Stock Market Bubbles: The Impact of the Coronavirus Pandemic on the Market

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Abstract

This paper investigates the current conditions of the Stock Market (as of December 2020) and attempts to assess whether it is entering a bubble. Using the dividend yield and Shiller-CAPE ratio of the S&P, along with market data from the dotcom and 2008 housing bubbles, this paper evaluates if the market is over or underpriced and compares the current trends of the market to previous bubbles. The results show that the stock market has been on an overpricing trend since recovering from the March 2020 Coronavirus crash.

I. Introduction

There has been a great deal of speculation on whether the stock market is in a bubble, especially following its run-up after the 2020 Coronavirus Crash. The Coronavirus ("COVID-19") Crash was preceded by a decade of post-great recession economic growth. Unemployment rates were low, and market growth was steady[1]. Suddenly, with the outbreak of COVID-19 in the first quarter of 2020, oil prices and international markets began to plummet. Global economies introduced stimulus funding, and investors feared the year to come[2].

In March 2020, the stock market faced three days of record-breaking losses. On Monday, March 9, the Dow Jones Industrial Average (DJIA, or the "Dow") fell 7.79% (2,013.76 points) to 23,851.02. Dubbed "Black Monday 2020", it was the worst single-day drop in the Dow's history. Three days later, on March 12, 2020, the Dow fell 9.99% (2,352.60 points) to 21,200.62. This was followed by a final crash on March 16, when the Dow fell a record 12.93% (2,997.10 points) to 20,188.52[3]. These crashes were followed by weeks of a struggling market, finally recovering with a run-up in July 2020.

Past bubbles, such as the dotcom bubble, can help provide context as well as showcase the unpredictability of the market. As internet tech companies began to gain momentum around 1989, the dotcom bubble firmly took hold in 1995 and lasted until 2000. The NASDAQ Composite index rose 582% (from 751.49 to 5,132.52) between January 1995 and March 2000. It then fell 75% during its crash from March 2000 to October 2002[4]. For another recent example, we can look to the 2008 housing bubble (and subsequent crash), which started in 2006 and was the result of a rise in subprime lending that began in 1999. On September 29, 2008, the Dow fell

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7343658/
[2] https://www.nbcnews.com/business/markets/stocks-enter-correction-dow-plunges-500-points-coronavirus-fears-multiply-n1144116
[3] https://www.thebalance.com/fundamentals-of-the-2020-market-crash-4799950
[4] https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/dotcom-bubble/

777.68 points, its largest drop in history (until the Coronavirus Pandemic). Global panic ensued, with oil prices and the London Financial Times Stock Exchange (FSTE) plummeting. The record lows continued throughout 2008. On Monday, October 6, 2008, the Dow dropped 800 points to 9,955.50, its first close below 10,000 since 2004[5]. The market remained volatile until the trough of the crash on March 5, 2009, when the Dow closed at 6,594.44. This provoked more economic stimulus plans and federal bailouts, which allowed the market to recover.

This paper attempts to assess if the stock market's bullish behavior after the 2020 Coronavirus crash is indicative of a bubble. The following data will be used: historical stock data for the S&P 500 index (the "S&P"), historical data on Shiller's Cyclically-Adjusted Price-to-Earnings Ratio ("CAPE Ratio" or "Shiller-CAPE"), in addition to the dividend yield of the S&P, 10-year U.S. Treasury yield, and projected growth rate of earnings. All of these data can be found on Robert Shiller's online database, in addition to the projected growth rate of earnings derived from his S&P earnings data.

This paper is structured as follows: in Section II, a brief literature review will be made. Section III will cover Methodology and Data. Section IV will present the results, and Section V will discuss these results. Section VI concludes the paper.

II. Literature Review

This paper takes a similar approach to De Long and Shleifer's (1991) research in which they model the premia and discounts of the S&P composite to provide evidence that the market was severely overvalued at the time. A difference in their methodology is the use of closed-end mutual funds (funds with their market value derived from the fixed number of securities in the portfolio) to determine the premia and discount of the S&P. By comparing market prices to the

[5] https://www.thebalance.com/stock-market-crash-of-2008-3305535

net asset value of the closed-end mutual funds, De Long and Shleifer found that the stocks in the S&P were at least 30% overpriced compared to their closed-end counterparts. Contrary to De Long and Shleifer's research, Rappoport and White (1993) use econometric models to quantify the 1929 crash. While their measurements implied that there was a bubble in the market, a classic cointegration test of stock prices and dividends from Campbell and Shiller (1987) implied that the evidence for a bubble at that time is limited.

More recently, Rekenthaler (2020) identifies four qualitative conditions that have historically preceded stock market bubbles, namely: lower interest rates, emerging technology, investor amnesia, and new math (unsustainably inaccurate valuations). Of these four, investor amnesia and new math are the more qualitative indicators, with investor amnesia referring to a lack of discouragement from previous crashes. While the duration of the 2020 Coronavirus crash demonstrates that this is a weaker signal, it may become stronger with a new generation of social media "Robinhood" investors. Rekenthaler implies that the speculation from the large batch of new, younger investors has the potential to contribute to a bubble.

More qualitatively, Shiller (2000) conducted a study on investor confidence, as well as two types of investor outlooks on bubbles. To do this, Shiller compares investor confidence at the beginning and end of six-month intervals from 1989 to 1998. He then runs a time-series regression for a speculative bubble outlook ("an unstable situation with expectations for an increase in the short term only") and a negative speculative bubble outlook ("an unstable situation with expectations for a downturn in the short term only") alongside investor confidence ("a feeling that nothing can go wrong"). Shiller determines that investor confidence and market outlook vary significantly over time, but only by small percentages. Thus, Shiller concludes that investor speculation is not a strong indicator of the market's true status.

III. Methodology and Data

The aforementioned data will be used to create predictions of stock market indicators which will then be compared to the actual historical values to see if the market is over or undervalued, thereby providing insight into whether the current market is in a bubble. This comparison will be performed on data from the dotcom bubble (1/1994 - 7/2003), the 2008 housing crash (6/2005 - 12/2009), and the Coronavirus pandemic (1/2019 - 2/2021) in order to see the extremities of deviations from the expected value. As mentioned before, all data are from Robert Shiller's online database.

The indicators that will be used to estimate deviations from expected values are $\frac{D}{P}$, the dividend yield of the S&P, and the $CAPE$ Ratio.

The *CAPE* Ratio, also known as the Shiller $\frac{P}{E}$ Ratio, is defined as:

$$CAPE = \frac{Share\ Price}{10-year\ average\ of\ inflation-adjusted\ earnings}$$

The *CAPE* Ratio is a form of the Price-to-Equity Ratio, $\frac{P}{E}$, a financial metric commonly used to determine if a stock is over or undervalued. The Shiller-CAPE adjusts this metric for inflation and isolates the impact of the market's economic cycles.

The regressions used in this paper are then derived from the following equations:

$$\frac{1}{CAPE} = \alpha + \beta(R - \pi)$$

$$\frac{D}{P} = \alpha + \beta_1 R + \beta_2 g$$

With R representing the nominal 10-year Treasury yield, g representing the 5-year projected growth rate of earnings, and $R - \pi$ representing the real 10-year Treasury yield. $R - \pi$ is determined by subtracting the nominal 10-year Treasury yield by the average annual rate of inflation over the past 10 years for each of the three periods being investigated.

In order to determine g, a log-linear model was used to find the constant 5-year projected growth rate of earnings for the S&P. The model was structured as follows:

$$lnE = \alpha + \beta_1 Date$$

With l*nE* being the log of the earnings for each month and *Date* being the month the earnings took place. This model yielded a constant growth rate (β_1) of 4.153% over the period of 1/1871 - 2/2021. Given the constant growth rate, its beta coefficient can be assumed to be 1, allowing it to be carried over to the dependent variable, now $\frac{D}{P} - g$.

With the estimated beta coefficients found over their respective time periods, the predicted values for $\frac{1}{CAPE}$ and $\frac{D}{P}$ are found via plugging in the data for *R*, $R - \pi$, and *g*. These predicted indicator values are then compared to their actual values to determine how overvalued the market is, if at all. For the analysis, it is worth noting that when $Actual - Predicted > 0$ for the $\frac{1}{CAPE}$ and $\frac{D}{P}$ indicators, the model implies that the market is undervalued, despite the positive difference in the graphics.

Additionally, the predicted $\frac{1}{CAPE}$ and $\frac{D}{P}$ ($\frac{1}{\widehat{CAPE}}$ and $\frac{\hat{D}}{P}$) values can be used to predict the price, $\hat{P}$. This can be done by restructuring the previous equations to the following:

$$\hat{P} = \frac{10\text{-}year\ average\ of\ inflation\text{-}adjusted\ earnings}{1/\widehat{CAPE}}$$

$$\hat{P} = \frac{Dividends}{\widehat{D/P}}$$

Just as before, $Actual - Predicted$ will be computed for each of these two predicted price values in order to check how over or undervalued the market is compared to the model. For this analysis, a positive $Actual - Predicted$ value will indicate an overvalued market, and a negative $Actual - Predicted$ will indicate an undervalued market.

IV. Results

The regressions yielded the following results for the regression coefficients:

	1/CAPE		D/P - g	
	α	β	α	β
Dot-Com Bubble	0.02941	0.17192	-0.04035	0.28908
P-Values	<2e-16	0.0325	< 2e-16	5.06E-10
2008	0.06692	-1.32325	0.005591	-0.6286
P-Values	<2e-16	<2e-16	0.0229	2.84E-15
2020	0.03325	-0.10664	-0.02257	-0.03481
P-Values	1.83E-13	0.511	7.90E-11	0.738

Table 1: Regression Coefficients

With these coefficients used in their respective equations, predictive values for $\frac{1}{CAPE}$ and $\frac{D}{P} - g$ were found in order to calculate the deviations from their actual values. These deviations are visualized over time as follows:

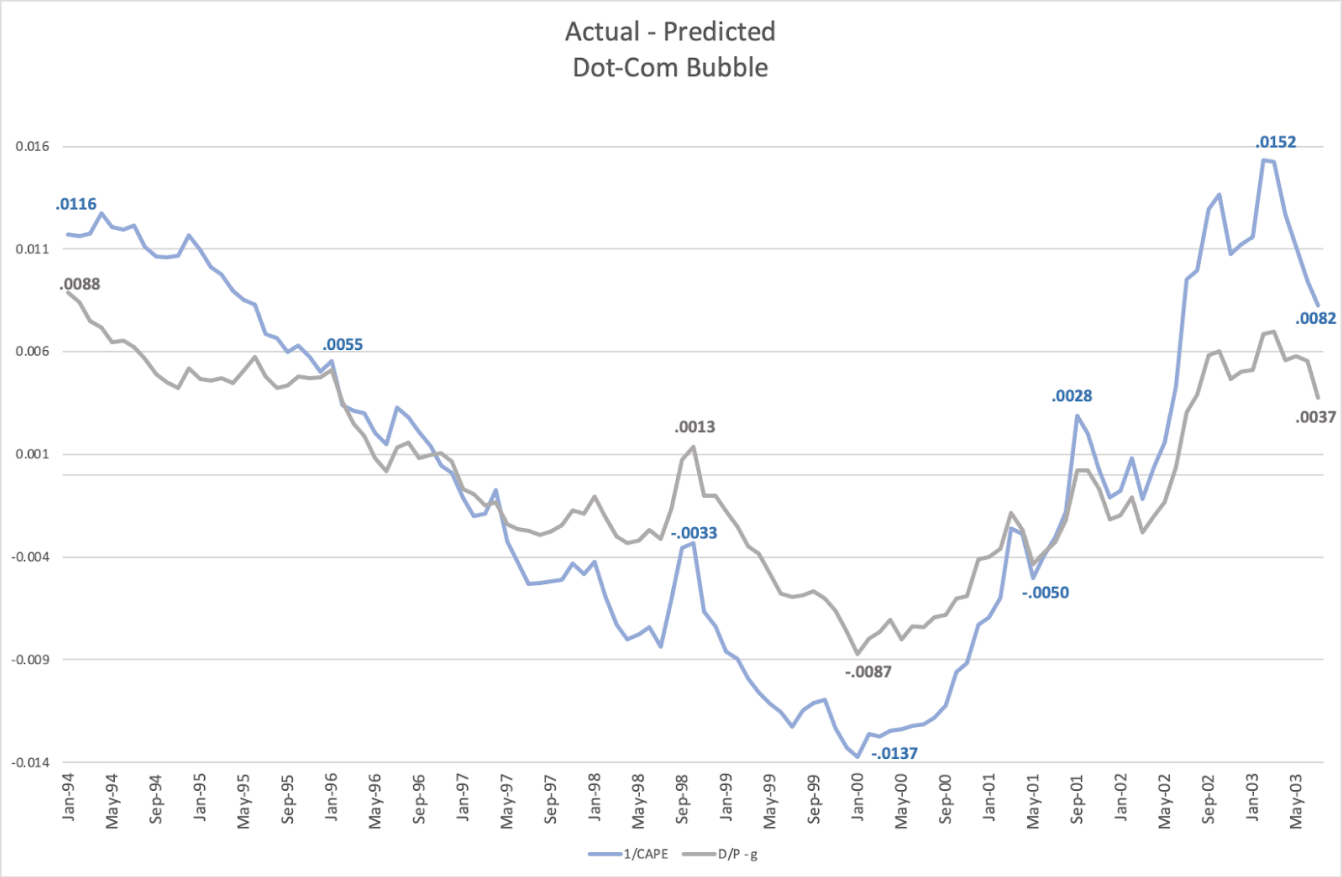

Figure 1: The difference between actual and predicted values for $\frac{1}{CAPE}$ and $\frac{D}{P} - g$ in the Dot-Com Bubble

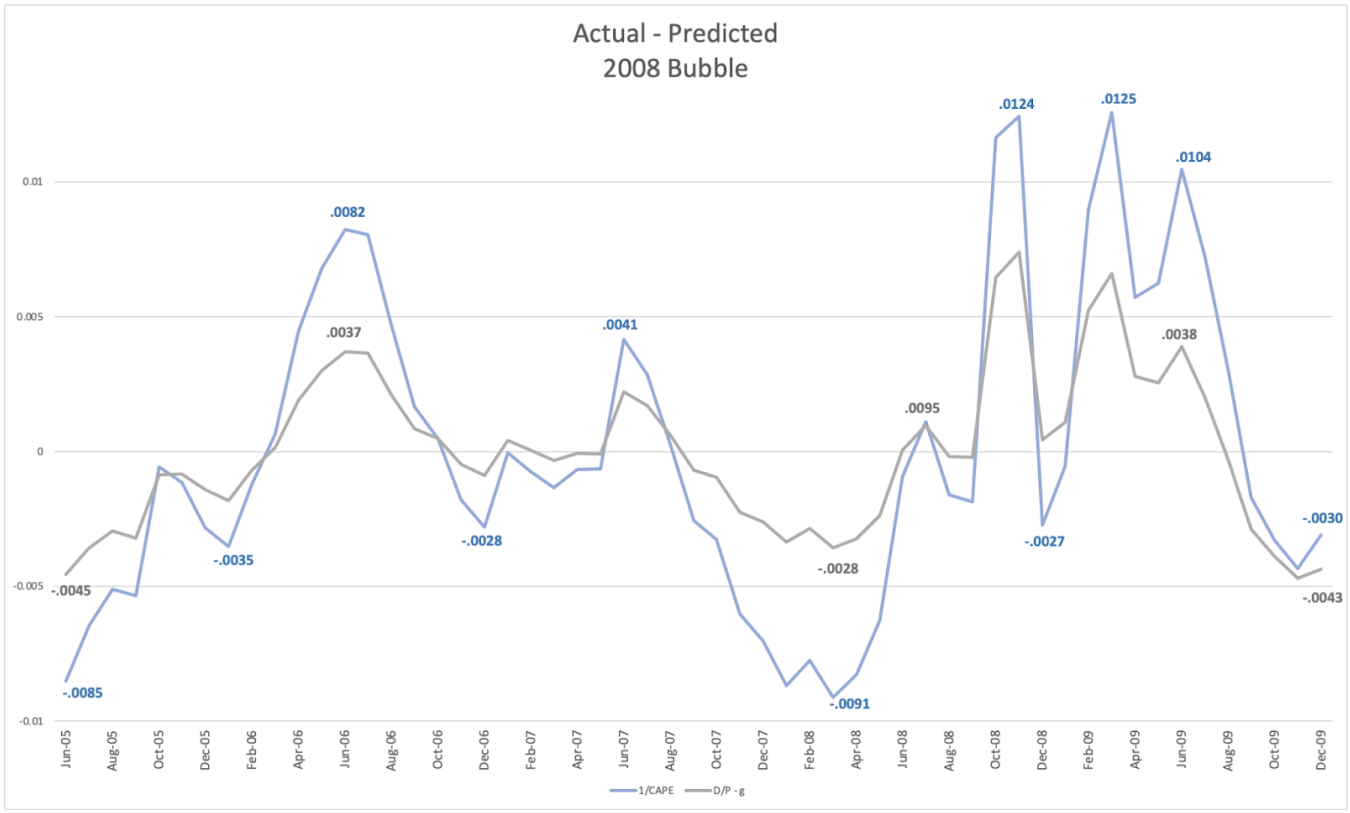

Figure 2: The difference between actual and predicted values for $\frac{1}{CAPE}$ and $\frac{D}{P} - g$ in the 2008 Bubble

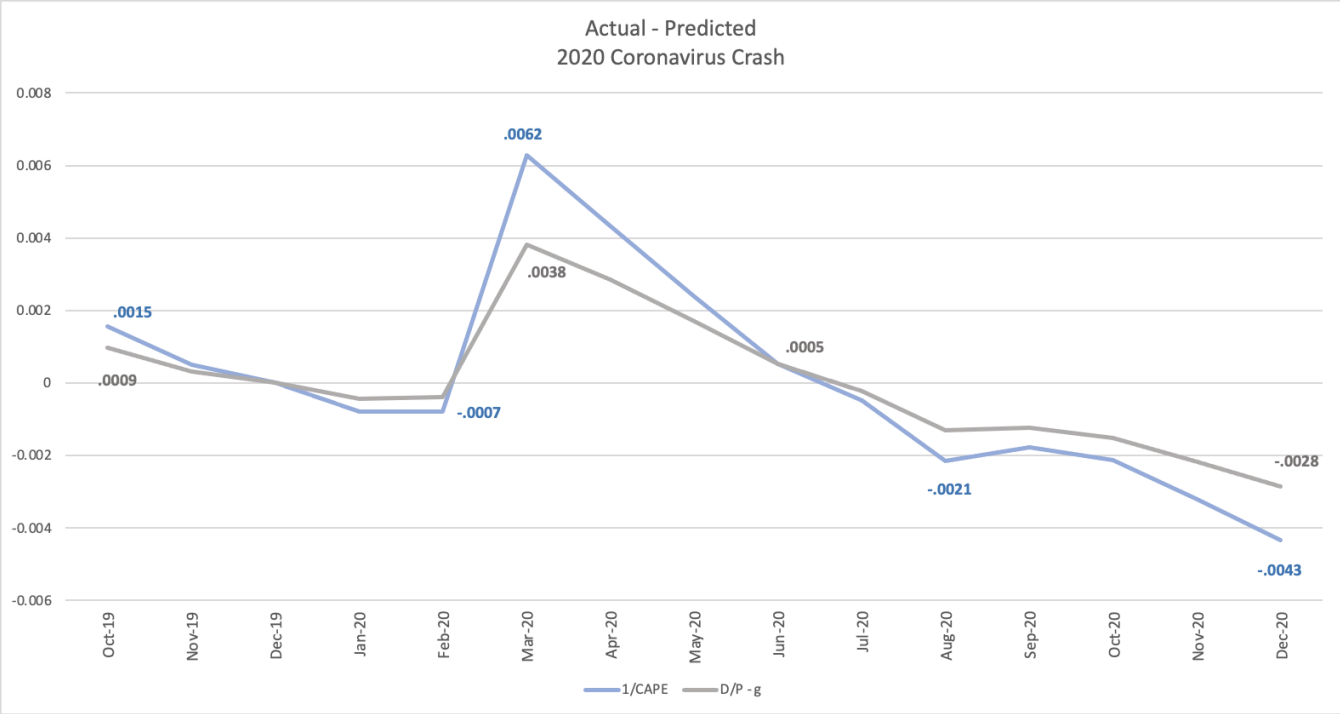

Figure 3: The difference between actual and predicted values for $\frac{1}{CAPE}$ and $\frac{D}{P} - g$ in the Coronavirus Crash

With these predicted values for $\frac{1}{CAPE}$ and $\frac{D}{P}$, deviations in actual and predicted price (derived from the two models) are visualized over time as follows:

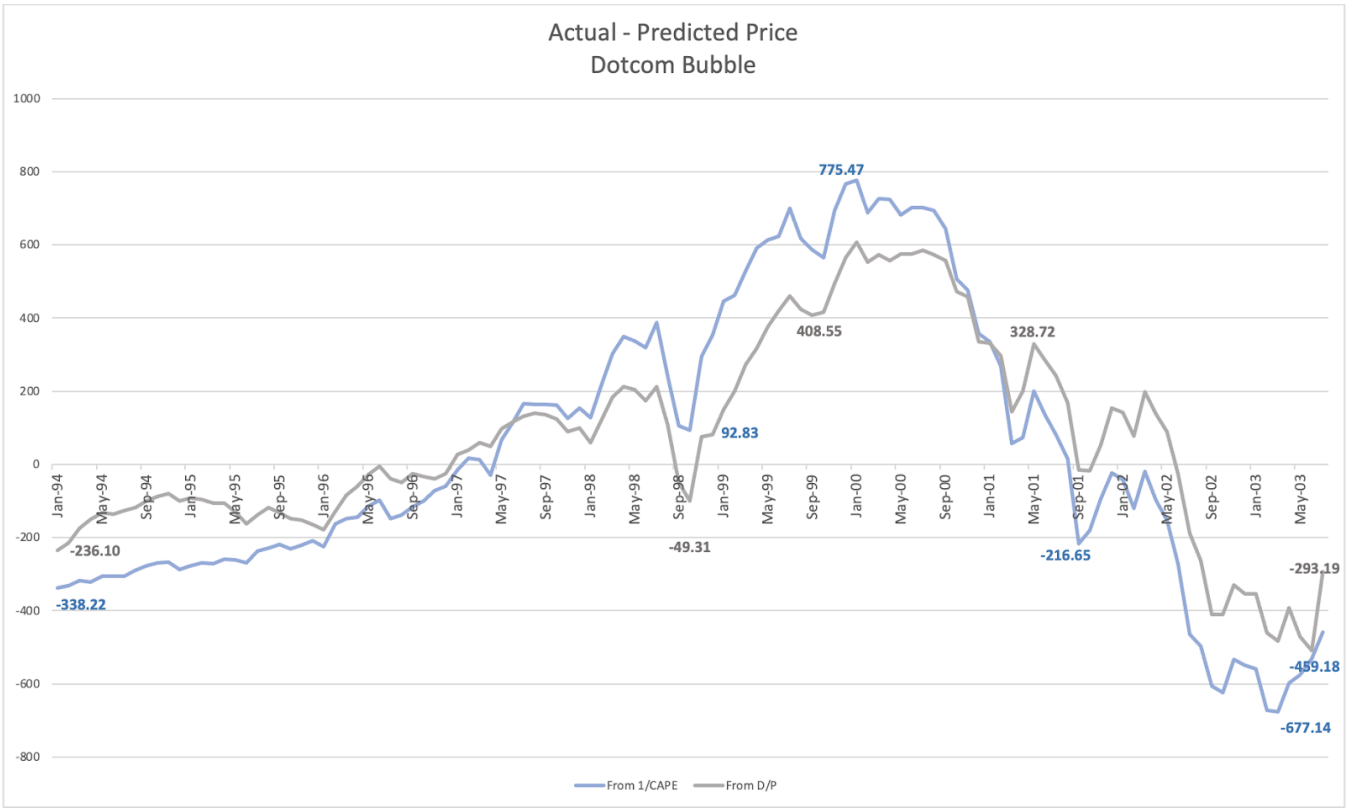

Figure 4: The difference between actual and predicted price from $\frac{1}{\widehat{CAPE}}$ and $\frac{\hat{D}}{P}$ in the Dot-Com Bubble

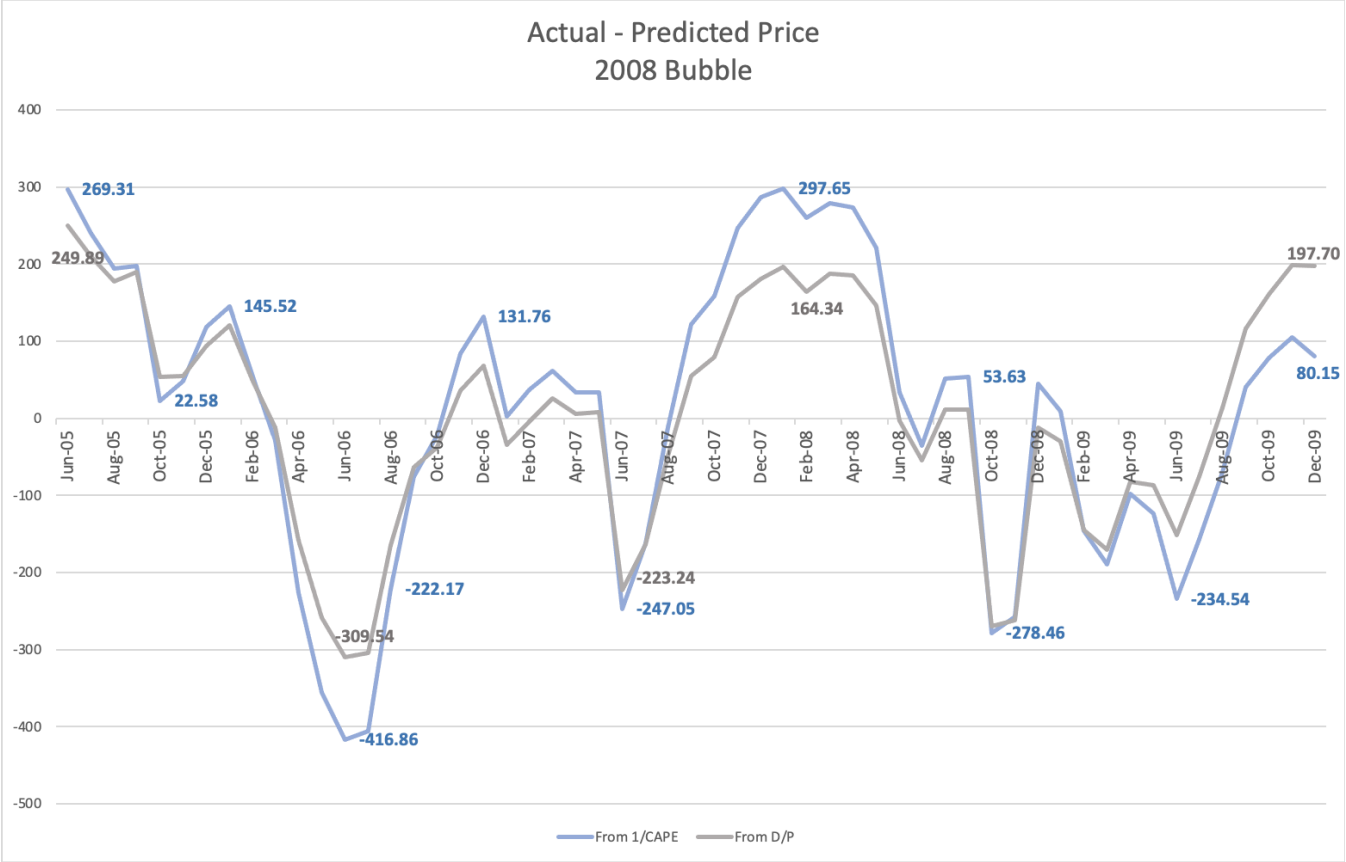

Figure 5: The difference between actual and predicted price from $\frac{1}{\widehat{CAPE}}$ and $\frac{\hat{D}}{P}$ in the 2008 Bubble

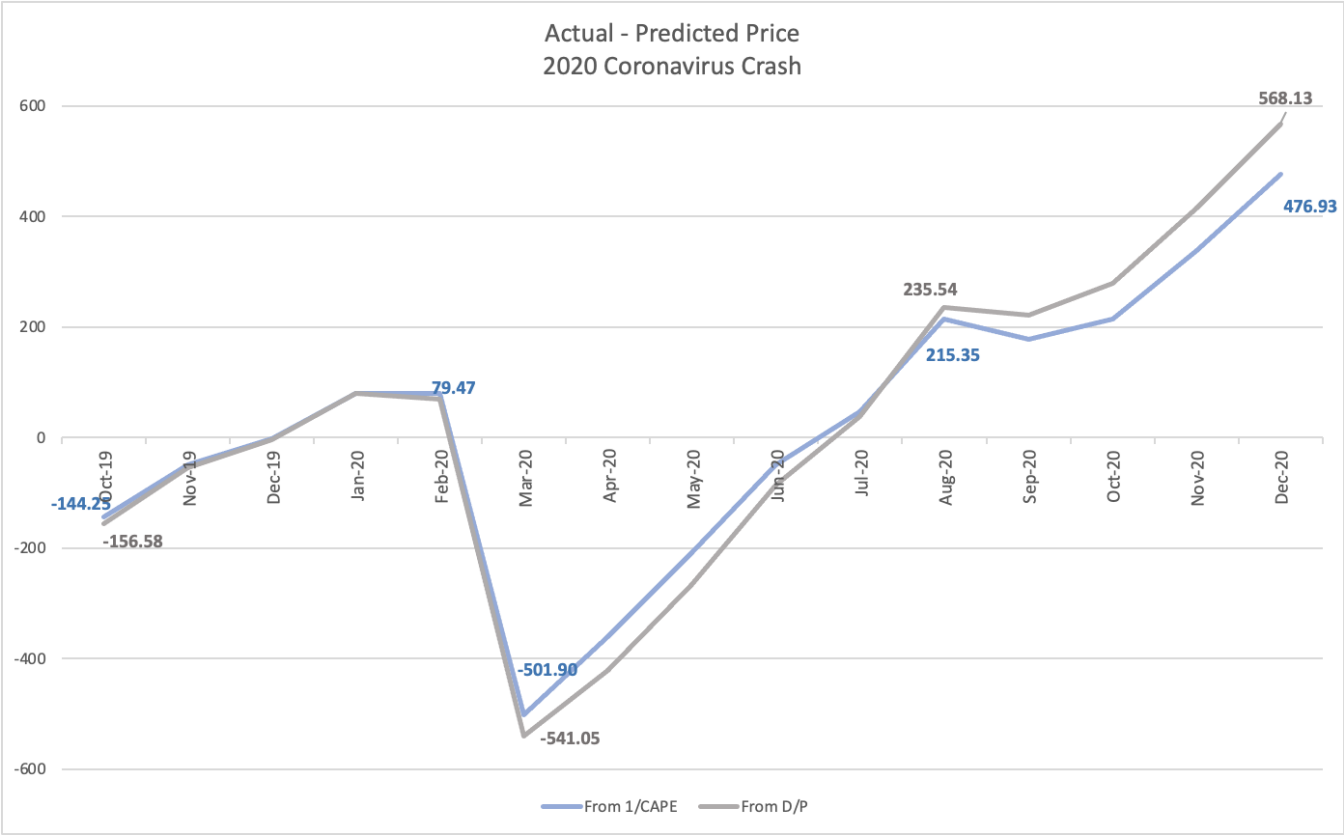

Figure 6: The difference between actual and predicted price from $\frac{1}{\widehat{CAPE}}$ and $\frac{\hat{D}}{P}$ in the 2020 Coronavirus Crash

V. Discussion

The difference in the actual and predicted values for the analyzed indicators show an overpricing in the market historically for the lead-up to the dotcom and 2008 bubbles. As seen in Figure 1, the model aligns with the dotcom bubble run-up and crash, showing the market beginning its overpricing in January 1997, and crashing in September 2001 and June 2002 for the $\frac{1}{CAPE}$ and $\frac{D}{P} - g$ indicators, respectively. There are discrepancies in the ratios from September to October 1998 and September 2001 to May 2002. The September to October 1998 discrepancy occurs when the $\frac{1}{CAPE}$ predictor indicates an overpricing in the market, while the $\frac{D}{P}$ ratio breaks its general trend of an overpricing to show an underpricing for just those two months. This

underpricing from the $\frac{D}{P} - g$ indicator was caused by a temporary drop in price, therefore making the difference between the actual indicator and the predictor positive for those two months. From September 2001 to May 2002, the $\frac{D}{P}$ indicator remains overpriced while the $\frac{1}{CAPE}$ indicator becomes underpriced due to declines in the Treasury yield and actual $\frac{1}{CAPE}$ values. The $\frac{D}{P} - g$ indicator remains overpriced as the price of the S&P remained relatively stable during this period, then depicts an underpricing when the S&P finally drops 110.43 points in June 2002.

For the 2008 bubble, the model oscillates between an under and overpricing throughout the whole sample of June 2005 to December 2012. The model remained predominantly overpriced until the big market crash of September 2008, with an underpricing trend from March to October 2006 and June to August 2007. The underpricing in March 2006 was due to an increase in Treasury rates (from 4.57 to 4.72 between February and March, eventually going up to 5.11 in May and June of 2006). Additionally, the index price declined from May to July 2006, finally reverting to its upward trend in October 2006. The short-lived underpricing in June 2007 can be explained similarly with an increase in Treasury rates (from 4.75 to 5.1 between May and June). This underpricing was quickly corrected in September 2007. The model then depicts the run-up from September 2007 to September 2008 as an overpricing. The market is accurately depicted as underpriced from October 2008 to August 2009, the most severe period of the crash. In the middle of this crash, there is a discrepancy between the two indicators from December 2008 to January 2009. The $\frac{D}{P} - g$ indicator displays a slight underpricing of the market, and the $\frac{1}{CAPE}$ indicator displays a slightly larger overpricing of the market. This discrepancy is due to a drastic decrease in yield (0.0353 to 0.0242) from November to December 2008. Additionally,

this drop in yield caused the over and under pricings to decrease in magnitude. This corrects back to a severe underpricing after December 2008, until the end of the crash in August 2009.

The 2020 Coronavirus Crash model shows no discrepancies between the two indicators in the entire sample period. The model shows very little over or under pricing in the market until the crash in March 2020, when it dropped to a large underpricing. In July 2020, the indicators show that the market recovered and has continued on an increasing overpricing trend since then.

The analysis from the predictive price values aligns with the previous discussion. For the dotcom bubble, the overpricing (of the predicted price, " $\hat{P}$ ") begins around January 1997 and lasts until September 2001 from the $\frac{1}{CAPE}$ indicator and June 2002 from the $\frac{D}{P}$ indicator. At its peak, the market was 775.47 points overpriced in January 2000 (from the $\frac{1}{CAPE}$ indicator). According to this model, the ultimate trough of the underpricing during the dotcom crash occurred in March 2003, when the market was 677.14 points underpriced (again from the $\frac{1}{CAPE}$ indicator). This predictive price analysis also matches with history and the predictive indicator analysis. As for the housing crisis, the model shows an overpricing from September 2007 to July 2008, with its peak in January 2008 (at 297.65 points overpriced from the $\frac{1}{CAPE}$ indicator). This overpricing was abruptly corrected with the September 2008 crash, continuing until August 2009. At the worst of this crash, the market was underpriced by 287.46 points (from the $\frac{1}{CAPE}$ indicator). Lastly, this model incorrectly indicates a crash in the market from April to September 2006, caused by an increase in the Treasury rate in those months (reducing the $\frac{1}{CAPE}$ indicator, thus inflating $\hat{P}$ and causing the negative difference in $Actual - Predicted$).

The analysis for the predictive $\frac{1}{CAPE}$ and $\frac{D}{P}$ in the 2020 model exactly mimics the results seen in the predictive price model. The market was slightly overpriced prior to the March 2020 crash (at 79.47 and 70.12 points overpriced from the $\frac{1}{CAPE}$ and $\frac{D}{P}$ indicators in February 2020,

respectively), when it jumped down to its maximum underpricing in the sample (at 501.90 and 541.05 points underpriced from the $\frac{1}{CAPE}$ and $\frac{D}{P}$ indicators, respectively). The market worked away from this underpricing to begin its overpricing trend in July 2020, which is continuing upward and currently at 476.93 and 568.13 points overpriced from the $\frac{1}{CAPE}$ and $\frac{D}{P}$ indicators, respectively (as of December 2020).

Some assumptions were made in the process of estimating these indicators, such as the use of a constant growth rate from the log-linear model of S&P Earnings from 1/1871 to 2/2021. This constant growth rate, and the assumption that its beta is 1 in order to regress with it on the dependent variable side, may have reduced the accuracy of the predictions due to the extrapolation that it could apply to all of the models. Additionally, determining the real 10-year Treasury yield requires the nominal yield to be subtracted by the average annual rate of inflation over the past 10 years ($R - \pi$). This could have led to less accurate results due to the aggregation of inflation in the average calculation. Regardless, the historical price data from the dotcom and 2008 crashes demonstrate that these models hold.

VI. Conclusion

The stock market is not exempt from the unprecedented effects of the Coronavirus pandemic. Beginning with the violent crash in March 2020, the stock market continues to behave unpredictably. After conducting analyses on the dotcom, 2008, and Coronavirus market crashes using the dividend yield of the S&P 500 and Shiller-CAPE index as predictive indicators, this paper demonstrated that the market completely recovered from its crash in March and has been overvalued since July 2020.

Regardless of current events, it is always difficult to speculate on the health of the market. However, using solely the two indicators analyzed in this paper (with data as of December 2020), it can be concluded that the market is overvalued, with momentum that is similar to previous bubbles. Though this could leave investors wary of an imminent crash, it is simply not possible to predict the timing of such events, especially given the volatility of the world and market today. Therefore, the results of this paper are only meant to evaluate current market conditions.

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