficients found for each of the aforementioned variables, as a function of other variables (which are not significantly correlated with the control variable). With this report, we have also included the natural log of all variables as experimental (dependent) variables; these variables are denoted by a "LN_" prefix below.

To compare the effectiveness of these regressions, we calculate the percentage error between the forecasted value (based on the given regression, using the values from the immediately preceding quarter) and the actual value for the period between 4Q2005 and 4Q2019, inclusive.

Table 4: Regression Aggregate Errors for 4Q2005 through 4Q2019

Variable	Min Abs. Error	Average Error	Max Abs. Error
Real GDP Growth	3.62%	**	***
Nominal GDP Growth	***	***	***
Real Disposable Income Growth	0.69%	-30.91%	***
Nominal Disposable Income Growth	0.70%	-8.69%	453.78%
Inflation	2.25%	-314.99%	***
Unemployment Rate	0.35%	43.24%	625.26%
1-month Treasury Yield	3.42%	**	***
3-month Treasury Yield	0.52%	0.99%	404.58%
6-month Treasury Yield	0.76%	7.17%	127.62%
1-year Treasury Yield	16.24%	**	***
3-year Treasury Yield	0.07%	10.70%	142.99%
5-year Treasury Yield	64.78%	321.68%	754.81%
7-year Treasury Yield	1.29%	26.49%	186.25%
10-year Treasury Yield	0.36%	-4.60%	118.01%
20-year Treasury Yield	4.41%	22.95%	94.73%
30-year Treasury Yield	0.13%	9.96%	41.00%
30-year Mortgage Rate	0.01%	-4.24%	50.78%
Moody's AAA Curve	0.32%	1.29%	37.19%
Moody's BAA Curve	0.12%	-6.87%	31.22%
BBB Corporate Yield	3.86%	-25.50%	53.24%
Prime Rate	0.41%	-0.05%	24.22%
US Average Retail Gasoline Price	0.91%	55.38%	218.95%
Cost of Federal Funds	1.64%	-34.16%	277.55%

Dow Jones Total Stock Market Index	0.39%	7.73%	85.57%
S&P 500 Stock Price Index	2.34%	-44.28%	387.46%
Commercial Real Estate Price Index	0.04%	-11.19%	56.62%
Residential Home Price Index	11.21%	82.73%	141.51%
Market Volatility Index	0.11%	29.80%	236.61%

** The indicated value has a percentage error less than -1000%.

*** The indicated value has a percentage error greater than 1000%.

Real & Nominal GDP Growth, Real & Nominal Disposable Income Growth, and CPI Inflation Rate

Regression For Real GDP Growth

	Dependent variable (+/- SE):
	Real GDP growth
Constant	-11.970 (+/- 10.284)
	p = 0.260
US Fed Reserve O-N Loan Rate	74.486 (+/- 11.202)
	p = 0.00001***
Real disposable income growth	5.460 (+/- 1.180)
	p = 0.0003***
Nominal disposable income growth	-5.413 (+/- 1.137)
	p = 0.0002***
CPI Inflation Rate	5.022 (+/- 0.960)
	p = 0.0001***
BBB corporate yield	9.671 (+/- 1.513)
	p = 0.00001***
Home Price Index	-0.278 (+/- 0.068)
	p = 0.001***
Commercial Real Estate Price Index	0.209 (+/- 0.048)
	p = 0.0004***
LN_30-year Treasury Yield	-116.854 (+/- 15.475)
	p = 0.00000***
LN_20-year Treasury Yield	66.729 (+/- 16.201)
	p = 0.001***
10-year Treasury Yield	132.922 (+/- 21.399)
	p = 0.00001***
LN_10-year Treasury Yield	-203.481 (+/- 43.890)

	p = 0.0003***
1-month Treasury Yield	-117.040 (+/- 17.591)
	p = 0.00001***
LN_1-month Treasury Yield	3.906 (+/- 0.600)
	p = 0.00001***
7-year Treasury Yield	-214.704 (+/- 33.459)
	p = 0.00001***
LN_7-year Treasury Yield	323.855 (+/- 59.631)
	p = 0.00004***
3-month Treasury Yield	34.117 (+/- 7.670)
	p = 0.0004***
5-year Treasury Yield	103.846 (+/- 17.378)
	p = 0.00002***
LN_5-year Treasury Yield	-212.244 (+/- 35.017)
	p = 0.00001***
LN_3-year Treasury Yield	64.058 (+/- 9.439)
	p = 0.00001***
1-year Treasury Yield	13.498 (+/- 4.442)
	p = 0.008***
LN_1-year Treasury Yield	-26.408 (+/- 3.601)
	p = 0.00000***
Observations	40
R^2	0.889
Adjusted R^2	0.760
Residual Std. Error	0.716 (df = 18)
F Statistic	6.874*** (df = 21; 18)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For Nominal GDP Growth

	Dependent variable (+/- SE):
	Nominal GDP growth
Constant	52.844 (+/- 13.707)
	p = 0.002***
US Fed Reserve O-N Loan Rate	54.338 (+/- 9.034)
	p = 0.00001***
Moody's AAA Curve	-10.183 (+/- 2.078)
	p = 0.0001***
Moody's BAA Curve	5.781 (+/- 1.642)
	p = 0.003***
Home Price Index	-0.694 (+/- 0.089)
	p = 0.00000***
Commercial Real Estate Price Index	0.291 (+/- 0.050)
	p = 0.00002***
Market Volatility Index	0.495 (+/- 0.131)
	p = 0.002***
LN_Market Volatility Index	-11.290 (+/- 3.470)
	p = 0.005***
20-year Treasury Yield	-127.949 (+/- 18.527)
	p = 0.00001***
LN_20-year Treasury Yield	349.497 (+/- 56.001)
	p = 0.00001***
10-year Treasury Yield	246.490 (+/- 32.824)
	p = 0.00000***
LN_10-year Treasury Yield	-557.984 (+/- 81.734)
	p = 0.00001***
1-month Treasury Yield	-56.209 (+/- 10.065)
	p = 0.00003***

LN_1-month Treasury Yield	4.937 (+/- 0.726)
	p = 0.00001***
7-year Treasury Yield	-140.165 (+/- 18.650)
	p = 0.00000***
LN_7-year Treasury Yield	286.482 (+/- 41.653)
	p = 0.00001***
LN_5-year Treasury Yield	-38.416 (+/- 10.256)
	p = 0.002***
6-month Treasury Yield	-41.720 (+/- 12.094)
	p = 0.003***
LN_3-year Treasury Yield	21.318 (+/- 5.955)
	p = 0.002***
1-year Treasury Yield	65.348 (+/- 10.903)
	p = 0.00001***
LN_1-year Treasury Yield	-22.451 (+/- 3.054)
	p = 0.00000***
Observations	40
R^2	0.873
Adjusted R^2	0.740
Residual Std. Error	0.901 (df = 19)
F Statistic	6.556*** (df = 20; 19)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For Real Disposable Income Growth

	Dependent variable (+/- SE):
	Real disposable income growth
Constant	-0.015 (+/- 2.724)
	p = 0.996
10-year Treasury Yield	1.151 (+/- 1.087)
	p = 0.297
Observations	40
R^2	0.029
Adjusted R^2	0.003
Residual Std. Error	3.790 (df = 38)
F Statistic	1.122 (df = 1; 38)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For Nominal Disposable Income Growth

	Dependent variable (+/- SE):
	Nominal disposable income growth
Constant	0.474 (+/- 2.839)
	p = 0.869
10-year Treasury Yield	1.593 (+/- 1.133)
	p = 0.168
Observations	40
R^2	0.049
Adjusted R^2	0.024
Residual Std. Error	3.950 (df = 38)
F Statistic	1.978 (df = 1; 38)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For CPI Inflation Rate

	Dependent variable (+/- SE):
	CPI Inflation Rate
Constant	4.060 (+/- 1.343)
	p = 0.008***
US Fed Reserve O-N Loan Rate	-12.960 (+/- 1.020)
	p = 0.000***
Real GDP growth	0.120 (+/- 0.023)
	p = 0.0001***
Real disposable income growth	-1.138 (+/- 0.031)
	p = 0.000***
Nominal disposable income growth	1.115 (+/- 0.028)
	p = 0.000***
BBB corporate yield	-1.665 (+/- 0.158)
	p = 0.000***
Home Price Index	0.050 (+/- 0.009)
	p = 0.00002***
Commercial Real Estate Price Index	-0.040 (+/- 0.005)
	p = 0.00000***
LN_30-year Treasury Yield	17.784 (+/- 2.509)
	p = 0.00001***
LN_20-year Treasury Yield	-10.266 (+/- 2.517)
	p = 0.001***
10-year Treasury Yield	-23.520 (+/- 1.922)
	p = 0.000***
LN_10-year Treasury Yield	38.453 (+/- 4.351)
	p = 0.00000***
1-month Treasury Yield	20.686 (+/- 1.352)
	p = 0.000***

LN_1-month Treasury Yield	-0.641 (+/- 0.078)
	p = 0.00000***
7-year Treasury Yield	36.768 (+/- 3.594)
	p = 0.000***
LN_7-year Treasury Yield	-58.241 (+/- 5.995)
	p = 0.000***
3-month Treasury Yield	-6.487 (+/- 0.784)
	p = 0.00000***
5-year Treasury Yield	-17.890 (+/- 1.941)
	p = 0.00000***
LN_5-year Treasury Yield	38.034 (+/- 2.968)
	p = 0.000***
LN_3-year Treasury Yield	-11.024 (+/- 0.912)
	p = 0.000***
1-year Treasury Yield	-2.127 (+/- 0.680)
	p = 0.006***
LN_1-year Treasury Yield	4.446 (+/- 0.372)
	p = 0.000***
Observations	40
R^2	0.997
Adjusted R^2	0.994
Residual Std. Error	0.111 (df = 18)
F Statistic	301.153*** (df = 21; 18)
Note:	*p<0.1; **p<0.05; ***p<0.01

Unemployment Rate

Regression For Unemployment Rate

	Dependent variable (+/- SE):
	Unemployment Rate
Constant	16.209 (+/- 0.950)
	p = 0.000***
Dow Total Stock Market Index	-0.0001 (+/- 0.00003)
	p = 0.001***
Commercial Real Estate Price Index	-0.026 (+/- 0.005)
	p = 0.00001***
30-year Treasury Yield	-5.659 (+/- 0.848)
	p = 0.00000***
20-year Treasury Yield	7.075 (+/- 0.969)
	p = 0.00000***
1-month Treasury Yield	0.793 (+/- 0.285)
	p = 0.010***
7-year Treasury Yield	-1.825 (+/- 0.313)
	p = 0.00001***
1-year Treasury Yield	-1.177 (+/- 0.330)
	p = 0.002***
LN_1-year Treasury Yield	0.561 (+/- 0.095)
	p = 0.00001***
Observations	40
R^2	0.994
Adjusted R^2	0.993
Residual Std. Error	0.177 (df = 31)
F Statistic	671.015*** (df = 8; 31)
Note:	*p<0.1; **p<0.05; ***p<0.01

Treasury Yields (1, 3, & 6-month; 1, 3, 5, 7, 10, 20, & 30-year series)

Regression For 1-Month Treasury Yield

	Dependent variable (+/- SE):
	1-month Treasury Yield
Constant	-1.870 (+/- 0.163)
	p = 0.000***
Moody's AAA Curve	-0.128 (+/- 0.025)
	p = 0.00004***
Moody's BAA Curve	0.092 (+/- 0.021)
	p = 0.0002***
Real disposable income growth	0.077 (+/- 0.010)
	p = 0.00000***
Nominal disposable income growth	-0.073 (+/- 0.010)
	p = 0.00000***
CPI Inflation Rate	0.047 (+/- 0.007)
	p = 0.00001***
Prime Rate	0.526 (+/- 0.047)
	p = 0.000***
US Avg Retail Gasoline Price ($-gal; all grades, all formulations)	0.064 (+/- 0.013)
	p = 0.00005***
10-year Treasury Yield	0.999 (+/- 0.208)
	p = 0.0001***
LN_10-year Treasury Yield	-2.438 (+/- 0.511)
	p = 0.0001***
7-year Treasury Yield	-1.518 (+/- 0.364)
	p = 0.0004***
LN_7-year Treasury Yield	3.134 (+/- 0.709)
	p = 0.0002***

3-month Treasury Yield	0.484 (+/- 0.047)
	p = 0.000***
5-year Treasury Yield	0.709 (+/- 0.188)
	p = 0.001***
LN_5-year Treasury Yield	-1.090 (+/- 0.279)
	p = 0.001***
Observations	40
R^2	1.000
Adjusted R^2	1.000
Residual Std. Error	0.016 (df = 25)
F Statistic	7,106.454*** (df = 14; 25)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For 3-Month Treasury Yield

	Dependent variable (+/- SE):
	3-month Treasury Yield
Constant	0.019 (+/- 0.019)
	p = 0.310
Real disposable income growth	-0.048 (+/- 0.015)
	p = 0.004***
Nominal disposable income growth	0.046 (+/- 0.015)
	p = 0.004***
CPI Inflation Rate	-0.034 (+/- 0.012)
	p = 0.007***
1-month Treasury Yield	0.544 (+/- 0.049)
	p = 0.000***
7-year Treasury Yield	-0.028 (+/- 0.010)
	p = 0.008***
6-month Treasury Yield	0.454 (+/- 0.047)
	p = 0.000***
Observations	40
R^2	0.999
Adjusted R^2	0.999
Residual Std. Error	0.028 (df = 33)
F Statistic	5,025.372*** (df = 6; 33)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For 6-Month Treasury Yield

	Dependent variable (+/- SE):
	6-month Treasury Yield
Constant	0.052 (+/- 0.034)
	p = 0.130
10-year Treasury Yield	-0.111 (+/- 0.025)
	p = 0.0001***
3-month Treasury Yield	0.933 (+/- 0.017)
	p = 0.000***
5-year Treasury Yield	0.209 (+/- 0.032)
	p = 0.00000***
Observations	40
R^2	0.997
Adjusted R^2	0.997
Residual Std. Error	0.046 (df = 36)
F Statistic	4,160.847*** (df = 3; 36)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For 1-Year Treasury Yield

	Dependent variable (+/- SE):
	1-year Treasury Yield
Constant	-0.464 (+/- 0.280)
	p = 0.108
US Avg Retail Gasoline Price ($-gal; all grades, all formulations)	-0.120 (+/- 0.041)
	p = 0.006***
30-year Treasury Yield	-1.697 (+/- 0.360)
	p = 0.00005***
LN_30-year Treasury Yield	4.606 (+/- 1.169)
	p = 0.0004***
10-year Treasury Yield	1.291 (+/- 0.340)
	p = 0.001***
LN_10-year Treasury Yield	-2.242 (+/- 0.779)
	p = 0.007***
3-month Treasury Yield	0.907 (+/- 0.031)
	p = 0.000***
Observations	40
R^2	0.990
Adjusted R^2	0.988
Residual Std. Error	0.088 (df = 33)
F Statistic	552.753*** (df = 6; 33)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For 3-Year Treasury Yield

	Dependent variable (+/- SE):
	3-year Treasury Yield
Constant	-0.521 (+/- 0.263)
	p = 0.056*
Unemployment Rate	-0.217 (+/- 0.030)
	p = 0.00000***
BBB corporate yield	0.365 (+/- 0.106)
	p = 0.002***
30-year Treasury Yield	0.382 (+/- 0.108)
	p = 0.002***
3-month Treasury Yield	0.510 (+/- 0.059)
	p = 0.000***
Observations	40
R^2	0.931
Adjusted R^2	0.923
Residual Std. Error	0.191 (df = 35)
F Statistic	118.102*** (df = 4; 35)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For 5-Year Treasury Yield

	Dependent variable (+/- SE):
	5-year Treasury Yield
Constant	0.407 (+/- 0.267)
	p = 0.138
Nominal GDP growth	0.049 (+/- 0.014)
	p = 0.002***
Real disposable income growth	0.124 (+/- 0.024)
	p = 0.00002***
Nominal disposable income growth	-0.106 (+/- 0.023)
	p = 0.0001***
Unemployment Rate	-0.182 (+/- 0.025)
	p = 0.00000***
30-year Treasury Yield	2.316 (+/- 0.376)
	p = 0.00000***
LN_30-year Treasury Yield	-4.757 (+/- 1.233)
	p = 0.001***
1-month Treasury Yield	-1.210 (+/- 0.257)
	p = 0.00005***
6-month Treasury Yield	1.537 (+/- 0.260)
	p = 0.00001***
Observations	40
R^2	0.953
Adjusted R^2	0.941
Residual Std. Error	0.140 (df = 31)
F Statistic	79.072*** (df = 8; 31)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For 7-Year Treasury Yield

	Dependent variable (+/- SE):
	7-year Treasury Yield
Constant	-3.446 (+/- 0.555)
	p = 0.00000***
SP500 Stock Price Index	0.001 (+/- 0.0001)
	p = 0.00000***
BBB corporate yield	1.014 (+/- 0.104)
	p = 0.000***
Observations	40
R^2	0.728
Adjusted R^2	0.713
Residual Std. Error	0.288 (df = 37)
F Statistic	49.488*** (df = 2; 37)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For 10-Year Treasury Yield

	Dependent variable (+/- SE):
	10-year Treasury Yield
Constant	-1.612 (+/- 0.149)
	p = 0.000***
Real GDP growth	0.027 (+/- 0.008)
	p = 0.002***
Real disposable income growth	0.042 (+/- 0.011)
	p = 0.0005***
Nominal disposable income growth	-0.031 (+/- 0.010)
	p = 0.006***
Dow Total Stock Market Index	0.00003 (+/- 0.00000)
	p = 0.00000***
30-year Treasury Yield	1.051 (+/- 0.028)
	p = 0.000***
6-month Treasury Yield	-0.568 (+/- 0.182)
	p = 0.005***
LN_6-month Treasury Yield	-0.248 (+/- 0.066)
	p = 0.001***
1-year Treasury Yield	0.654 (+/- 0.199)
	p = 0.003***
LN_1-year Treasury Yield	0.360 (+/- 0.087)
	p = 0.0003***
Observations	40
R^2	0.989
Adjusted R^2	0.986
Residual Std. Error	0.066 (df = 30)
F Statistic	308.999*** (df = 9; 30)

Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For 20-Year Treasury Yield

	Dependent variable (+/- SE):
	20-year Treasury Yield
Constant	-3.621 (+/- 0.982)
	p = 0.001***
SP500 Stock Price Index	0.001 (+/- 0.0003)
	p = 0.0004***
Unemployment Rate	0.368 (+/- 0.075)
	p = 0.00003***
BBB corporate yield	0.956 (+/- 0.103)
	p = 0.000***
LN_Market Volatility Index	-0.538 (+/- 0.149)
	p = 0.001***
Observations	40
R^2	0.854
Adjusted R^2	0.837
Residual Std. Error	0.252 (df = 35)
F Statistic	51.029*** (df = 4; 35)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For 30-Year Treasury Yield

	Dependent variable (+/- SE):
	30-year Treasury Yield
Constant	0.490 (+/- 0.088)
	p = 0.00001***
10-year Treasury Yield	1.317 (+/- 0.036)
	p = 0.000***
LN_5-year Treasury Yield	-0.650 (+/- 0.100)
	p = 0.00000***
3-year Treasury Yield	-0.195 (+/- 0.043)
	p = 0.0001***
Observations	40
R^2	0.986
Adjusted R^2	0.984
Residual Std. Error	0.076 (df = 36)
F Statistic	817.318*** (df = 3; 36)
Note:	*p<0.1; **p<0.05; ***p<0.01

30-year Mortgage Rate

Regression For 30-Year Mortgage Rate

	Dependent variable (+/- SE):
	30-year Mortgage Rate
Constant	1.446 (+/- 0.148)
	p = 0.000***
30-year Treasury Yield	0.674 (+/- 0.036)
	p = 0.000***
LN_1-month Treasury Yield	-0.090 (+/- 0.028)
	p = 0.004***
1-year Treasury Yield	0.437 (+/- 0.060)
	p = 0.000***
Observations	40
R^2	0.917
Adjusted R^2	0.910
Residual Std. Error	0.126 (df = 36)
F Statistic	132.572*** (df = 3; 36)
Note:	*p<0.1; **p<0.05; ***p<0.01

Moody's AAA & BAA Rates

Regression For Moody's AAA Curve

	Dependent variable (+/- SE):
	Moody's AAA Curve
Constant	0.901 (+/- 0.380)
	p = 0.024**
Unemployment Rate	0.096 (+/- 0.026)
	p = 0.001***
BBB corporate yield	0.609 (+/- 0.105)
	p = 0.00001***
Observations	40
R^2	0.737
Adjusted R^2	0.723
Residual Std. Error	0.283 (df = 37)
F Statistic	51.916*** (df = 2; 37)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For Moody's BAA Curve

	Dependent variable (+/- SE):
	Moody's BAA Curve
Constant	4.546 (+/- 0.812)
	p = 0.00001***
SP500 Stock Price Index	-0.001 (+/- 0.0002)
	p = 0.00004***
BBB corporate yield	0.465 (+/- 0.168)
	p = 0.010***
Prime Rate	0.452 (+/- 0.116)
	p = 0.0005***
5-year Treasury Yield	-1.322 (+/- 0.362)
	p = 0.001***
LN_5-year Treasury Yield	2.006 (+/- 0.517)
	p = 0.0005***
Observations	40
R^2	0.868
Adjusted R^2	0.849
Residual Std. Error	0.228 (df = 34)
F Statistic	44.698*** (df = 5; 34)
Note:	*p<0.1; **p<0.05; ***p<0.01

BBB Corporate Yield

Regression For BBB Corporate Yield

	Dependent variable (+/- SE):
	BBB corporate yield
Constant	0.650 (+/- 0.277)
	p = 0.026**
Moody's AAA Curve	-0.894 (+/- 0.189)
	p = 0.00005***
Moody's BAA Curve	1.001 (+/- 0.131)
	p = 0.00000***
Real GDP growth	0.131 (+/- 0.035)
	p = 0.001***
Nominal GDP growth	-0.107 (+/- 0.030)
	p = 0.002***
Market Volatility Index	0.010 (+/- 0.003)
	p = 0.003***
1-month Treasury Yield	-0.448 (+/- 0.157)
	p = 0.008***
LN_7-year Treasury Yield	2.671 (+/- 0.296)
	p = 0.000***
LN_3-year Treasury Yield	-0.983 (+/- 0.146)
	p = 0.00000***
1-year Treasury Yield	0.653 (+/- 0.184)
	p = 0.002***
Observations	40
R^2	0.945
Adjusted R^2	0.929
Residual Std. Error	0.140 (df = 30)

F Statistic	57.482*** (df = 9; 30)
Note:	*p<0.1; **p<0.05; ***p<0.01

Prime Rate

Regression For Prime Rate

	Dependent variable (+/- SE):
	Prime Rate
Constant	3.043 (+/- 0.019)
	p = 0.000***
US Fed Reserve O-N Loan Rate	1.039 (+/- 0.013)
	p = 0.000***
LN_1-month Treasury Yield	-0.041 (+/- 0.006)
	p = 0.00000***
Observations	40
R^2	0.999
Adjusted R^2	0.999
Residual Std. Error	0.028 (df = 37)
F Statistic	13,693.720*** (df = 2; 37)
Note:	*p<0.1; **p<0.05; ***p<0.01

US Average Retail Gasoline Price

Regression For US Avg Retail Gasoline Price (-Gal; All Grades, All Formulations)

	Dependent variable (+/- SE):
	US Avg Retail Gasoline Price ($-gal; all grades, all formulations)
Constant	-3.026 (+/- 0.671)
	p = 0.0001***
SP500 Stock Price Index	0.001 (+/- 0.0002)
	p = 0.00002***
Nominal GDP growth	0.065 (+/- 0.017)
	p = 0.001***
20-year Treasury Yield	0.934 (+/- 0.149)
	p = 0.00000***
LN_1-month Treasury Yield	-0.156 (+/- 0.043)
	p = 0.002***
5-year Treasury Yield	1.831 (+/- 0.469)
	p = 0.0005***
LN_5-year Treasury Yield	-4.050 (+/- 0.544)
	p = 0.00000***
6-month Treasury Yield	2.012 (+/- 0.610)
	p = 0.003***
1-year Treasury Yield	-2.144 (+/- 0.705)
	p = 0.005***
Observations	40
R^2	0.907
Adjusted R^2	0.883
Residual Std. Error	0.182 (df = 31)
F Statistic	37.831*** (df = 8; 31)
Note:	*p<0.1; **p<0.05; ***p<0.01

Cost of Federal Funds (Primary Credit Rate)

Regression For US Fed Reserve O-N Loan Rate

	Dependent variable (+/- SE):
	US Fed Reserve O-N Loan Rate
Constant	-2.283 (+/- 0.161)
	p = 0.000***
Moody's BAA Curve	-0.048 (+/- 0.015)
	p = 0.004***
Unemployment Rate	0.042 (+/- 0.009)
	p = 0.0001***
Prime Rate	0.717 (+/- 0.047)
	p = 0.000***
30-year Treasury Yield	0.549 (+/- 0.113)
	p = 0.00004***
20-year Treasury Yield	-0.638 (+/- 0.118)
	p = 0.00001***
3-month Treasury Yield	0.327 (+/- 0.043)
	p = 0.000***
LN_5-year Treasury Yield	0.249 (+/- 0.043)
	p = 0.00001***
Observations	40
R^2	0.999
Adjusted R^2	0.999
Residual Std. Error	0.022 (df = 32)
F Statistic	6,933.790*** (df = 7; 32)
Note:	*p<0.1; **p<0.05; ***p<0.01

Dow Jones Total Stock Market Index (end-of-quarter) and S&P 500 (quarterly average)

Regression For Dow Total Stock Market Index

	Dependent variable (+/- SE):
	Dow Total Stock Market Index
Constant	37,777.000 (+/- 1,416.742)
	p = 0.000***
Unemployment Rate	-1,956.383 (+/- 122.724)
	p = 0.000***
Market Volatility Index	-94.068 (+/- 19.619)
	p = 0.00004***
1-month Treasury Yield	2,833.820 (+/- 380.598)
	p = 0.000***
5-year Treasury Yield	-4,418.636 (+/- 1,522.591)
	p = 0.007***
LN_5-year Treasury Yield	6,922.194 (+/- 2,189.547)
	p = 0.004***
Observations	40
R^2	0.979
Adjusted R^2	0.976
Residual Std. Error	967.940 (df = 34)
F Statistic	312.070*** (df = 5; 34)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For S&P500 Stock Price Index

	Dependent variable (+/- SE):
	SP500 Stock Price Index
Constant	3,912.931 (+/- 186.023)
	p = 0.000***
BBB corporate yield	-345.513 (+/- 61.505)
	p = 0.00001***
10-year Treasury Yield	-2,101.816 (+/- 335.865)
	p = 0.00000***
7-year Treasury Yield	3,138.945 (+/- 719.425)
	p = 0.0002***
5-year Treasury Yield	-1,953.160 (+/- 468.519)
	p = 0.0003***
LN_5-year Treasury Yield	2,171.515 (+/- 411.861)
	p = 0.00001***
LN_3-year Treasury Yield	-729.858 (+/- 227.090)
	p = 0.003***
1-year Treasury Yield	567.092 (+/- 69.722)
	p = 0.000***
Observations	40
R^2	0.976
Adjusted R^2	0.971
Residual Std. Error	100.237 (df = 32)
F Statistic	187.380*** (df = 7; 32)
Note:	*p<0.1; **p<0.05; ***p<0.01

House and Commercial Real Estate Price Indexes

Regression For Home Price Index

	Dependent variable (+/- SE):
	Home Price Index
Constant	239.779 (+/- 5.616)
	p = 0.000***
Unemployment Rate	-11.125 (+/- 0.470)
	p = 0.000***
30-year Treasury Yield	35.706 (+/- 7.486)
	p = 0.00004***
LN_30-year Treasury Yield	-105.836 (+/- 24.391)
	p = 0.0002***
3-month Treasury Yield	8.141 (+/- 0.901)
	p = 0.000***
Observations	40
R^2	0.989
Adjusted R^2	0.988
Residual Std. Error	2.966 (df = 35)
F Statistic	771.266*** (df = 4; 35)
Note:	*p<0.1; **p<0.05; ***p<0.01

Regression For Commercial Real Estate Price Index

	Dependent variable (+/- SE):
	Commercial Real Estate Price Index
Constant	417.381 (+/- 14.059)
	p = 0.000***
US Fed Reserve O-N Loan Rate	-87.037 (+/- 27.939)
	p = 0.005***
Unemployment Rate	-18.662 (+/- 1.048)
	p = 0.000***
BBB corporate yield	-13.896 (+/- 3.347)
	p = 0.0003***
1-month Treasury Yield	132.120 (+/- 29.107)
	p = 0.0001***
LN_1-month Treasury Yield	-6.648 (+/- 1.608)
	p = 0.0003***
LN_5-year Treasury Yield	75.260 (+/- 19.407)
	p = 0.001***
LN_3-year Treasury Yield	-58.176 (+/- 16.866)
	p = 0.002***
1-year Treasury Yield	-58.047 (+/- 8.642)
	p = 0.00000***
LN_1-year Treasury Yield	39.398 (+/- 6.321)
	p = 0.00000***
Observations	40
R^2	0.994
Adjusted R^2	0.992
Residual Std. Error	4.329 (df = 30)
F Statistic	511.244*** (df = 9; 30)

Note:	*p<0.1; **p<0.05; ***p<0.01

Market Volatility Index

Regression For Market Volatility Index

	Dependent variable (+/- SE):
	Market Volatility Index
Constant	-12.161 (+/- 9.870)
	p = 0.226
BBB corporate yield	8.716 (+/- 2.313)
	p = 0.001***
Observations	40
R^2	0.272
Adjusted R^2	0.253
Residual Std. Error	7.564 (df = 38)
F Statistic	14.194*** (df = 1; 38)
Note:	*p<0.1; **p<0.05; ***p<0.01

Appendix A: Data Sources

The following table lists the attributes provided by Capitalytics as part of its macro-economic forecast service. The sources for data that are defined by the document "2020 Supervisory Scenarios for Annual Stress Tests Required under the Dodd-Frank Act Stress Testing Rules and the Capital Plan Rule" (found at https://www.federalreserve.gov/newsevents/pressreleases/files/bcreg20200206a1.pdf) are listed. Please note that shaded attributes are not discussed within this report.

Table 5: Data Values and Referenced Sources

Attribute	Referenced Source[46]
Real GDP growth	Bureau of Economic Analysis (NIPA table 1.1.6, line 1)
Nominal GDP growth	Bureau of Economic Analysis (NIPA table 1.1.5, line 1)
Real disposable income growth	Bureau of Economic Analysis (NIPA table 2.1, line 27, and NIPA table 1.1.4, line 2)
Nominal disposable income growth	Bureau of Economic Analysis (NIPA table 2.1, line 27)
Unemployment rate	Bureau of Labor Statistics (series LNS14000000)
CPI inflation rate	Bureau of Labor Statistics (series CUSR0000SA0)
3-month Treasury yield	Quarterly average of 3-month Treasury bill secondary market rate on a discount basis, H.15 Release, Selected Interest Rates, Federal Reserve Board (series RIFSGFSM03_N.B)
5-year Treasury yield	Quarterly average of the yield on 5-year U.S. Treasury bonds, constructed for the FRB/U.S. model by Federal Reserve staff based on the Svensson smoothed term structure model; see Lars E. O. Svensson (1995), "Estimating Forward Interest Rates with the Extended Nelson-Siegel Method," Quarterly Review, no. 3, Sveriges Riksbank, pp. 13-26

[46] Per https://www.federalreserve.gov/newsevents/pressreleases/files/bcreg20190213a1.pdf

10-year Treasury yield	Quarterly average of the yield on 10-year U.S. Treasury bonds, constructed for the FRB/U.S. model by Federal Reserve staff based on the Svensson smoothed term structure model; see Lars E. O. Svensson (1995), "Estimating Forward Interest Rates with the Extended Nelson-Siegel Method," Quarterly Review, no. 3, Sveriges Riksbank, pp. 13-26
BBB corporate yield	Merrill Lynch 10-year BBB corporate bond yield, Z.1 Release (Financial Accounts of the United States), Federal Reserve Board (series FL073163013.Q).[47]
Mortgage rate	Quarterly average of weekly series for the interest rate of a conventional, conforming, 30-year fixed-rate mortgage, obtained from the Primary Mortgage Market Survey of the Federal Home Loan Mortgage Corporation.
Prime rate	Quarterly average of monthly series, H.15 Release, Selected Interest Rates, Federal Reserve Board (series RIFSPBLP_N.M).
Dow Jones Total Stock Market Index (end-of-qtr value)	Dow-Jones
House Price Index	Price Index for Owner-Occupied Real Estate, CoreLogic National, Z.1 Release (Financial Accounts of the United States), Federal Reserve Board (series FL075035243.Q).
Commercial Real Estate Price Index	Commercial Real Estate Price Index, Z.1 Release (Financial Accounts of the United States), Federal Reserve Board (series FL075035503.Q divided by 1000).
Market Volatility Index (VIX)	VIX converted to quarterly frequency using the maximum close-of-day value in any quarter, Chicago Board Options Exchange.

[47] The Merrill Lynch 10-year BBB corporate bond rate is being discontinued from future Z.1 releases as of April 30, 2019 due to licensing restrictions.

Euro Area Real GDP Growth	Percent change in real gross domestic product at an annualized rate, staff calculations based on Statistical Office of the European Communities via Haver, extended back using ECB Area Wide Model dataset (ECB Working Paper series no. 42).
Euro Area Inflation	Percent change in the quarterly average of the harmonized index of consumer prices 16 Federal Reserve Supervisory Scenarios at an annualized rate, staff calculations based on Statistical Office of the European Communities via Haver.
Euro Area Bilateral Dollar Exchange Rate (USD/Euro)	End-of-quarter rates from the H.10 Release, Foreign Exchange Rates, Federal Reserve Board.
Developing Asia Real GDP Growth	Percent change in real gross domestic product at an annualized rate, staff calculations based on Bank of Korea via Haver; Chinese National Bureau of Statistics via CEIC; Indian Central Statistical Organization via CEIC; Census and Statistics Department of Hong Kong via CEIC; and Taiwan Directorate-General of Budget, Accounting, and Statistics via CEIC.
Developing Asia Inflation	Percent change in the quarterly average of the consumer price index, or local equivalent, at an annualized rate, staff calculations based on Chinese National Bureau of Statistics via CEIC; Indian Ministry of Statistics and Programme Implementation via Haver; Labour Bureau of India via CEIC; National Statistical Office of Korea via CEIC; Census and Statistic Department of Hong Kong via CEIC; and Taiwan Directorate General of Budget, Accounting, and Statistics via CEIC.
Developing Asia bilateral dollar exchange rate (F/USD, index)	End-of-quarter rates from the H.10 Release, Foreign Exchange Rates, Federal Reserve Board.
Japan Real GDP Growth	Percent change in gross domestic product at an annualized rate, Cabinet Office via Haver.

Japan Inflation	Percent change in the quarterly average of the consumer price index at an annualized rate, staff calculations based on Ministry of Internal Affairs and Communications via Haver.
Japan Bilateral Dollar Exchange Rate (Yen/USD)	End-of-quarter rates from the H.10 Release, Foreign Exchange Rates, Federal Reserve Board.
UK Real GDP Growth	Percent change in gross domestic product at an annualized rate, Office for National Statistics via Haver.
UK Inflation	Percent change in the quarterly average of the consumer price index at an annualized rate, staff calculations based on Office for National Statistics via Haver.
UK Bilateral Dollar Exchange Rate (USD/Pound)	End-of-quarter rates from the H.10 Release, Foreign Exchange Rates, Federal Reserve Board.

The above dataset from the Federal Reserve can be downloaded manually or automatically. Manual downloads are available at https://www.federalreserve.gov/supervisionreg/ccar-2020.htm (shown below, as of Feb 2020) by clicking the link marked "Historical data (ZIP)". Alternatively, downloading the file at https://www.federalreserve.gov/supervisionreg/files/2020-historical-data.zip using HTTP client software will also download the official dataset.

Decompressing the zip-file will provide two files in CVS format: one containing US domestic data elements on a quarterly basis, and the other containing international data elements on a quarterly basis[48].

[48] Again, due to the requirements of this client, international data elements are not being discussed in this document.

Since the CCAR dataset is only released annually (through 4Q2019 as of this writing), and Capitalytics provides quarterly updates to its forecasts, the CCAR dataset is supplemented by the data sources shown below on a quarterly basis. All datasets discussed herein are supplemented with data through (including) 4Q2019.

Table 6: Supplementary Data Sources for Data Attributes

Attribute	Supplementary Data Source
Real GDP growth	Bureau of Economic Analysis (NIPA table 1.1.6, line 1)
Nominal GDP growth	Bureau of Economic Analysis (NIPA table 1.1.5, line 1)
Real disposable income growth	Bureau of Economic Analysis (NIPA table 2.1, line 27, and NIPA table 1.1.4, line 2)
Nominal disposable income growth	Bureau of Economic Analysis (NIPA table 2.1, line 27)
Unemployment rate	Bureau of Labor Statistics (series LNS14000000)
CPI inflation rate	Bureau of Labor Statistics (series CUSR0000SA0)
3-month Treasury yield	Quarterly average of 3-month Treasury bill secondary market rate on a discount basis, H.15 Release

5-year Treasury yield	Federal Reserve Economic Research website (https://fred.stlouisfed.org/series/GS5), with "Quarterly" frequency and "Average" aggregation method
10-year Treasury yield	Federal Reserve Economic Research website (https://fred.stlouisfed.org/series/GS10), with "Quarterly" frequency and "Average" aggregation method
BBB corporate yield	Federal Reserve Economic Research website (https://fred.stlouisfed.org/series/BAMLC0A4CBBBEY), with "Quarterly" frequency and "Average" aggregation method
Mortgage rate	Federal Reserve Economic Research website (https://fred.stlouisfed.org/series/MORTGAGE30US), with "Quarterly" frequency and "Average" aggregation method
Prime rate	Federal Reserve Economic Research website (https://fred.stlouisfed.org/series/MPRIME), with "Quarterly" frequency and "Average" aggregation method
Dow Jones Total Stock Market Index (end-of-qtr value)	Dow-Jones as provided by the Wall Street Journal (https://quotes.wsj.com/index/DWCF/advanced-chart)
House Price Index	CoreLogic, index level (end-of-quarter)
Commercial Real Estate Price Index	From the Financial Accounts of the United States, Federal Reserve Board (Z.1 release); the series corresponds to the data for price indexes: Commercial Real Estate Price Index (series FL075035503.Q, divided by 1000). Series FL075035503.Q is also available at https://www.quandl.com/data/FED/FL075035503_Q-Interest-rates-and-price-indexes-commercial-real-estate-price-index-Quarterly-Levels-NSA
Market Volatility Index (VIX)	Federal Reserve Economic Research website (https://fred.stlouisfed.org/series/VIXCLS), with

	"Quarterly" frequency and "Average" aggregation method
Euro Area Real GDP Growth	Quarterly series for "European Union GDP Annual Growth Rate" per tradingeconomics.com
Euro Area Inflation	Quarterly average of monthly series for "European Union Inflation Rate" per tradingeconomics.com
Euro Area Bilateral Dollar Exchange Rate (USD/Euro)	End-of-quarter rates from the H.10 Release, Foreign Exchange Rates, Federal Reserve Board.
Developing Asia Real GDP Growth	The nominal GDP-weighted aggregate of the Real GDP growth for China, India, South Korea, Hong Kong Special Administrative Region, and Taiwan per OECD
Developing Asia Inflation	The nominal GDP-weighted aggregate of the inflation rate for China, India, South Korea, Hong Kong Special Administrative Region, and Taiwan per OECD
Developing Asia bilateral dollar exchange rate (F/USD, index)	End-of-quarter rates from the H.10 Release, Foreign Exchange Rates, Federal Reserve Board.
Japan Real GDP Growth	Quarterly average of monthly series for "Japan GDP Growth Rate" per tradingeconomics.com
Japan Inflation	Quarterly average of monthly series for "Japan Inflation Rate" per tradingeconomics.com
Japan Bilateral Dollar Exchange Rate (Yen/USD)	End-of-quarter rates from the H.10 Release, Foreign Exchange Rates, Federal Reserve Board.
UK Real GDP Growth	Quarterly average of monthly series for "United Kingdom GDP Growth Rate" per tradingeconomics.com
UK Inflation	Quarterly average of monthly series for "United Kingdom Inflation Rate" per tradingeconomics.com
UK Bilateral Dollar Exchange Rate (USD/Pound)	End-of-quarter rates from the H.10 Release, Foreign Exchange Rates, Federal Reserve Board.

While all data that is required for the Annual Stress Tests is available from https://www.federalreserve.gov/supervisoryreg/files/2020-historical-data.zip, Capitalytics provides 13 additional metrics per the information in the following table. These values are available from the point at which they are collected (which varies from metric to metric) through (and including) 4Q2019.

Table 7: Supplementary Data Attributes and Sources

Attribute	Capitalytics Source
1-month Treasury yield	https://fred.stlouisfed.org/series/dgs1mo
6-month Treasury yield	https://fred.stlouisfed.org/series/dgs6mo
1-year Treasury yield	https://fred.stlouisfed.org/series/dgs1
3-year Treasury yield	https://fred.stlouisfed.org/series/dgs3
7-year Treasury yield	https://fred.stlouisfed.org/series/dgs7
20-year Treasury yield	https://fred.stlouisfed.org/series/dgs20
30-year Treasury yield	https://fred.stlouisfed.org/series/dgs30
US Average Retail Gasoline Price ($/gal; all grades, all formulations)	https://fred.stlouisfed.org/series/gasallm
S&P 500 Stock Price Index	https://fred.stlouisfed.org/series/S&P 500 Stock Price Index
Primary Credit	https://fred.stlouisfed.org/series/FEDFUNDS
Moody's AAA Rate	https://fred.stlouisfed.org/series/aaa
Moody's BAA Rate	https://fred.stlouisfed.org/series/baa
Dow Jones Total Industrial Average	https://fred.stlouisfed.org/series/djia

Appendix B: Methodologies

Capitalytics uses non-structured macroeconomic forecasting techniques in order to prepare its clients for what trends and relationships drive certain metrics, and what values those metrics may take on in the coming months.

Section I: General Forecasting Methodology

Generally, the most effective overall forecasting techniques have been found to be a hybridization of multiple other techniques. Capitalytics uses several forecasting schemes, and aggregates the results, as part of its analysis methodology. This section describes the process that is executed for generating these results.

For each metric, four distinct forecasts are produced.

1. The first forecast uses the full quarterly history of the metric as an input to an additive exponential smoothing representation. The process that is executed is that provided by R's[49] "forecast" package[50]; specifically, the "ets" function (see p.39 of https://cran.r-project.org/web/packages/forecast/forecast.pdf)[51] is designed to automatically determine the best fitting representation out of the "Generic 'ETS' Methodology" (discussed later in this section), including optimal parameters thereto, given a sequence of values. In our work, we have restricted our study to only "additive" forms (i.e., we set "`additive.only=TRUE`" in our calls), and our optimization criteria is set to the mean of absolute residuals (i.e., "`opt.crit=mae`"). Therefore, calls to generate our estimates through this procedure look something like the following command, where "`s`" is an appropriately populated array, vector, time series, or similar object.

[49] As of this writing, v.3.6.2 of the "R" language is available at https://cran.r-project.org/.

[50] As of this writing, v.8.11 of the forecast package is available at https://CRAN.R-project.org/package=forecast.

[51] It should be noted that Microsoft's Excel software includes a FORECAST.ETS function which is documented as potentially producing comparable results; however, we have not been able to re-create its output independently, and, given the documentation, flexibility, and source availability of the R packages, Capitalytics has decided that it is a preferable option at this time.

```
> m<-ets(s, model='ZZZ', opt.crit=c('mae'), additive.only=TRUE)
```

The results of this call are shown above each dataset, including the representation type returned (as described later this section), the initial values that are used by the software, the optimal smoothing parameters estimated, and the $n+1^{st}$ forecasted value given the first n values of the metric's sequence (the "fitted" values)[52], and the determined parameters. While fitting forecasts to previous values,

- "forecast error" is defined as being actual values less forecasted values,
- "% error" is defined as forecast error divided by actual value, and
- "score" is defined as mean absolute forecast error over an appropriate range (generally the duration of the collected past values, less the first two to four years of collected values)[53].

2. The second forecast uses the differences between successive quarterly values in order to forecast the future quarterly differences. It should be noted that these sequences are (obviously) one data-point shorter than those in the preceding procedure. These values are forecasted using the same procedure as described in the first section, with forecasted values for the actual metric being built using the last known value for the metric and forecasts of incremental changes to the metric provided.

   An edited example for loading the SP500 end-of quarter values, and the differences between successive quarterly values, is shown below.

```
> sp<-c(130.659129, 1250.520109, 998.4076848, 812.047, 799.5264066, 927.5045326,
1041.372826, … )
> sp_ts<-ts(sp,freq=4,end=c(2017,4))
> sp_ts
```

[52] While this procedure does generate fitted values for intermediate samples within a sequence -- and allow for generating a forecasted set of samples to extend a sequence - according to the identified parameter set, it does not directly provide for determining the optimal parameter set of a sub-sequence. Capitalytics is currently codifying the process herein so that we may prescribe a "most likely" long term representation for each forecast, and determine the likely effects of errors in the forecasts by estimating the "recent term" values of dy/dx_i (where y is the metric being estimated and x_i is each of the parameters within the representation) and then compensating for recent quantified errors. We can also consider how "finite" a window to account for in building a set of parameters; these representations are theoretically using all history in building a forecast, but the values for alpha, beta, etc. implicitly give an indication of how much history of a metric is truly impacting a specific value.

[53] It bears noting that a lower value for the "score" indicates better accuracy of an algorithm.

```
          Qtr1      Qtr2      Qtr3      Qtr4
2008            130.6591 1250.5201  998.4077
2009  812.0470  799.5264  927.5045 1041.3728
       …

       > m<-ets(sp_ts,model='ZZZ',opt.crit=c('mae'),additive.only=TRUE)
       > dsp_ts<-diff(sp_ts)
       > dsp_ts
           Qtr1        Qtr2        Qtr3        Qtr4
2008                      1119.860980 -252.112424
2009 -186.360685  -12.520593  127.978126  113.868293
       …

       > m<-ets(dsp_ts,model='ZZZ',opt.crit=c('mae'),additive.only=TRUE
```

3. The third forecast uses the sequence of numbers from the second forecast, but partitions the dataset based on the quarter in which they are incurred. Assuming that the differences between quarters are associated with the ending points of each quarter (i.e., the difference between third and fourth quarter values are associated with a date of December 31st), four sequences of numbers are now created, with annual forecasts now being produced for each sequence using the same procedures as previously outlined. The final sequence appropriately interleaves the forecasted data-points.

4. The fourth forecast builds three sequences of values based the history of the metric to an observed point:

    - the slope of the "best fitting" line (based on minimizing the total absolute error) using the immediately preceding 2 years of values[54];
    - the same slope using the immediately preceding 4 years of values; and,
    - the same slope using the immediately preceding 8 years of values.

    While two years of data would provide for a relatively responsive change in aggregate values to be reflected given a change in the economic conditions, eight years of data (a not unreasonable estimate for an "economic cycle") would allow for a much more slowly moving change in average window for a counterbalance.

[54] The value for this slope is calculated using Microsoft Excel's SLOPE function, with the first argument being the appropriate number of preceding values for the metric, and the second argument being the same number of corresponding "end-of-quarter" dates.

Using these datasets independently, we are able to use our previous procedure to generate forecasts for each slope, and then average the results on a quarterly basis. Multiplying the average slope by the duration of the following quarter (in days) provides an estimate for the change in the metric's value during that following quarter, just as in our second forecast.

Obviously, this technique requires at least eight years of data to pass before being able to produce any data. However, in order to err on the side of conservatism, we generally allow a sequence to "mature" for two to four years before believing that its initial transience has become less significant and its results are trustworthy. If a dataset does not have enough data to complete one of these analyses, the analysis is dropped. In other words, if the metric does not have +/-11 years of data available, the 8-year slopes cannot be reliably calculated, and the average slope is only based on the 2- & 4-year slopes[55].

5. In some cases, we may find variables with extremely tight cross-connections that can be justified as part of their nature (treasury bill yield rates, for example, with a magnitude or correlation greater than ~0.95). In these cases, we are able to additionally enhance our forecast by building a forecast that expresses one variable (the "dependent" variable, $y(t)$) in terms of another (the "independent" variable, $x(t)$) with a coefficient of determination (R^2), such that

$$y(t) = m(t) * x(t) + b(t) .$$

Notice that the "slope" and "intercept" terms in this expression are time varying expressions that are re-evaluated with each data-point, not simply constants.

By averaging the results of these distinct forecasts in order to provide an aggregate forecast, the error for which can be characterized and measured, Capitalytics aims to provide a robust dataset that can be used for future business decisions.

[55] See the SP500 metric's analysis.

It was stated earlier that Capitalytics uses each metric's complete history in order to generate a matching representation and forecast. It should be recognized that we also perform the same analyses for periods starting no more than 100, 80, 60, and 40 quarters prior to the forecasted period. However, we have found the results of all of these analyses are more reactionary and less coherent than that already presented within this report.

Section II: Exponentially Smoothed State Space Representations & Generic "ETS" Methodology

Exponential smoothing was proposed in the late 1950s (Brown 1959, Holt 1957 and Winters 1960 are key pioneering works) and has motivated some of the most successful forecasting methods. Forecasts produced using exponential smoothing methods are weighted averages of past observations, with the weights decaying exponentially as the observations get older. In other words, the more recent the observation the higher the associated weight. (See the following equation for one example of this type of equation which requires $0 \leq \alpha \leq 1$, and estimates future values of $\hat{y}$ given a history of values denoted as y_t. The ε_{T+1} term denotes an error term, the *residual*, which determines the value of the forecasting function.) This framework generates reliable forecasts quickly and for a wide spectrum of time series.

$$\hat{y}_{T+1|T} = \alpha y_T + \alpha(1-\alpha)y_{T-1} + \alpha(1-\alpha)^2 y_{T-2} + \cdots + \varepsilon_{T+1}$$

In this study, the relevance of quarterly samples more than 3 years old is eliminated by setting the number of terms in this type of expression to no more than 13.

The challenge with these forecasting techniques is to estimate the value of α such that some criteria is optimized, e.g., minimizing the sum of squared errors (SSE), across all values of a set of historical values.

There are other forms of exponential smoothing methods that may account for any combination of forecasting *levels* (as in the Theta method), *trends* (for which a metric may, for instance, be growing or lessening according to a linear or higher order function), and *seasonality* (for which a metric may have engrained "cycles" on, e.g., a monthly, quarterly, or annual basis).

By considering variations in the combination of the trend and seasonal components, fifteen exponential smoothing methods are possible. Each method is labelled by a pair of letters (T,S) defining the type of 'Trend' and 'Seasonal' components. For example, (A,M) is the method with an additive trend and multiplicative seasonality; (M,N) is the method with multiplicative trend and no seasonality; and so on. Per Section 7.6 of Hyndman & Athanasopoulos, some of these methods are well known per the following table.

Table 8: Mathematical Methods Associated with Trend & Seasonal Components

Trend & Seasonal Components	Method
(N,N)	simple exponential smoothing
(A,N)	Holts linear method
(M,N)	Exponential trend method
(A_d,N)	additive damped trend method
(M_d,N)	multiplicative damped trend method
(A,A)	additive Holt-Winters method
(A,M)	multiplicative Holt-Winters method
(A_d,M)	Holt-Winters damped method

Additionally, the following table (again from Section 7.6 of Hyndman & Athanasopoulos) gives the recursive formulae for applying all possible fifteen exponential smoothing methods. Each cell includes the forecast equation for generating h-step-ahead forecasts and the smoothing equations for applying the method. By recursively applying the appropriate expressions to generate consecutive forecasts, this framework can be an extremely powerful tool.

Section III: Regression Construction

Capitalytics also generates a regression to estimate future values of the variables that we track in terms of current-day values. By using R's "lm" function, we estimate the next quarter's values for each variable in terms of the preceding set of variables' values. These regressions are built using the immediately preceding 57 sets of variables' values.

Each output variable is considered in turn as the response variable, with all other variables as possibilities for the control (independent) variables *excluding* any variables that have an 80% correlation with the response variable. Successive linear regressions are built; if any of the control variables' p-values exceed 5%, or if the model's p-value exceeds 5% and the number of considered control variables is greater than one, the most offensive control variable is dropped, and the regression is re-run.

Trend	Seasonal: N	Seasonal: A	Seasonal: M
N	$\hat{y}_{t+h\|t} = \ell_t$ $\ell_t = \alpha y_t + (1-\alpha)\ell_{t-1}$	$\hat{y}_{t+h\|t} = \ell_t + s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t - s_{t-m}) + (1-\alpha)\ell_{t-1}$ $s_t = \gamma(y_t - \ell_{t-1}) + (1-\gamma)s_{t-m}$	$\hat{y}_{t+h\|t} = \ell_t s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t / s_{t-m}) + (1-\alpha)\ell_{t-1}$ $s_t = \gamma(y_t / \ell_{t-1}) + (1-\gamma)s_{t-m}$
A	$\hat{y}_{t+h\|t} = \ell_t + hb_t$ $\ell_t = \alpha y_t + (1-\alpha)(\ell_{t-1} + b_{t-1})$ $b_t = \beta^*(\ell_t - \ell_{t-1}) + (1-\beta^*)b_{t-1}$	$\hat{y}_{t+h\|t} = \ell_t + hb_t + s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t - s_{t-m}) + (1-\alpha)(\ell_{t-1} + b_{t-1})$ $b_t = \beta^*(\ell_t - \ell_{t-1}) + (1-\beta^*)b_{t-1}$ $s_t = \gamma(y_t - \ell_{t-1} - b_{t-1}) + (1-\gamma)s_{t-m}$	$\hat{y}_{t+h\|t} = (\ell_t + hb_t)s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t / s_{t-m}) + (1-\alpha)(\ell_{t-1} + b_{t-1})$ $b_t = \beta^*(\ell_t - \ell_{t-1}) + (1-\beta^*)b_{t-1}$ $s_t = \gamma(y_t / (\ell_{t-1} + b_{t-1})) + (1-\gamma)s_{t-m}$
A_d	$\hat{y}_{t+h\|t} = \ell_t + \phi_h b_t$ $\ell_t = \alpha y_t + (1-\alpha)(\ell_{t-1} + \phi b_{t-1})$ $b_t = \beta^*(\ell_t - \ell_{t-1}) + (1-\beta^*)\phi b_{t-1}$	$\hat{y}_{t+h\|t} = \ell_t + \phi_h b_t + s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t - s_{t-m}) + (1-\alpha)(\ell_{t-1} + \phi b_{t-1})$ $b_t = \beta^*(\ell_t - \ell_{t-1}) + (1-\beta^*)\phi b_{t-1}$ $s_t = \gamma(y_t - \ell_{t-1} - \phi b_{t-1}) + (1-\gamma)s_{t-m}$	$\hat{y}_{t+h\|t} = (\ell_t + \phi_h b_t)s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t / s_{t-m}) + (1-\alpha)(\ell_{t-1} + \phi b_{t-1})$ $b_t = \beta^*(\ell_t - \ell_{t-1}) + (1-\beta^*)\phi b_{t-1}$ $s_t = \gamma(y_t / (\ell_{t-1} + \phi b_{t-1})) + (1-\gamma)s_{t-m}$
M	$\hat{y}_{t+h\|t} = \ell_t b_t^h$ $\ell_t = \alpha y_t + (1-\alpha)\ell_{t-1}b_{t-1}$ $b_t = \beta^*(\ell_t / \ell_{t-1}) + (1-\beta^*)b_{t-1}$	$\hat{y}_{t+h\|t} = \ell_t b_t^h + s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t - s_{t-m}) + (1-\alpha)\ell_{t-1}b_{t-1}$ $b_t = \beta^*(\ell_t / \ell_{t-1}) + (1-\beta^*)b_{t-1}$ $s_t = \gamma(y_t - \ell_{t-1}b_{t-1}) + (1-\gamma)s_{t-m}$	$\hat{y}_{t+h\|t} = \ell_t b_t^h s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t / s_{t-m}) + (1-\alpha)\ell_{t-1}b_{t-1}$ $b_t = \beta^*(\ell_t / \ell_{t-1}) + (1-\beta^*)b_{t-1}$ $s_t = \gamma(y_t / (\ell_{t-1}b_{t-1})) + (1-\gamma)s_{t-m}$
M_d	$\hat{y}_{t+h\|t} = \ell_t b_t^{\phi_h}$ $\ell_t = \alpha y_t + (1-\alpha)\ell_{t-1}b_{t-1}^{\phi}$ $b_t = \beta^*(\ell_t / \ell_{t-1}) + (1-\beta^*)b_{t-1}^{\phi}$	$\hat{y}_{t+h\|t} = \ell_t b_t^{\phi_h} + s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t - s_{t-m}) + (1-\alpha)\ell_{t-1}b_{t-1}^{\phi}$ $b_t = \beta^*(\ell_t / \ell_{t-1}) + (1-\beta^*)b_{t-1}^{\phi}$ $s_t = \gamma(y_t - \ell_{t-1}b_{t-1}^{\phi}) + (1-\gamma)s_{t-m}$	$\hat{y}_{t+h\|t} = \ell_t b_t^{\phi_h} s_{t-m+h_m^+}$ $\ell_t = \alpha(y_t / s_{t-m}) + (1-\alpha)\ell_{t-1}b_{t-1}^{\phi}$ $b_t = \beta^*(\ell_t / \ell_{t-1}) + (1-\beta^*)b_{t-1}^{\phi}$ $s_t = \gamma(y_t / (\ell_{t-1}b_{t-1}^{\phi})) + (1-\gamma)s_{t-m}$

Appendix C: Variable Correlations

The following table shows the correlation factors between all of the listed variables for which the absolute value of the correlation is greater than 0.6, indicating a noteworthy degree of correlation. As is discussed in Appendix B of this report, correlations greater than 0.95 warrant further investigation as the relationship between variables may be useful for our research.

Table 9: Correlation Factors found as of 4Q2019

Variable 1	Variable 2	Correlation
BBB Corporate Yield	Commercial Real Estate Price Index	-0.726312
BBB Corporate Yield	Dow Jones Total Stock Market Index	-0.794263
BBB Corporate Yield	3-month Treasury yield	0.749281
BBB Corporate Yield	Home Price Index	-0.76514
BBB Corporate Yield	Prime Rate	0.72833
BBB Corporate Yield	US Average Retail Gasoline Price	0.704075
BBB Corporate Yield	10-year Treasury yield	0.912665
BBB Corporate Yield	1-year Treasury yield	-0.620716
BBB Corporate Yield	20-year Treasury yield	-0.798771
BBB Corporate Yield	30-year Mortgage Rate	0.931118
BBB Corporate Yield	3-year Treasury yield	-0.689533
BBB Corporate Yield	5-year Treasury yield	0.87081
BBB Corporate Yield	7-year Treasury yield	-0.75339
Commercial Real Estate Price Index	6-month Treasury yield	0.661793
Commercial Real Estate Price Index	US Average Retail Gasoline Price	-0.654439
Commercial Real Estate Price Index	10-year Treasury yield	-0.810397
Commercial Real Estate Price Index	1-year Treasury yield	0.680864
Commercial Real Estate Price Index	20-year Treasury yield	0.889795
Commercial Real Estate Price Index	30-year Treasury yield	0.763216
Commercial Real Estate Price Index	3-year Treasury yield	0.769262
Commercial Real Estate Price Index	5-year Treasury yield	-0.731646
Commercial Real Estate Price Index	7-year Treasury yield	0.854933
Primary Credit	Commercial Real Estate Price Index	0.646634
Primary Credit	**1-month Treasury yield**	**0.992835**
Primary Credit	3-month Treasury yield	-0.775246
Primary Credit	**6-month Treasury yield**	**0.993963**
Primary Credit	Home Price Index	0.60802
Primary Credit	Prime Rate	-0.782998
Primary Credit	US Average Retail Gasoline Price	-0.629222
Primary Credit	10-year Treasury yield	-0.741825
Primary Credit	**1-year Treasury yield**	**0.98719**

Primary Credit	20-year Treasury yield	0.787421
Primary Credit	30-year Mortgage Rate	-0.732808
Primary Credit	**3-year Treasury yield**	**0.95436**
Primary Credit	5-year Treasury yield	-0.781551
Primary Credit	7-year Treasury yield	0.891507
Dow Jones Total Stock Market Index	Commercial Real Estate Price Index	0.910318
Dow Jones Total Stock Market Index	6-month Treasury yield	0.604206
Dow Jones Total Stock Market Index	Home Price Index	0.845139
Dow Jones Total Stock Market Index	US Average Retail Gasoline Price	-0.632956
Dow Jones Total Stock Market Index	10-year Treasury yield	-0.794519
Dow Jones Total Stock Market Index	1-year Treasury yield	0.625163
Dow Jones Total Stock Market Index	20-year Treasury yield	0.842319
Dow Jones Total Stock Market Index	30-year Treasury yield	0.860757
Dow Jones Total Stock Market Index	3-year Treasury yield	0.719906
Dow Jones Total Stock Market Index	5-year Treasury yield	-0.693659
Dow Jones Total Stock Market Index	7-year Treasury yield	0.823446
1-month Treasury yield	**6-month Treasury yield**	**0.99525**
1-month Treasury yield	**1-year Treasury yield**	**0.988421**
1-month Treasury yield	3-year Treasury yield	0.930617
1-month Treasury yield	7-year Treasury yield	0.767721
3-month Treasury yield	6-month Treasury yield	-0.785336
3-month Treasury yield	1-year Treasury yield	-0.793684
3-month Treasury yield	3-year Treasury yield	-0.799448
3-month Treasury yield	5-year Treasury yield	0.933072
6-month Treasury yield	**1-year Treasury yield**	**0.998023**
6-month Treasury yield	**3-year Treasury yield**	**0.972985**
Home Price Index	**Commercial Real Estate Price Index**	**0.952799**
Home Price Index	6-month Treasury yield	0.625875
Home Price Index	10-year Treasury yield	-0.802325
Home Price Index	1-year Treasury yield	0.645114
Home Price Index	20-year Treasury yield	0.853648
Home Price Index	30-year Treasury yield	0.640019
Home Price Index	3-year Treasury yield	0.729499
Home Price Index	5-year Treasury yield	-0.731749
Home Price Index	7-year Treasury yield	0.81238
Prime Rate	**3-month Treasury yield**	**0.991822**
Prime Rate	6-month Treasury yield	-0.794807
Prime Rate	US Average Retail Gasoline Price	0.690034
Prime Rate	10-year Treasury yield	0.833621
Prime Rate	1-year Treasury yield	-0.801637
Prime Rate	20-year Treasury yield	-0.673432
Prime Rate	3-year Treasury yield	-0.800649
Prime Rate	5-year Treasury yield	0.90551
Prime Rate	7-year Treasury yield	-0.763977

Real Disposable Income Growth	Nominal Disposable Income Growth	0.908865
Real GDP Growth	Nominal GDP Growth	0.932717
US Average Retail Gasoline Price	3-month Treasury yield	0.699162
US Average Retail Gasoline Price	6-month Treasury yield	-0.652907
US Average Retail Gasoline Price	10-year Treasury yield	0.776451
US Average Retail Gasoline Price	1-year Treasury yield	-0.676941
US Average Retail Gasoline Price	20-year Treasury yield	-0.752596
US Average Retail Gasoline Price	3-year Treasury yield	-0.74793
US Average Retail Gasoline Price	5-year Treasury yield	0.762933
US Average Retail Gasoline Price	7-year Treasury yield	-0.783539
S&P 500 Stock Price Index	BBB Corporate Yield	0.659115
S&P 500 Stock Price Index	**Commercial Real Estate Price Index**	**-0.965849**
S&P 500 Stock Price Index	Primary Credit	0.783235
S&P 500 Stock Price Index	**Dow Jones Total Stock Market Index**	**-0.956305**
S&P 500 Stock Price Index	1-month Treasury yield	0.769139
S&P 500 Stock Price Index	3-month Treasury yield	-0.742558
S&P 500 Stock Price Index	6-month Treasury yield	0.779036
S&P 500 Stock Price Index	Home Price Index	-0.948792
S&P 500 Stock Price Index	Prime Rate	-0.754513
S&P 500 Stock Price Index	Unemployment Rate	0.946959
S&P 500 Stock Price Index	1-year Treasury yield	0.77033
S&P 500 Stock Price Index	20-year Treasury yield	-0.612557
S&P 500 Stock Price Index	30-year Treasury yield	-0.689351
S&P 500 Stock Price Index	3-year Treasury yield	0.650404
Unemployment Rate	30-year Treasury yield	-0.60803
10-year Treasury yield	3-month Treasury yield	0.864394
10-year Treasury yield	6-month Treasury yield	-0.757333
10-year Treasury yield	1-year Treasury yield	-0.774347
10-year Treasury yield	3-year Treasury yield	-0.828326
10-year Treasury yield	**5-year Treasury yield**	**0.981495**
10-year Treasury yield	7-year Treasury yield	-0.874994
20-year Treasury yield	3-month Treasury yield	-0.677058
20-year Treasury yield	6-month Treasury yield	0.807553
20-year Treasury yield	10-year Treasury yield	-0.875155
20-year Treasury yield	1-year Treasury yield	0.831254
20-year Treasury yield	3-year Treasury yield	0.899308
20-year Treasury yield	5-year Treasury yield	-0.815505
20-year Treasury yield	**7-year Treasury yield**	**0.969095**
30-year Mortgage Rate	Commercial Real Estate Price Index	-0.786541
30-year Mortgage Rate	Dow Jones Total Stock Market Index	-0.784084
30-year Mortgage Rate	3-month Treasury yield	0.876395
30-year Mortgage Rate	6-month Treasury yield	-0.751139
30-year Mortgage Rate	Home Price Index	-0.788312
30-year Mortgage Rate	Prime Rate	0.849998

30-year Mortgage Rate	US Average Retail Gasoline Price	0.803243
30-year Mortgage Rate	**10-year Treasury yield**	**0.993762**
30-year Mortgage Rate	1-year Treasury yield	-0.768434
30-year Mortgage Rate	20-year Treasury yield	-0.873875
30-year Mortgage Rate	3-year Treasury yield	-0.821099
30-year Mortgage Rate	**5-year Treasury yield**	**0.979398**
30-year Mortgage Rate	7-year Treasury yield	-0.864927
30-year Treasury yield	10-year Treasury yield	-0.622051
30-year Treasury yield	**20-year Treasury yield**	**0.989135**
30-year Treasury yield	3-year Treasury yield	0.601996
30-year Treasury yield	7-year Treasury yield	0.840045
3-year Treasury yield	**1-year Treasury yield**	**0.983333**
5-year Treasury yield	6-month Treasury yield	-0.792718
5-year Treasury yield	1-year Treasury yield	-0.805668
5-year Treasury yield	3-year Treasury yield	-0.839012
7-year Treasury yield	3-month Treasury yield	-0.774709
7-year Treasury yield	6-month Treasury yield	0.911775
7-year Treasury yield	1-year Treasury yield	0.92779
7-year Treasury yield	**3-year Treasury yield**	**0.977312**
7-year Treasury yield	5-year Treasury yield	-0.857476

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