MARKET UNCERTAINTY IN TIMES OF CRISIS:

A COMPARATIVE ANALYSIS

by

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A THESIS

Presented to the Department of Business Administration
and the Robert D. Clark Honors College
in partial fulfillment of the requirements for the degree of
Bachelor of Science

May 2022

An Abstract of the Thesis of

Haley Thayer for the degree of Bachelor of Science
in the Department of Business Administration to be taken May 2022

Title: Market Uncertainty in Times of Crisis: A Comparative Analysis

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Since the onset of the 21st century, the US and global financial markets have achieved all time high returns and seen immense benefits from an ever more globalizing world and economy. Markets have also experienced two of the most devastating financial crises since the Great Depression, the 2008 financial crisis and the Covid-19 pandemic. Despite the differences in both crises, the purpose of this thesis is to conduct a qualitative comparative analysis of the uncertainty during both crises and how news, good and bad, changes uncertainty. We will specifically look at two different measures of uncertainty, the VIX index and the EPU US Daily News index. Although there is not an industry standard in how to account for future market uncertainty, this thesis attempts to begin to understand the relationship between news and uncertainty using metrics of past uncertainty. Further, this thesis attempts to understand the effectiveness of using various proxies as measurements for uncertainty. This thesis will ultimately focus on using volatility as a proxy for uncertainty, which can be seen using modeling with the VIX index. In this thesis, I will discuss the theoretical background behind market uncertainty and why it is important to be studied. I also will briefly discuss the main events of each crisis, then empirically analyze the relative impact of good and bad news on market uncertainty in both crises.

Acknowledgements

I would like to thank Professor Brandon Julio for acting as my primary thesis advisor and taking the time to help develop the foundation for this thesis and provide continuous feedback. I would also like to thank Professor Youchang Wu for serving as my second reader and Professor Anita Chari for acting as my CHC representative. I am grateful to have a Thesis Committee comprised of such distinguished professors to help me fully examine my topic and consider various perspectives. I could not complete this thesis process, and therefore my undergraduate degree, without the support of the Clark Honors College and Lundquist Business Honors Program. I feel extremely blessed to have gotten to spend the past four years learning from excellent professors, who challenged me and provide irreplaceable mentorship, especially throughout this thesis process. All of this could not be possible without the support and unconditional love from my family and friends. Specifically, I would like to thank my dad and mom, Mike and Kristy, for removing all barriers for me so I could learn and enjoy everything I have wanted to at the University of Oregon. You have been the best support system and thank you for always believing in me.

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Chapter 1: Understanding Market Uncertainty

When considering the term market uncertainty, it might seem like a straightforward idea – when an individual is uncertain about various concerns in the market. However, the concept of market uncertainty is much more complex, and even more difficult to measure. As the impacts of market uncertainty are increasingly being studied, financial crises can act as prime examples as to the large impacts uncertainty can have on the markets. Despite being difficult to measure, many experts would argue that ignoring market uncertainty completely as a factor in investing and market predictions is remiss of a whole set of risks. Although investors and researchers are shifting their mindset to be more aware of this additional set of risks, there is not a strong forward-looking measure to predict or control specifically for market uncertainty.

The purpose of this research is to compare the effects of good and bad news on two different measurements of uncertainty in two different financial crises. By comparing both crises instead of focusing on just one, we can compare the effects and attempt to better understand why market uncertainty fluctuations around bad and good news. Further, both uncertainty indexes that will be considered will use a different proxy as a form of measurement, which will also be qualitatively analyzed.

In this research, we will create a timeline of significant news in each crisis, then categorize those news stories as good and bad. Then, we will be able to build a model to analyze the impacts of instances of good and bad news on two measures of uncertainty, the VIX and the EPU US daily news indices. This research will find that the VIX acts as

a better proxy and shows that bad news has a more significant impact on market uncertainty than good news does.

The concept of market uncertainty is rooted in the Market Uncertainty Theory. One assumption we make about the markets in traditional theory is that efficient market prices already account for all known factors and information and change instantaneously to react to changes in known information. Market instability is typically caused by what we refer to as unknown factors, which is any type of information that the market is not aware of and is *uncertain.* Therefore, specifically in times of crisis, as the known information set is both growing and contracting in significant ways, we expect the efficient market prices to attempt to adjust to it. In these times of crisis, the larger shift in the known and unknown information sets, typically the larger the correction of market prices, and therefore, much higher volatility. Conceptually, we can interpret the "unknown information set" as "the uncertainty of the correctness of efficient market prices".[1]

It is important to note that, market prices will never be completely correct. Further, market uncertainty does not equate to market risks, as market risks are measured in reference to the known information about the market[2]. Theory argues that *market risks* are inherently included in the correct pricing of the market dependent on the known set of information, and *market uncertainty* is not. These market risks do not challenge the validity of the efficient market prices, but rather are incorporated into the current prices.

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[1] *Market uncertainty and market instability*. (n.d.). Retrieved May 16, 2022, from https://www.bis.org/ifc/publ/ifcb34ad.pdf

[2] Bernstein, P. L. (n.d.). *Against the gods: The remarkable story of risk--a book review*. Retrieved May 16, 2022, from https://www.ams.org/notices/199901/rev-zabell.pdf

The Market Uncertainty Theory argues that efficient market prices are not created equal, meaning that although the markets attempt to adjust to the correct price given the know information available, the uncertainty in the validity of the market prices contributes to mispricing. For example, in the 2008 financial crisis, the effects of the subprime mortgage crisis were very uncertain, and although markets attempted to correct to the vast amount of information becoming available in the peak of the crisis, the validity of these prices remained very significantly uncertain.

Measuring Market Uncertainty

Once prevailing issue of the markets is that market uncertainty can have a very significant effect on prices and overall movements of the market, yet there is not existing standard practice for measuring market uncertainty and incorporating it into either the private or public sector. Patrick Slovik, an economist at the Intergovernmental Economic Organization, argues that "the problem of market instability is that the market participants and market regulators are following an incomplete economic paradigm". Meaning that the prevailing view is that market uncertainty does not matter, because of the inability to identify the "unknown information set". Both the private and public sector adopt the sentiment that nothing much can be done about it.[3]

However, research into market uncertainty is expanding, as well as various ways to measure uncertainty in the market. There are many ways in which economists and uncertainty experts have attempted to measure uncertainty. The most common, and arguably traditional, is using a proxy for uncertainty, such as volatility (as we will see

[3] Knight, F. H. (1948). *Risk, uncertainty and Profit*. Houghton Mifflin.

below). There are many different proxies that have been used, but there is much dispute over the accuracy of these proxies and their ability to be exogenous representations of uncertainty. Some of the most prominent research done into measuring uncertainty without using proxies is "Measuring Uncertainty" by Jurado, Ludvigson and Ng. They attempt to create "direct econometric estimates of time varying economic uncertainty"[4]. However, for the purpose of this research, we will focus on the traditional measurement of uncertainty, which is using proxies, so we can more effectively compare the different results in which different proxies give us. There are two most relevant different measurement indices that we will use for our modeling, the Economic Policy Uncertainty (EPU) index and the Cboe Volatility Index (VIX), which will be discussed below.

[4] Jurado, K., Ludvigson, S. C., & Ng, S. (2015). Measuring uncertainty. *American Economic Review*, *105*(3), 1177–1216. https://doi.org/10.1257/aer.20131193

Economic Policy Uncertainty (EPU)

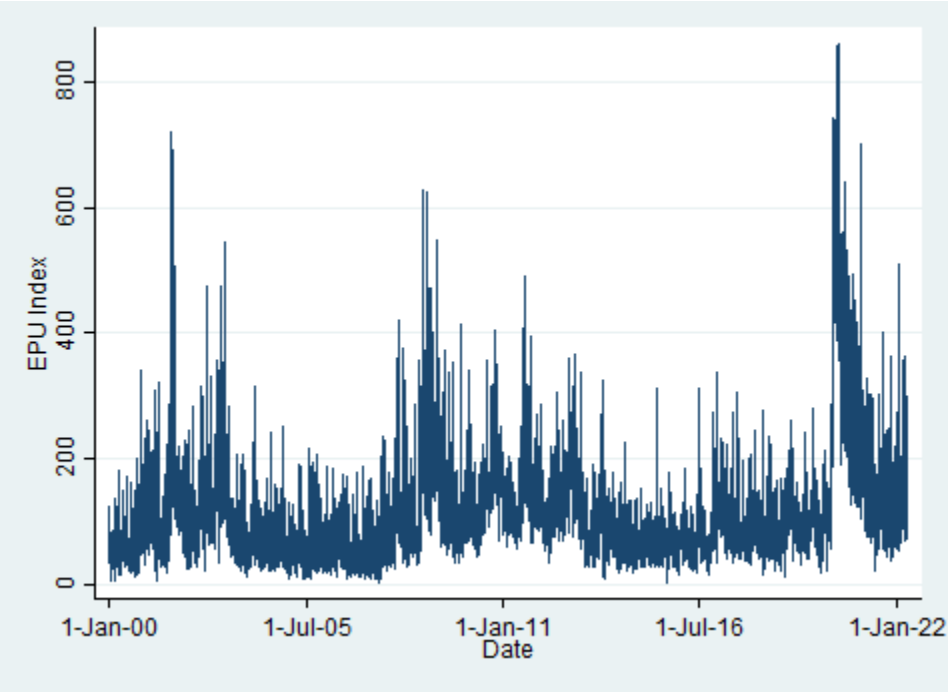

Figure 1: Economic Policy Uncertainty (EPU) US Daily News Index Historical Data

This figure shows daily EPU data ranging from January 2020 to April 2022. We can see significant spikes during the financial crises, including the dot-com bubble in the early 2000's, the 2008 crisis and the 2020 pandemic. This figure further shows significant fluctuations in the uncertainty even in times without a financial crisis.

The EPU index is a daily index that measures policy-related economic uncertainty using daily news coverage[5]. We consider specifically the US Daily News Index, which based on thousands of newspaper sources in the US. and the index searches for terms related to uncertainty used in the articles. The criteria requires an article to contain at least one term from three sets of terms, "economic" or "economy", "uncertain" or "uncertainty" and "legislation", "deficit", "regulation", "congress", "federal reserve" or "white house".

[5] *US EPU (monthly, daily, categorical)*. Economic Policy Uncertainty Index. (n.d.). Retrieved May 16, 2022, from https://policyuncertainty.com/us_monthly.html

The frequency of these word combinations related to uncertainty act as a proxy for uncertainty. Since there is also an ever-increasing number of newspapers over their sampling period, they correct for growth by counting the number of total newspaper articles in a day. The fundamental idea of the index is that in times of increased uncertainty, there will be an increased number of articles that include the search terms.

The index was created by Scott Baker, Nick Bloom and Steven Davis, three prominent researchers in the causes of market uncertainty and its consequences. This index was created in 2016, and is founded on their research paper, "Measuring Economic Policy Uncertainty". The findings of this index shows that the US index has large spikes during close presidential elections, wars, the 9/11 attacks, the 2008 failure of Lehman Brothers, the 2011 debt-ceiling dispute and any other large disputes over fiscal policy. The paper further found that increases in uncertainty and decreases investment, output and employment.[6]

[6] Baker, S., Bloom, N., & Davis, S. (2015). Measuring economic policy uncertainty. https://doi.org/10.3386/w21633

Cboe Volatility Index (VIX)

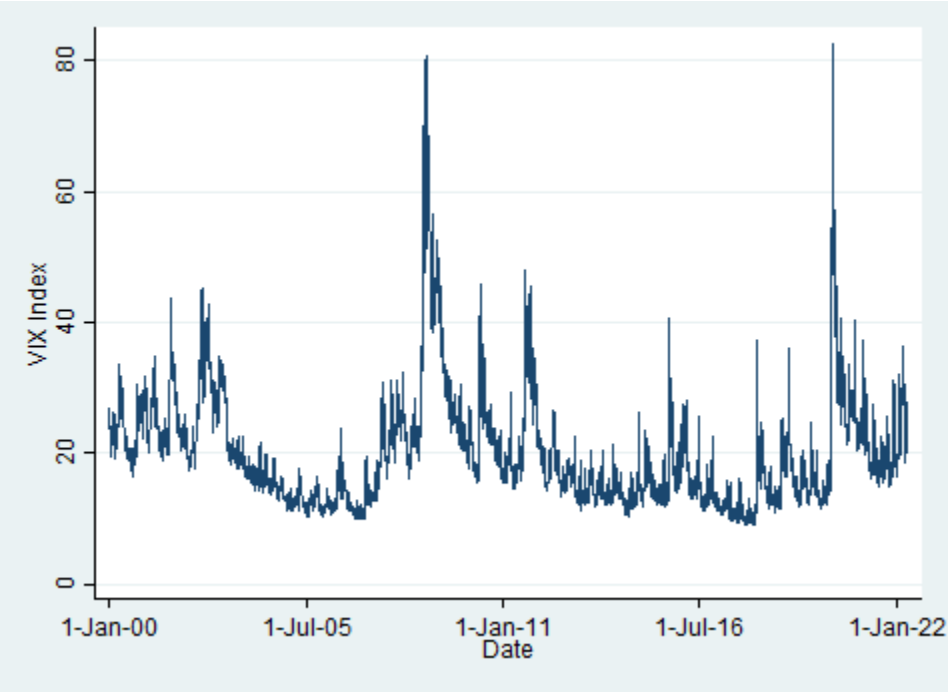

Figure 2: Cboe Volatility Index (VIX) Daily Historical Data

This figure graphically represents the level of uncertainty measured using the VIX index, beginning in January 2000 up to April 2022. This data reflects daily levels of uncertainty. We can see a large spike in 2008 and again in 2020, reflecting the 2008 financial crisis and the pandemic, respectively. We can see that the 2008 crisis seems to have sustained volatility for longer than the pandemic.

The Cboe Volatility Index[7], known commonly as the VIX index, is a benchmark that provides an "up-to-the-minute" estimate of expected market volatility of the S&P 500. The index is fundamentally built to provide an instantaneous estimate of how the market will think the S&P 500 will fluctuate in the next 30 days. Simply put, the VIX instantaneously calculates the midpoint between the real time option bid/ask quotes for the S&P 500. By doing this, the index can measure the volatility of the market at a

[7] Cboe Volatility Index (VIX) Daily Historical Data. Cboe Global Markets. (n.d.). Retrieved May 16, 2022, from https://www.cboe.com/tradable_products/vix/vix_historical_data/

given time during the trading day. It is important to note that the VIX is a forward-looking measure, and is not a measure of actual volatility, which would measure the variability of known prices that have been realized historically.[8]

The VIX is also considered, colloquially, as the "fear index". Since market volatility can be used as a proxy of uncertainty, as was done in a 2019 study of policy news and stock market volatility[9], it can give us insight into instantaneous market reactions to an increase in the know set of information. This study created a newspaper-based Equity Market Volatility tracker that moved in conjunction with the VIX index. The study found that the share of newspaper reporting's that discuss uncertainty increases along with the VIX, and the two are positively related. In the study, volatility (the VIX index) is being used as a proxy for uncertainty. The authors argue that volatility is impacted as the known set of information will expand based on the emergence of crisis related news, bad or good; due to this, they argue the VIX is the best index to measure the impact of good and bad news on market uncertainty.

[8] ING Think. (2018, February 6). *A history of Vix Spikes in three charts*. ING Think. Retrieved May 16, 2022, from https://think.ing.com/articles/a-history-of-vix-spikes-in-3-charts
[9] Baker, S., Bloom, N., Davis, S., & Kost, K. (2019). Policy News and stock market volatility. https://doi.org/10.3386/w25720

Chapter 2: Financial Crises

The 2008 Financial Crisis

On September 15th, 2008, Lehman Brothers, the fourth largest investment bank in the United States, filed for Chapter 11 bankruptcy. The investment bank, over leveraged in mortgage-backed securities that were primarily backed by subprime loans, met its demise when these went into default. September 15th is commonly regarded as the beginning of the financial crisis, although the issues in these subprime mortgages began to show head far before that. The role in which financial industry leaders played in this crisis remains hotly debated even years later, and the world continues to ask the question – how was this able to happen?

The answer begins in 2006, when housing prices began to fall for the first time in decades.[10] Although this encouraged and enabled buying, many homeowners, specifically ones with questionable credit, began to gain approval for mortgage loans. The further issue became not only the bad credit of these applicants, but also the size of the loans that were being granted, some of which were 100% or more of the homes total value. Since house prices prior to 2006 were at an all-time high, mortgage loan delinquency rose, leading to the creation of the United States housing bubble.

One of the underlying contributing factors to the crisis was the deregulation of the financial system, which had been occurring slowly prior to 2008. Banks were allowed to invest in housing related derivatives, something that they were not able to do prior. The banks were allowed to use their deposits to invest in derivatives, which was

[10] Amadeo, K. (n.d.). *2008 financial crisis causes, costs, and could it happen again?* The Balance. Retrieved May 16, 2022, from https://www.thebalance.com/2008-financial-crisis-3305679

legalized by the Financial Services Modernization Act of 1999. This act was passed to "compete with foreign firms in the global sphere", and banks agreed to only invest in low-risk securities to protect their clients. However, as these derivatives became increasingly profitable, the banks began to make riskier and riskier investments. Even worse, these derivatives were exempt from regulatory oversight.

Of the derivatives, the most popular quickly became mortgage-backed securities, and as profitability rose, the demand for the subprime mortgages that they were based on grew. This incentivized institutions to continue to loan to risk borrowers. These mortgage-backed securities were owned in hedge funds, mutual funds, corporate assets, pension funds, and other financial institutions around the globe. Although these assets were risky, funds attempted to mitigate risk through purchasing credit default swaps. Credit default swaps were thought of as "insurance", in that they were a derivative contract that allowed the buyer to make various payments to the seller and in return receives promise of compensation for the potential credit losses resulting from default.[11]

As delinquency continued to rise in the subprime lending market, Freddie Mac, which is the Federal Home Loan Mortgage Corporation, announced it would stop investing in certain subprime loans. This signaled a growing sentiment of concern regarding these subprime loans. By early 2007, major concerns within the US regarding the growing housing bubble began to show, as American real estate investment trust that specialized in subprime lending, New Century, filed for Chapter 11 Bankruptcy. A

[11] Guardian News and Media. (2012, August 6). *Financial crisis: Timeline*. The Guardian. Retrieved May 16, 2022, from https://www.theguardian.com/business/2012/aug/07/credit-crunch-boom-bust-timeline

few months later, margin calls led Bear Stearns to bail out two of its hedge funds. These hedge funds had a combined exposure of $20 billion to collateralized debt obligation related to subprime mortgages. By the beginning of 2008, banks began to realize their vast exposure and that they would inevitably need to absorb the great losses. Due to this, banks halted all lending to one another, which subsequently caused LIBOR, the interbank borrowing costs, to rise. The Federal Reserve attempted to increase liquidity in the banking sector through Term Auction Facility, but very quickly realized the issue was much more widespread.

Other funds faced increasing exposure to the subprime mortgage issue, and when Lehman Brothers' filed for bankruptcy on September 15th, the effects were felt not only in the US, but across the globe, and began the collapse of the financial industry. One of the most prominent sellers of the credit default swaps was AIG, which was American Insurance Group. Following Lehman Brother's bankruptcy, when these credit default swaps were losing all their value, AIG did not have enough cash flow to cover all the swaps that they had sold. This led to the United States government to intervene, and it bought AIG for $85 billion on September 16th, 2008.

Following these huge events and others, a run on the money markets began, as investors quickly moved their money to Treasury bonds. The US government became acutely aware of the impacts a bankruptcy of the nation's money market funds would have, so they quickly submitted a $700 billion bailout package to Congress. As global stock markets began to collapse, the bailout package failed to get passed until October 1st, 2008. At this point, the damage had been done.

The recession broke many records for the market, including largest one-day point drop, largest bankruptcy filed in the US (Lehman Brothers). The meltdown continued into 2009, as US and global leaders coordinated unprecedented collective action to confront the crisis. Market uncertainty hit record highs, and the US economy did not begin to recover until the latter half of 2009, however, the lasting effects left the financial industry changed forever.

The 2020 Covid-19 Pandemic[12]

The 2020 Covid-19 pandemic was completely unprecedented, and while wholly different than the 2008 recession, some parallels can be drawn between the two regarding market uncertainty and the impact news has on both uncertainty and market performance. The pandemic can be traced back to Wuhan, China, where a cluster of patients began to experience symptoms such as shortness of breath and fever. This is identified on January 7th, 2020 as novel coronavirus being the agent causing the outbreak.

Despite ineffective and virtually performative screenings done at major US airports with flights arriving from China, the first case of Covid-19 is identified in Washington on January 20th. While the virus was spreading the wildfire in China, Italy officially became the second global hotspot of the virus, leading to a government order that effectively locked down the entire country of Italy. Panic rose as the world watched China and Italy battle the virus. It didn't take long for President Donald Trump to

[12] Centers for Disease Control and Prevention. (2022, January 5). CDC Museum Covid-19 Timeline. Centers for Disease Control and Prevention. Retrieved May 16, 2022, from https://www.cdc.gov/museum/timeline/covid19.html

declare a national emergency, on March 12th. The United States also began to lock down its states and implement mask mandates outside the home.

By the beginning of April, the US surpasses Italy to become the world's leader in Covid-19 deaths. President Trump announces Operation Warp Speed, which was an initiative to create and distribute a vaccine as soon as possible. This produced funding for pharmaceutical companies in their pursuit to create a vaccine and provided CDC support to expedite the approval processes. Although the idea of a vaccine was promising, it was still at least a year out, and by May 2020, US unemployment hit 14.7%. This was the highest unemployment since the Great Depression, which affected the low income and minority workers unproportionally. The outlook at the beginning of summer 2020 was grim – as the US death toll surpassed 100,000 and The World Bank announces that the pandemic will send the global economy into the worst recession since WWII.[13]

While the world was plunged into increasing uncertainty, the US erupted in national protests supporting the Black Lives Matter movement. After months of social distancing and stay at home orders, suddenly the streets in almost all major US cities were flooded with thousands of protesters, leaving many downtown city areas vandalized and looted, while triggering a conversation about police brutality and race in America.

The protests across the nation along with the worsening conditions of the pandemic created a whirlpool of uncertainty, as the term "unprecedented times"

[13] Taylor, D. B. (2020, February 13). *A timeline of the coronavirus pandemic*. The New York Times. Retrieved May 16, 2022, from https://www.nytimes.com/article/coronavirus-timeline.html

seemingly became the slogan of the pandemic. President Donald Trump and his administration tested positive for Covid-19 in early October, right before New Zealand officially declared itself "virus free", after some of the strictest lockdown precautions in the world.

As Joe Biden is elected as the new President of the United States, many saw hope for the future, specifically in terms of the social agenda of the incoming administration. Despite the US becoming extremely polarized over the politicization of both the Covid-19 pandemic and the Black Lives Matter movement, the country was able to temporarily come together over the Emergency Use Authorization (EUA) of the first vaccine for Covid-19, made by Pfizer. Within a week, another EUA was approved for the second Covid-19 vaccine, by Moderna. In increasingly positive news, US Congress passed the second Covid-19 Relief Act.

In the following months up until the writing of these thesis, a third vaccine by Johnson and Johnson was given EUA, and the US has weathered two surges of Covid-19 variants, the Delta and Omicron variants. By this month, May 2022, the last of the remaining mask mandates across the US have been lifted, besides in healthcare settings. Dr. Anthony Fauci, head of the National Institute of Allergy and Infectious Diseases and chief medical adviser for President Joe Biden, recently announced that the "United States is out of the pandemic phase" after more than two years. [14]

[14] Public Broadcasting Service. (2022, April 26). *Dr. Fauci on why the U.S. is 'out of the pandemic phase'*. PBS. Retrieved May 16, 2022, from https://www.pbs.org/newshour/show/dr-fauci-on-why-the-u-s-is-out-of-the-pandemic-phase-2

Comparative Analysis

The 2008 financial crisis and the Covid-19 pandemic have glaring differences, to causes, duration, effects and much more. Despite this, the purpose of doing a comparative analysis by looking at the impact of news in each is simple – to better understand how news throughout a crisis effects uncertainty in the market. How does the market respond to news of the Troubled Asset Relief Program (TARP) being passed in 2008? How about the news of President Donald Trump testing positive for Covid-19? Or the EUA of a vaccine? This thesis explores the relationship between and effects of good or bad news on market uncertainty, and which has a greater effect on uncertainty.

Chapter 3: Empirical Analysis

Methodology

With the understanding of the 2008 financial crisis, the Covid-19 pandemic, and various measurements for market uncertainty, I will build a model in which expresses the relationship between the effect of good and bad news on market uncertainty. First, we must have an indicator of good or bad news on a certain day. To do this, I created a "Good News" variable, which can have an integer value of 0, 1 or 2 per day. A value of 0 is representative of no good news occurring that day. A 1 indicates a reasonable level of good news, and a 2 represents the news for that day was very good. Further, I created a "Bad News" variable, which can also have integer values of 0, 1 or 2. A value of 0 represents no bad news occurring that day, a 1 with moderately bad news, and a 2 with significantly bad news.

In this analysis, the 2008 financial crisis is January 2007 through December 2009. The Covid-19 pandemic denoted as starting December 2019 through December 2021. Within these two time periods, I found the most remarkable and reported upon news and sorted it by its affiliated date. For each date, it is then categorized as good or bad news; once this is determined, that date is then assigned an integer value to represent the severity of the news. The news included in this analysis is news that is directly related to the crisis and excludes any important news that is not directly related. This is to look primarily at how the financial crises effected uncertainty on a given day.

N=6215	Good News	Bad News	No News
Financial Crisis	98	110	986
Covid-19 Pandemic	29	47	814

Table 1: Good and Bad News Observations

Within the data, there is 6,215 observations ranging from 2000 to the present day. Within the designated time of the financial crisis, there are 1,194 observations with 98 instances of good news and 110 instances of bad news, and 986 days with no significant remarkable news. During the Covid-19 pandemic there are 890 observable days, with 29 instances of good news and 47 instances of good news, with 814 days without significant news.

In the 2008 financial crisis, an example of good news for the purpose of this research would be the Fed announcing in 2009 it is "tentatively seeing evidence" the US recession is easing, and very good news would be the US Senate approval of the asset relief bailout package, titled the Troubled Asset Relief Program (TARP). Bad news during this time would be Lehman Brothers announcing it is actively looking to be sold, while very bad news would be the subsequent Lehman Brothers bankruptcy filing and collapse.[15]

In the Covid-19 pandemic, an example of good and very good news would the first human trials of a Covid-19 vaccine beginning by Moderna and the subsequent

[15] Introduction: Timeline of the crisis. (2016). *The Global Financial Crisis*, 15–26. https://doi.org/10.4324/9781315557649-6

approval of that vaccine for emergency use authorization, respectively. An example of bad news would be the White House Coronavirus Task Force declaring he virus a public health emergency, and very bad news would be President Donald Trump declaring the virus a national emergency and enacting lockdown procedures.[16]

Important to note is the subjectivity of good and bad news. According to the fundamental theory of market uncertainty, as news becomes available and the market can adjust to the new information, good news would be categorized as news that positively impacts the market. Vice versa, bad news would be considered news that negatively impacts the market. Although this is a simplification, it is sufficient as means of strictly categorizing good and bad news in the context of this research.

Another limitation of this type of categorization is not only the subjectivity, but the growing mass of news that is published every day. Further, news emerges at different rates and can potentially have a lagged impact on the market[17]. For all intents and purposes of this study, data collection was done through timeline analysis of each crisis, to find the initial release date of a piece of significant news related to the crisis. Once the significant news was collected for each crisis, it was categorized as good or bad news and given a corresponding score based on its significance and potential effect.

Of the two ways of measuring market uncertainty above, I will use both the VIX and EPU data initially to run regressions on the impact of good and bad news. However, as will be discussed below, it became apparent that the EPU data proves more challenges to the model than benefits, and eventually was excluded from the modeling.

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[16] Katella, K. (2021, March 9). *Our pandemic year-A covid-19 timeline*. Yale Medicine. Retrieved May 16, 2022, from https://www.yalemedicine.org/news/covid-timeline

[17] This concern will be addressed in the model through the creation of a lagged variable.

Further, inclusion of the S&P 500 as a control variable was initially considered, however when it was included it produced biased estimates. Intuitively, this holds, as the VIX index is a measure of volatility in the publicly traded markets and cannot be exogenous of the S&P 500. The VIX index and the S&P 500, although not directly correlated, do have a strong history of maintaining an inverse relationship.

Modeling

VIX

VIX Index

	Percentiles	Smallest		
1%	9.93	9.14		
5%	11.19	9.15		
10%	12.02	9.19	Obs	5613
25%	13.82	9.22	Sum of Wgt.	5613
50%	17.89		Mean	20.00858
		Largest	Std. Dev.	8.743529
75%	23.53	79.13		
90%	30.22	80.06	Variance	76.4493
95%	35.79	80.86	Skewness	2.190001
99%	54.92	82.69	Kurtosis	10.72889

Table 2: Summary of VIX Index Observations

Starting with the VIX index data, we are utilizing 5613 observations, with the smallest measure of volatility being 9.14 and the largest being 82.69. These observations have a mean of 20 with a standard deviation of 8.74. With 50% of the observations falling below 17.89, we can see this data is skewed towards lower levels of volatility. Because of this, we must separate out times of crisis and periods that are not considered to be crises.

-> crisis = 0

Variable	Obs	Mean	Std. Dev.	Min	Max
VIX	4857	18.88037	7.203548	9.14	82.69

-> crisis = 1

Variable	Obs	Mean	Std. Dev.	Min	Max
VIX	756	27.25688	13.17982	9.89	80.86

Table 3: VIX Observations in Financial Crisis

Because our VIX data covers a much larger period than the specifically the financial crisis and the pandemic, it is important than we can restrict (and later control for) volatility during times of crisis. This is because we will see much higher levels of volatility (and therefore higher VIX) during the crises. 'Crisis=1' represents VIX observations that are within the designated financial crisis time frame. Within the financial crisis, we see that the mean level of volatility is 27.26, while it is only 18.88 outside of the crisis. Further, in the crisis the standard deviation is 13.18 versus 7.20 not in the crisis, which speaks to the increased volatility and heighted instability.

-> covid = 0

Variable	Obs	Mean	Std. Dev.	Min	Max
VIX	5031	19.489	8.470725	9.14	80.86

-> covid = 1

Variable	Obs	Mean	Std. Dev.	Min	Max
VIX	582	24.49998	9.730999	12.1	82.69

Table 4: VIX Observations in Covid-19 Pandemic

Further, during the Covid-19 pandemic, we see the VIX index had an average of 24.50, while other periods had a lower mean of 19.49. The Covid-19 pandemic also had a higher standard of deviation. We can see that this summary implies a lower average

VIX index during the pandemic than during the financial crisis. It is important to note that as we attempt to restrict and control for certain times of financial crisis, the mean and standard deviation can become biased by the other financial crisis.

VARIABLES	(1) VIX Index	(2) VIX Index	(3) VIX Index
Good News	-0.2611	-0.3250**	-0.4317
	[-1.168]	[-2.134]	[-1.133]
Crisis Good News			0.1238
			[0.298]
Bad News	2.0239***	0.9681***	1.0733***
	[9.943]	[6.890]	[3.096]
Crisis Bad News			-0.1232
			[-0.325]
Lagged VIX Index		0.7518***	0.7519***
		[88.224]	[88.148]
Financial Crisis Period			9.7881***
			[14.768]
COVID Period			0.1220
			[0.207]
Constant	23.2020***	5.7758***	5.7719***
	[38.933]	[13.886]	[13.871]
Observations	5,613	5,323	5,323
R-squared	0.912	0.966	0.966

t-statistics in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 5: VIX Regression Outputs

To begin with the VIX data, I constructed a simple model with Good News and Bad News as the variables, and a dummy variable for each month to control for months in which volatility is much high, such as a crisis. This model resulted in a Good News coefficient of -0.2611, however not statistically significant, and a Bad News coefficient of 2.0239, which is statistically significant at the 99% confidence interval. As expected, this indicates that a one-unit increase in Good News results in a slight decrease in the VIX volatility index, while a one-unit increase in Bad News results in a much larger increase in VIX. Although it is expected that Good News has an inverse relationship

with VIX and Bad News has a positive relationship with the index, the model remains too simplistic to fairly draw any conclusion from it.

To further expand the model, I added VIX1, which is a 1-day lagged variable. This lagged variable is included to account for effects of a heightened or low level of volatility the day before, as the VIX index is seemingly affected by the level of volatility the prior day. The coefficient for Good News in this model is -0.3250, which is statistically significant at the 95% confidence interval, and the coefficient for Bad News is 0.9681, which is statistically significant at the 99% confidence interval.

However, because the times of crisis are significantly more volatile and reactive, I wanted to create a model that can focus on the impacts of good and bad news specifically during the times of the crises. To do this, I implemented two additional variables to the model, Financial Crisis Period and COVID period. This allows the model to show what the baseline reaction is to good and bad news, in addition to the added volatility that occurs during a time of financial crisis.

$$VIX = \beta_0 + \beta_1 Good\ News + \beta_2 Good\ News * 1_{crisis} + \beta_3 Bad\ News + \beta_4 Bad\ News * 1_{crisis}$$

Figure 3: Final Regression Equation

To see the effects of Good News during the crisis, it would be the summation of β_1 and β_2, -0.4317 and 0.1238, therefore a one-unit increase of Good News during the financial crisis decreases VIX by -0.3079. For Good News in the Covid-19 pandemic, it would simply be β_1, so VIX was expected to decrease by -0.4317 per one unit increase of Good News in the pandemic.

Similarly, we can examine the effects of Bad News in the crisis, as it would be the sum of β_3 and β_4, 1.0733 and -0.1232, therefore a one-unit increase in Bad News during the pandemic would increase VIX by 0.9501. The pandemic effects can be seen in β_3, so a one-unit increase in Bad News increases VIX by 1.0733. It is important to note that in this more complex model, the only coefficient that is statistically significant is that of the Bad News.

EPU

EPU Index

	Percentiles	Smallest		
1%	17.95	3.32		
5%	29.86	3.38		
10%	38.67	4.15	Obs	6215
25%	58.44	4.81	Sum of Wgt.	6215
50%	90.29		Mean	115.2029
		Largest	Std. Dev.	89.79561
75%	142.56	743.13		
90%	215.17	807.66	Variance	8063.252
95%	282.35	855.17	Skewness	2.547852
99%	496.99	861.1	Kurtosis	12.81354

Table 6: Summary of EPU Index Observations

EPU daily news index data set we are using has 6215 observations, with the smallest being 3.32 and the largest being 861.1. The EPU uses a different form of measurement than the VIX Index, therefore the scale of the numbers are not directly comparable. The mean of the EPU index data it is 115.20, with the 50th percentile being at 90.29. It seems uncertainty in this index is also skewed downwards, similar to the VIX. Therefore, we must also control for times of crisis and not.

-> crisis = 0

Variable	Obs	Mean	Std. Dev.	Min	Max
EPU	5119	115.4757	92.08395	3.32	861.1

-> crisis = 1

Variable	Obs	Mean	Std. Dev.	Min	Max
EPU	1096	113.9286	78.25167	3.38	626.03

Table 7: EPU Observations in Financial Crisis

During the financial crisis, there are 1096 EPU index observations with a mean of 113.93 with a standard deviation of 78.25. Comparatively, time periods outside the financial crisis have a mean of 115.48 with a standard deviation of 92.08. This seems counterintuitive, as this can be interpreted as time periods outside the financial crisis have higher uncertainty and higher fluctuations in this volatility.

-> covid = 0

Variable	Obs	Mean	Std. Dev.	Min	Max
EPU	5372	100.008	66.94422	3.32	719.07

-> covid = 1

Variable	Obs	Mean	Std. Dev.	Min	Max
EPU	843	212.0317	141.6338	20.63	861.1

Table 8: EPU Observations during Covid-19 Pandemic

In the Covid-19 pandemic, the average EPU index is 212.03 with a large standard deviation of 141.63. This is similar to what we might expect, as times outside of the pandemic have an average EPU index of 100.01 with a standard deviation of 66.94. However, it is difficult to reconcile as to why the EPU data does not show a similar relationship during the 2008 financial crisis. One explanation could be changes in the sheer mass of news reporting increasing between the financial crisis and the

pandemic; another could be changes to the way in which articles are written and sensationalized to invoke fear in the more recent years. This is indicative of the EPU index potentially not being the more reliable choice for a dataset.

VARIABLES	(1) EPU Index	(2) EPU Index	(3) EPU Index
Good News	8.0212*	6.9830*	3.9721
	[1.915]	[1.725]	[0.387]
Crisis Good News			3.9599
			[0.354]
Bad News	6.8162*	5.6576	-9.0832
	[1.868]	[1.604]	[-1.083]
Crisis Bad News			17.9411*
			[1.940]
Lagged EPU Index		0.2573***	0.2577***
		[20.535]	[20.557]
Financial Crisis Period			1.7322
			[0.111]
COVID Period			371.6536***
			[22.169]
Constant	53.5700***	40.7555***	40.7379***
	[4.393]	[3.365]	[3.364]
Observations	6,215	6,214	6,214
R-squared	0.647	0.670	0.671

t-statistics in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 9: EPU Regression Outputs

Now using the EPU daily news index, we can use the same three models as above to measure the effects of good and bad news on market uncertainty. However, when running the first regression using just Good News and Bad News as the variables, we see that the variables have a positive relationship with the EPU index. Good News has a coefficient of 8.0212 and Bad News has a coefficient of 6.8162. Although these are statistically significant at the 90% confidence interval, this suggests that good and bad news both increase market uncertainty.

Further, by adding a 1 day lagged EPU index variable, similar to how we did with the VIX models, both coefficients lower slightly, and Bad News is no longer statistically significant. In this case, the lagged variable is arguably not as necessary, as this index does not measure volatility, and increased appearance of certain key words the day prior most likely will have less of an effect on the following day's number of articles with key uncertainty words.

Finally, we can run our final regression to specifically target the effects of Good and Bad News during the crises. In terms of Good News, the coefficient during the crisis would be 7.932 and the pandemic it would be 3.9721. Further, looking at Bad News, the coefficient during the crisis would be 8.8579 and during the pandemic it would be -9.0832. This is slightly concerning, as this suggests that during the pandemic, a one-unit increase of Bad News led to a large decrease in the EPU uncertainty index. Further, these are not statistically significant enough to draw a conclusion on.

Based on the modeling of the EPU data, I have chosen to exclude it from my final analysis. One of the issues with this data set is that since it is only looking for a few, broad terms and the frequency of those words used on a given day, as a proxy for market uncertainty is potentially an oversimplification. For example, words related to uncertainty could very well appear in an article classified as "good news", which might be the reasoning behind both Good News and Bad News variables both having a positive relationship to the EPU News Index, and why I have chosen to exclude this set of regressions related to the EPU data and focus solely on the VIX data.

Chapter 4: Conclusion

The results of the EPU and VIX models highlights a few key aspects of measuring uncertainty. First, with the EPU data showing a positive relationship between news, both bad and good, with market uncertainty is contrasted starkly with the VIX data showing a positive relationship with bad news and a negative relationship with good news. This shows while using the same data set of good and bad news with both indexes, we get completely different interpretations of the relationship of uncertainty and news. This is the concern with research into market uncertainty, as there are various proxies to use and approaches to take, but typically we receive wildly different results. This could be a testament to the concern with using proxies as a measurement, as was done with both the VIX and EPU data, which calls for further research into the understanding of market uncertainty.

While comparing both the financial crisis and the Covid-19 pandemic and the EPU and VIX data, we can see that the EPU data raises concerns as to the accuracy of the index as a proxy. With good news having a positive relationship with uncertainty, it is most likely due to the limitations of the index itself. Since the keywords that the index searches for cannot determine if the article is speaking about those terms favorable or unfavorable, articles of good news could potentially be biasing the index.

Looking at our final model, which uses the VIX data, we find that bad news increases uncertainty and good news decreases uncertainty. This might be what one expects. However, our results show that bad news has more of an effect on uncertainty than good news does.

Why does it have more of an effect on bad news? One plausible explanation could be that since we are looking at the VIX index, which measures volatility as a proxy of market uncertainty, one could potentially argue that although good news should ideally help the increase market returns and allow prices to correct due to increased information available, the introduction of good news might not necessarily change volatility. Especially since the VIX index is measured, simply put, by the midpoint between the bid/ask quotes in real time, good news could potentially still influence trading and therefore volatility.

In conclusion, our findings, using the VIX index, show that bad news increases uncertainty to more of a degree than good news reduces uncertainty. These preliminary findings call for more research into market uncertainty, its measurements, and the accuracy of proxies as a tool of measurement.

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