Space is an Uncorrelated Investment Sector

The Space Industry is Not Strongly Correlated to Major Market Indices or Alternative Asset Classes

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ABSTRACT

Over the last two decades, "NewSpace" has emerged as a burgeoning alternative investment sector, with dozens of venture capital and private equity firms investing in this rapidly growing industry. The space industry has also started being represented in other asset classes such as private equity, debt, and public markets. However, this new sector is not yet well understood by the capital allocators that invest in venture capital and other asset classes, due to the nascent nature of the industry and the relatively small sample size of public companies. This research was conducted to help such allocators understand how this new alternative investment sector relates to other investment opportunities. The findings of this research suggest that space is consistently weakly correlated to every asset class and investment sector tested in the study. This weak correlation, coupled with the industry's consistent growth over the period tested, may suggest that the space industry could offer valuable diversification and hedging opportunities for institutional investors. In this paper, the authors will discuss this lack of correlation to major market indices and alternative investment options and why this is important for capital allocators who frequently use correlation data to support portfolio decision-making.

I. Nomenclature

p	= the probability of obtaining test results at least as extreme as the result actually observed
$r\ xy$	= correlation coefficient between X and Y
$\bar{x}$	= *the average of the values* X within a sample
$X\ i$	= the values of X within a sample
$\bar{y}$	= the average of the values of Y within a sample
$Y\ i$	= the values of Y within a sample

II. Introduction

When institutional investors select assets to invest in, one of their most important considerations is the correlation between those assets. The goal of assessing correlation is to ensure that a portfolio of investments is hedged against multiple risk factors in addition to being diversified to maximize gains. This technique helps endowments, pension funds, insurance companies, and other asset managers reduce their risk profile by ensuring that a major and unexpected market issue (i.e. a Black Swan Event [1]), international market disruptions, currency fluctuations, interest rate uncertainty, and other investing risks do not seriously affect the overall value of their portfolio.

Historically, most asset managers used fixed-interest bonds to diversify their holdings outside of public market stocks. As these investors became more sophisticated, and as more alternative investment opportunities arose, the standard 60/40 split (60% stocks, 40% bonds) has been replaced with a 'basket' of investments spread across a wider number of diverse asset classes [2]. For more than two decades, institutional investors have also started diversifying their holdings into alternative investment classes such as:

- Real Estate, or Real Estate Investment Trusts (REITs)
- Global Stocks & Bonds
- Oil & Precious Metals
- Hedge Funds
- Private Equity & Venture Capital

In order to assess how these different asset classes will relate to each other in a portfolio of investments, asset allocators often use correlation to determine how returns move comparatively. Guggenheim Investments publishes correlation data of major asset classes to help asset allocators improve diversification and reduce risk.

Historical Correlation[1]: January 2013–December 2023

Click Asset Class to Highlight | RESET

	Positive	Negative
High	0.7-1.0	(0.7)-(1.0)
Moderate	0.4-0.7	(0.4)-(0.7)
Low	0.0-0.4	(0.0)-(0.4)

	Investment Grade Bonds	Cash	Commodities	Currencies	Equity Market Neutral	Event Driven	Global	Hedge Funds	International Equity	Long/Short Equity	Managed Futures	REITs	S&P 500*
Investment Grade Bonds	1.00												
Cash	0.12	1.00											
Commodities	(0.16)	(0.11)	1.00										
Currencies	(0.41)	(0.15)	(0.32)	1.00									
Equity Market Neutral	0.19	(0.07)	0.26	(0.53)	1.00								
Event Driven	0.16	(0.08)	0.60	(0.29)	0.33	1.00							
Global	0.38	(0.03)	0.45	(0.47)	0.30	0.79	1.00						
Hedge Funds	0.12	(0.10)	0.58	(0.27)	0.45	0.88	0.75	1.00					
International Equity	0.38	0.01	0.48	(0.57)	0.36	0.78	0.94	0.74	1.00				
Long/Short Equity	0.29	(0.02)	0.45	(0.41)	0.45	0.80	0.86	0.87	0.85	1.00			
Managed Futures	(0.13)	(0.08)	(0.03)	0.25	0.06	0.01	(0.07)	0.33	(0.11)	0.07	1.00		
REITs	0.55	(0.09)	0.26	(0.26)	0.27	0.62	0.77	0.62	0.69	0.67	0.07	1.00	
S&P 500*	0.36	(0.04)	0.40	(0.40)	0.25	0.74	0.98	0.72	0.87	0.84	(0.04)	0.77	1.00

Fig. 1 Guggenheim Investment Asset Class Historical Correlation [3]

While the space industry touches several asset classes, including public markets, debt, and private equity, there is very little data available about the industry's effect on these asset classes. Space, as a portfolio management theme, primarily exists within the private equity realm, specifically the high-risk, patient capital invested by the venture capital industry. The primary investors in these venture capital funds are institutional investors. Therefore, this research aims to characterize the space industry in terms that are useful to these capital allocators by testing the correlation between that space industry and the asset classes that are typically under consideration in hedging and diversification discussions.

The space industry is a rapidly evolving sector of the global economy. The aerospace industry has been active since the 1960s when the United States' state-sponsored space agency, NASA, turned to private companies to manufacture elements of its space program. Large aerospace companies such as Boeing, Lockheed Martin, Raytheon, and many others expanded their "aero" programs to include "space" technologies for both civil and defense customers, creating the "aerospace" industry.

However, over the last two decades, a new type of space industry has begun to emerge, characterized by customer focus, new product development approaches, and new business models [4]. This 'NewSpace' revolution has contributed to significant industry growth as new entrants develop novel business models that utilize the space environment to create profit. According to McKinsey & Company and the World Economic Forum, the space industry is predicted to grow from its current size of $630 Billion in 2023 to over $1.8 Trillion by 2035.

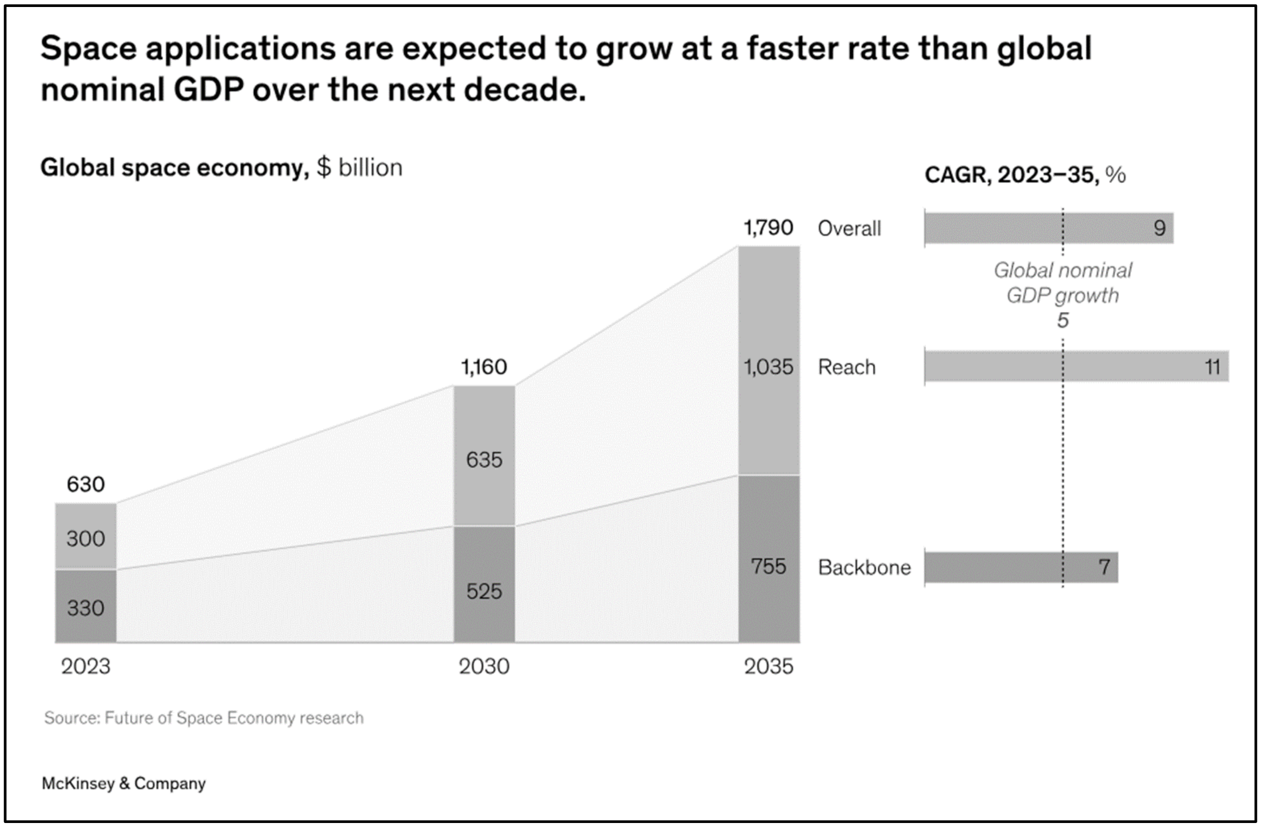

Fig. 2 Space Applications are Expect to Grow at a Faster Rate than Global Nominal GDP Over the Next Decade [5]

This new space industry has been largely driven by private investment, as opposed to the civil and defense sponsorship that was, historically, the most common source of capital in the aerospace industry. In fact, Bryce reports that among start-up space ventures, "venture capital firms account for nearly three-quarters of investors in 2022 and, along with corporations and angel investors, makeup over 90% of investors [6]." From the year 2000 until 2021, the total private investment in the space industry was $46.5 Billion, of which $27.1 Billion was from venture capital firms [7].

These venture capital firms typically receive investments from institutional investors. However, as of yet, there has not been any data on how these space investments relate to other assets that these institutional investors may be holding.

Hedging against market risks while still meeting the investors' goals has become a full-time job for asset managers, as well as an area of rigorous academic study. This paper is intended to add to this body of research with the first published study of the correlation of the space industry to other assets that might be purchased by institutional investors, allowing these investors, for the first time, to consider investment instruments with a space focus when calculating their overall portfolio's risk profile. In times of economic and market disruption and interest rate uncertainty, these considerations become even more poignant to asset managers.

III. Methodology

The performance of different asset classes can be difficult to compare when individual managers and asset classes have different return timing (some have capital locked up for a decade, some for only days or weeks), different fee structures, and different capital call structures. Because of this, the Year-Over-Year (YOY) change of an index of investments was determined to be the best standardized measure of asset class performance to compare different investment opportunities to each other.

The commercial space industry is experiencing a renaissance with expansion into multiple asset classes such as venture capital, debt, and public markets. However, there are still comparatively few datasets about the industry and even fewer that can specifically define the performance of space investments.

Within the public markets, there are only a small number of pure-play "NewSpace" companies listed, with only a few years of historical performance. The volatility in stock performance seen after the wave of space company SPACs in the early 2020s may also not have been representative of the industry overall as this volatility has been attributed to a lack of public market understanding of the long timelines and business models of the space industry [8] as well as the overall poor performance of SPACs from any industry during this timeframe. The results of this limited and potentially skewed dataset of public market NewSpace companies may give investors hesitancy when considering committing capital to this industry, so it is important to take a more comprehensive view of the industry's performance.

Traditional aerospace companies, such as Boeing, Lockheed, Airbus, and others, have significant historical public pricing data available, but these companies receive the bulk of their income from the "aero" side of their aerospace companies, such as airplanes, drones, and other defense projects, making these public market stocks a poor corollary for the commercial space industry.

Without a robust public market dataset, other measures of industry growth had to be collated as a way of assessing the change in the value of the space industry compared to widely available index data of established major markets and alternative asset classes.

In industries without significant public market data to analyze, other measures can be considered. For example, the U.S. Bureau of Economic Analysis (BEA) uses Gross Output per Industry as a standard measure of an industry's economic impact on the U.S. economy. Gross output data allows policymakers, analysts, and businesses to understand how different sectors interact and contribute to economic growth. It complements other metrics like gross domestic product (GDP) and provides a more detailed picture of the economy. However, the analysis performed by the U.S. BEA on the space industry only contains data from 2012 to 2021 [9], which is a relatively small dataset (only 10 years) to use for this type of correlation analysis.

Based on the availability and reliability of data, the authors chose three datasets to be analyzed for normal distribution and then correlation to a set of investment indices. All three of these datasets provided values for at least the years between 2005 and 2022, providing nearly two decades of data:

1. Global Space Economy ($B), from Space Foundation's The Space Report [10].
2. Commercial Space Industry ($B), a subset of the data of the Global Space Economy from Space Foundation's The Space Report.
3. The Number of Objects Launched into Space, as reported by Our World in Data [11].

The Space Foundation's The Space Report is a world-renowned resource for reliable data on the space industry. They publish data on a yearly basis that tracks the space industry from several angles, providing a rich dataset to understand the economic activity in the space realm. The data is typically published mid-year and includes information about the previous year's economic results as compared to historical data. As a measure of total industry revenue, this dataset provides a similar dataset as the U.S. BEA, but with more years of data for analysis. Over the period tested, this data shows consistent growth of the space industry, indicating that this sector may offer economic opportunity for governments, entrepreneurs, and investors.

Two datasets were gleaned from The Space Report, and both the Global Space Economy (in Billions of USD) and a subset of that data, the Commercial Space Industry (in Billions of USD) were used for this study. The authors wanted to ensure they were testing both the global space industry which includes the traditional business-to-government business model (such as traditional aerospace and defense contractors) as well as the more specific commercial space industry which has a stronger focus on business-to-business markets and is more relevant to the "NewSpace" ecosystem that has become the focus of many venture capital and private equity firms over the last few years.

The number of objects launched into space was used as a facsimile for industry growth as this number may be a leading indicator of revenue across the space domain. From the time of a satellite's launch, it can take a company months to years to start producing revenue from that asset, so the authors expect that the number of objects launched into space can help predict overall market size and revenue in upcoming years.

Space Industry Data						
	Global Space Economy		Commercial Space Industry ($B)		# Objects Launched into Space	
Year	Total Value ($B)	YOY Change	Total Value ($B)	YOY Change	Total Objects	YOY Change
2005	$177		$126		72	
2006	$207	17.10%	$152	20.57%	95	31.94%
2007	$225	8.57%	$167	10.32%	111	16.84%
2008	$235	4.70%	$171	2.35%	109	-1.80%
2009	$235	-0.27%	$163	-4.96%	125	14.68%
2010	$244	4.03%	$170	4.63%	120	-4.00%
2011	$271	11.06%	$193	13.37%	129	7.50%
2012	$286	5.45%	$209	8.19%	134	3.88%
2013	$291	2.03%	$214	2.53%	210	56.72%
2014	$329	12.80%	$248	16.11%	241	14.76%
2015	$344	4.68%	$271	9.22%	222	-7.88%
2016	$357	3.77%	$285	4.87%	221	-0.45%
2017	$387	8.21%	$309	8.48%	456	106.33%
2018	$401	3.86%	$315	2.20%	453	-0.66%
2019	$424	5.61%	$333	5.45%	586	29.36%
2020	$431	1.58%	$340	2.33%	1,274	117.41%
2021	$469	8.96%	$362	6.35%	1,810	42.07%
2022	$546	16.36%	$428	18.13%	2,163	19.50%

Fig. 3 Space Industry Data and Growth Rates

Before running a correlation analysis, it is important to check that the data being used is normally distributed. This standardization allows for testing to be much more efficient and reliable. Specifically, with regard to correlation coefficients, having normally distributed data ensures correlation analysis is valid and describes the distribution of the data accurately [12].

First, the authors checked if the data was normally distributed using the Shapiro-Wilk test, which evaluates data with a null hypothesis that the dataset is normally distributed. In null-hypothesis testing, the *p*-value is the probability of obtaining test results at least as extreme as the result observed, under the assumption that the null hypothesis is correct. A small *p*-value means that an extreme observed outcome would be very unlikely under the null hypothesis [13].

It was found that both the Global Space Economy and The Commercial Space Industry Year -Over -Year change were normally distributed and did not reject the null hypothesis. However, the Number of Objects Launched into Space was not distributed normally, due to the outlying outcomes in this dataset. After running the Shapiro-Wilks, the following were the results:

Global Space Economy	$p = 0.428$
Commercial Space Industry	$p = 0.733$
Number of Objects Launched into Space	$p = 0.005$

Fig. 4 *P*-Values of Space Datasets

As the Shapiro-Wilks test rejects the hypothesis of normality when the p-value is less than or equal to 0.05, the Number of Objects Launched into Space was rejected as a dataset to be used for correlation calculations. Using The Number of Objects Launched into Space may be beneficial when showing industry growth, but it is difficult to compare to market indices when it is not normally distributed [14]. The Number of Objects Launched into Space would be better explained with medians and percentiles as it is not an industry or economic growth rate, but simply a count of objects, and when you compare a numbered count to a growth rate of returns, they do not appear normally distributed.

To validate the remaining two space datasets, the authors ran a linear regression between both of the chosen space datasets and one of the comparative indices, in this case, the S&P 1200 [15]. This shows that there is no statistical significance between the S&P 1200 and the space indices. Figures 5 and 6 show the results of the linear regression, visualizing no linear correlation between the S&P 1200 and the Commercial Space Industry or the Global Space Economy.

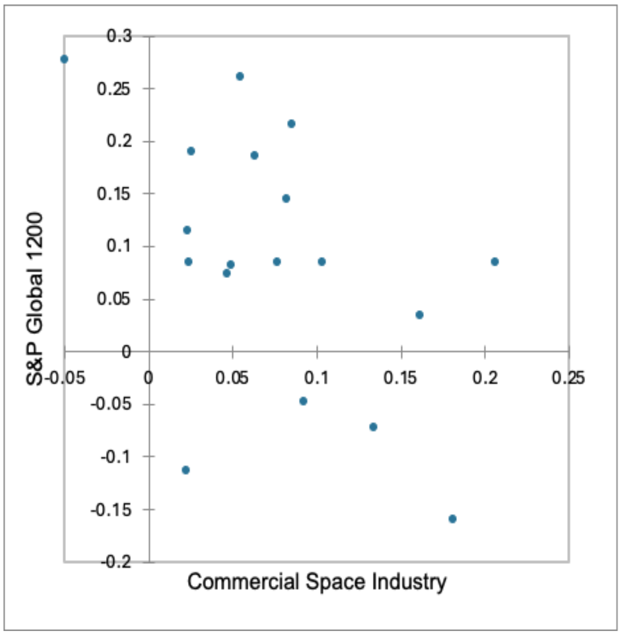

Fig. 5 Linear Regression Comparing the S&P 1200 and the Commercial Space Industry

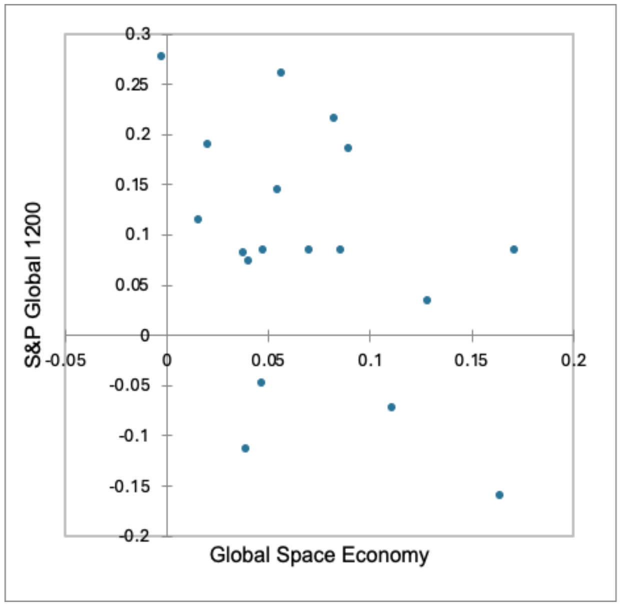

Fig. 6 Linear Regression Comparing the S&P 1200 and the Global Space Economy

The authors then charted the Year-Over-Year growth of the S&P 1200 and compared it to the Global Space Economy. It can be noted that the global space economy did not have a negative year of growth (within the dataset) and does not have as much volatility as the S&P 1200. The resulting chart (Figure 7, below) visually shows the Global Space Economy's mostly independent market movement.

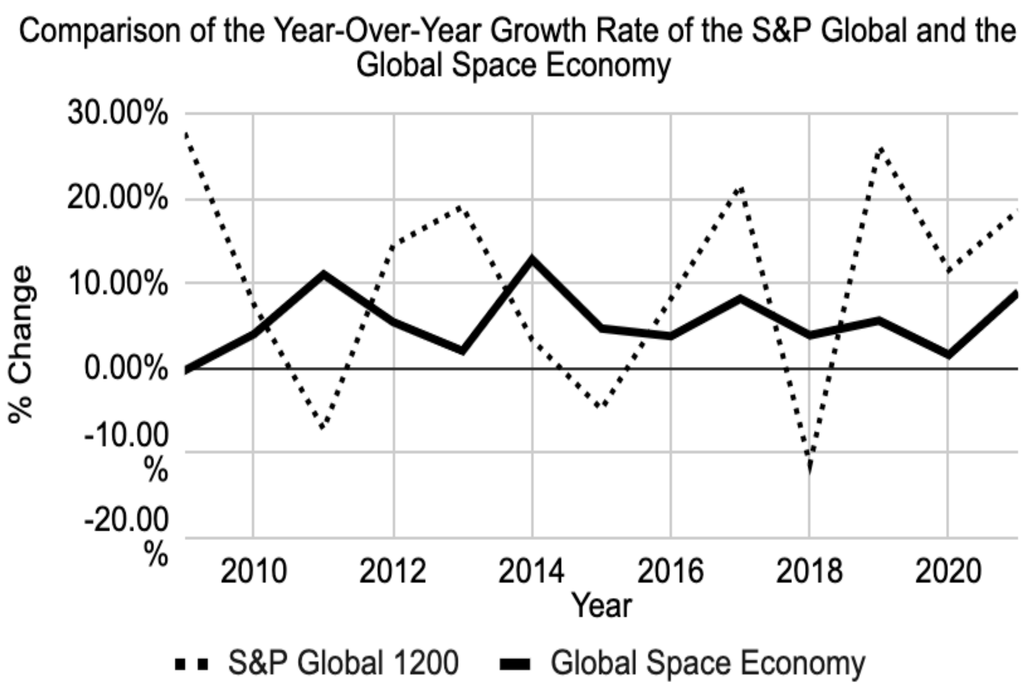

Fig. 7 Comparison of the Year-Over-Year Growth Rate of the S&P Global and the Global Space Economy

After verifying that there was no visual correlation, the authors turned to correlation calculation techniques to further define the relationship between the datasets and major market and alternative asset indices. Several techniques were considered, including nonlinear correlations such as the Spearman and Kendall methods. These methods measure monotonic relationships (both increasing, or one increasing while the other decreases, and not necessarily linear). The Spearman correlation is not appropriate for this data because it does not assume a linear relationship and is most useful when data is not normally distributed. The Kendall correlation also would not work well for this data because it is most useful when the dataset is small and contains statistical outliers [16].

Instead, the authors determined that a linear correlation called the Pearson linear correlation coefficient, would be the most useful. A Pearson correlation provides a single correlation coefficient that only describes the strength and direction of the relationship without specifying impact (causation)[16]. The correlation run by the authors compares Year-Over-Year growth rates as the normally distributed figure, and the results show each index's correlation value based on their growth rate per year, not by price or valuation. The standard formula to calculate the correlation coefficient (*r*) is:

$$r_{xy} = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \, \Sigma(y_i - \bar{y})^2}}$$

r_{xy} = correlation coefficient between x and y

x_i = the values of x within a sample

y_i = the values of y within a sample

$\bar{x}$ = the average of the values of x within a sample

$\bar{y}$ = the average of the values of y within a sample

Fig. 8: Correlation Coefficient (*r*) Formula [17]

This formula will return an *r*-value, or correlation coefficient, of between -1 and +1. To assess investment returns, it is useful to consider the following metrics of correlation coefficients:

- A correlation coefficient of +1 indicates a perfect positive correlation, meaning the assets move in the same direction, with similar timing. For example, the S&P 500 has a 0.98 correlation to global stocks according to Guggenheim Investments [3].This shows that similar performance should be expected for a portfolio of S&P 500 stocks and a portfolio of global stocks.
- A correlation coefficient of -1 indicates a perfect negative correlation, meaning the assets move in opposite directions, with similar timing.
- A correlation coefficient of 0 means that the returns of the assets are completely uncorrelated.

Correlation coefficients (*r*-value) can be further divided into ranges, allowing the easy identification of the weakness or the strength of the correlation. These generally accepted categories, according to Schober, Boer, and Schwarte [18] are:

Absolute Magnitude of the Observed Correlation Coefficient	Interpretation
0.00–0.10	Negligible correlation
0.10–0.39	Weak correlation
0.40–0.69	Moderate correlation
0.70–0.89	Strong correlation
0.90–1.00	Very strong correlation

Fig. 9: Interpretation of Correlation Coefficients

The Pearson correlation was then run between the two space datasets and eight chosen major market and alternative asset indices, which include both asset classes (stocks, real estate, hedge funds) and sector-specific investments (oil, gold, Bitcoin):

1. Global Stock Index - S&P 1200 [15]
2. Global Stock Index - MSCI [19]
3. Global Oil Index - S&P [20]
4. Crude Oil price per Barrel [21]
5. All REITs Index by NAREIT [22]
6. Eurekahedge Hedge Fund Index [23]
7. Price of Bitcoin (BTC in USD) [24]
8. Gold Return on Investment [25]

IV. Results

Correlation Values		Space Indices	
		Global Space Economy	Commercial Space Industry
Market Indices, Varied	Global Stock Index - S&P	**-0.51**	**-0.59**
	Global Stock Index - MSCI	-0.25	-0.22
	Global Oil Index - S&P	0.35	0.11
	Crude Oil Price per Barrel	-0.13	-0.25
	All REITs Index by NAREIT	0.12	0.30
	Eurekahedge Hedge Fund Index	0.39	0.39
	Price of BTC (in USD)	0.38	**0.47**
	Gold Return on Investment	0.04	-0.01

Fig. 10 Results of Correlation Calculations Between Two Space Datasets and Eight Major Market and Alternative Asset Class Indices

V. Discussion

The results of this research clearly show that the space industry is weakly correlated to most of the global market and alternative asset class indices to which it was compared, except for the moderate negative correlation seen between the S&P Global and both space indices and the moderate positive correlation between the price of Bitcoin and the Commercial Space Industry (in bold in the chart above, Figure 10). There are no correlation coefficients that are within the strong range, and most are well within the negligible or weak ranges. This data shows that whatever the source of financial capital (venture capital, private equity, debt, public markets, etc.), dedicated space portfolios within those asset classes may compete more effectively than the cumulative industrial sectors represented in the studied indices.

The moderate negative correlations between the S&P Global (-0.59 for the Global Space Economy and -0.51 for the Commercial Space Industry) only further prove that the space industry is not affected by global market drivers and tends to move opposite to the S&P Global. The authors hypothesize that this is due to the insulated nature of the industry which has continued to show positive growth even during volatile market conditions.

There is also a moderate positive correlation between the price of Bitcoin and the Commercial Space Industry (0.47). The authors hypothesize that this moderate correlation has been caused by the rapid increase in value in both asset classes during the period tested. It's also important to mention that BTC pricing data only became available in 2011 after the advent of the new asset class of cryptocurrencies, so the comparison period was significantly shorter than with the other datasets. As both industries continue to mature, this will need to be tested again in the future to determine if the two datasets continue to show a moderate correlation.

Interestingly, both space datasets show the weakest correlations to the Gold Return on Investment Index (0.04 for the Global Space Economy and -0.01 for the Commercial Space Industry). There is also a weakly negative correlation between the Crude Oil Price per Barrel and both datasets (-0.13 for the Global Space Economy and -0.25 for the Commercial Space Industry). Both assets (Gold and Oil) show significant volatility over the period tested. When compared to the stable growth of the space industry data, the volatility of the other industries may be the driver of these weak correlations

The space industry is the only dataset tested that did not have a negative year of growth between 2005 and 2022. It appears that when a Black Swan event like COVID-19 or the subprime mortgage crisis of 2008-2009 happens, the space industry may be minimally affected.

In Figure 11 (below), the Global Space Economy is represented by a solid black line, showing that the industry has not had a year of negative growth during the period tested. As a reference, the authors have chosen to compare the Global Space Economy with the S&P 1200 as well as the Gold Return on Investment Index, as these are the two indices with the most (S&P 1200) and least (Gold) correlation from the study's results.

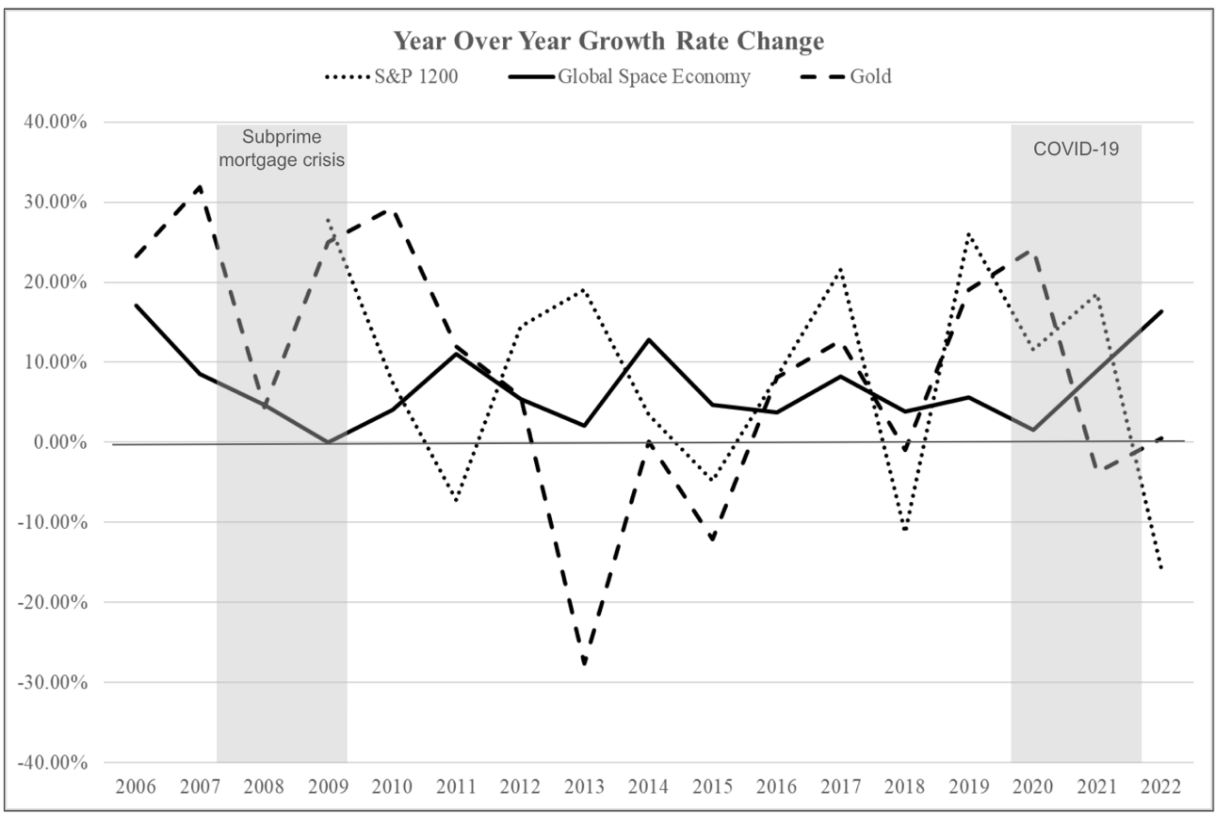

Fig. 11: Year Over Year Growth Rate Chart Comparing the Global Space Economy, the S&P 1200, and the Gold Return on Investment Index.

This consistent positive growth in the space industry may be attributable to several factors that are unique to this economic sector. The authors hypothesize that the following industry drivers may have impacted this distinctive growth profile:

- The Global Space Economy, and to a degree, the Commercial Space Industry, are largely driven by the world's largest space customer, the US government. According to some reports, the USG space budget accounts for at least 20% of the overall Global Space Economy [9], providing a steady stream of reliable income to these companies that are not tied to wider market conditions.
- The primary drivers of the rapid increase in objects being launched into space are the drastic reduction in launch costs [26] due to SpaceX and other private launch providers, and the reduction in the size [27] and weight of spacecraft (following the expectations of Moore's Law). These forces continue to put downward pressure on price and size regardless of broader market conditions.
- During the COVID-19 pandemic, most space companies around the world were given the 'essential' designation required to continue operations, even as other businesses were forced to close. This likely helped the industry weather the storm as operations were not severely hindered, even if supply chain hiccups caused production delays in some cases.

VI. Conclusion

Asset allocators often use both hedging and diversification strategies in selecting assets for their portfolios. According to the Chartered Alternative Investment Analyst Association, "Hedging refers to protecting a portfolio against a stock market crash, while diversification is about finding strategies that offer uncorrelated returns to equities [28]."

The space industry may be unique in its ability to offer both downside protection and a lack of correlation to other investment opportunities. The space industry has seen stable, continuous growth that is independent of overall market conditions. Accounting for 20% of the industry customer base, the U.S. governments' space spending may create a layer of stability that has reduced the space economy's volatility even during Black Swan events.

Two main factors that may be driving this growth are the decrease in launch costs, and underlying space technologies becoming smaller in size and weight while performance capabilities increase. Combined, these two factors have driven a rapid increase in the number of objects being launched into space, and the number of business opportunities that can be profitable.

As capital allocators continue to search for opportunities to diversify their portfolios while having the opportunity to realize outsized returns, the space industry should be considered as a potential investment sector. While the public market investment opportunities for this industry are still minimal, there are several private market investment options, such as the space-focused portfolio management strategies of several emerging private equity and venture capital firms. Accredited investors who have the ability to make such private market investments should conduct their own research to confirm the conclusions of this paper.

As this industry is still nascent, and its' lack of correlation and consistent growth continue to provide significant investment opportunities, further research should be conducted in the following areas to improve capital allocators' understanding of the industry and its investability:

- What are the market drivers that cause the space industry's weak correlation to other asset classes? The authors have theorized that this may be due to the insulated nature of an industry with strong government support, but this needs further review and research.
- What are the market drivers that cause the space industry's consistent growth? The authors have hypothesized some causes such as reduced launch cost and decreasing size of technology, but these need further review and research.
- What portion of the increase in the Number of Objects Launched into Space and the decreased costs of launch are directly related to SpaceX's Starlink constellation? It may be interesting to conduct correlation research with the removal of this outlier.
- Will the moderately positive correlation between the Commercial Space Industry and the price of Bitcoin continue? What are the factors that are driving this moderately positive correlation?

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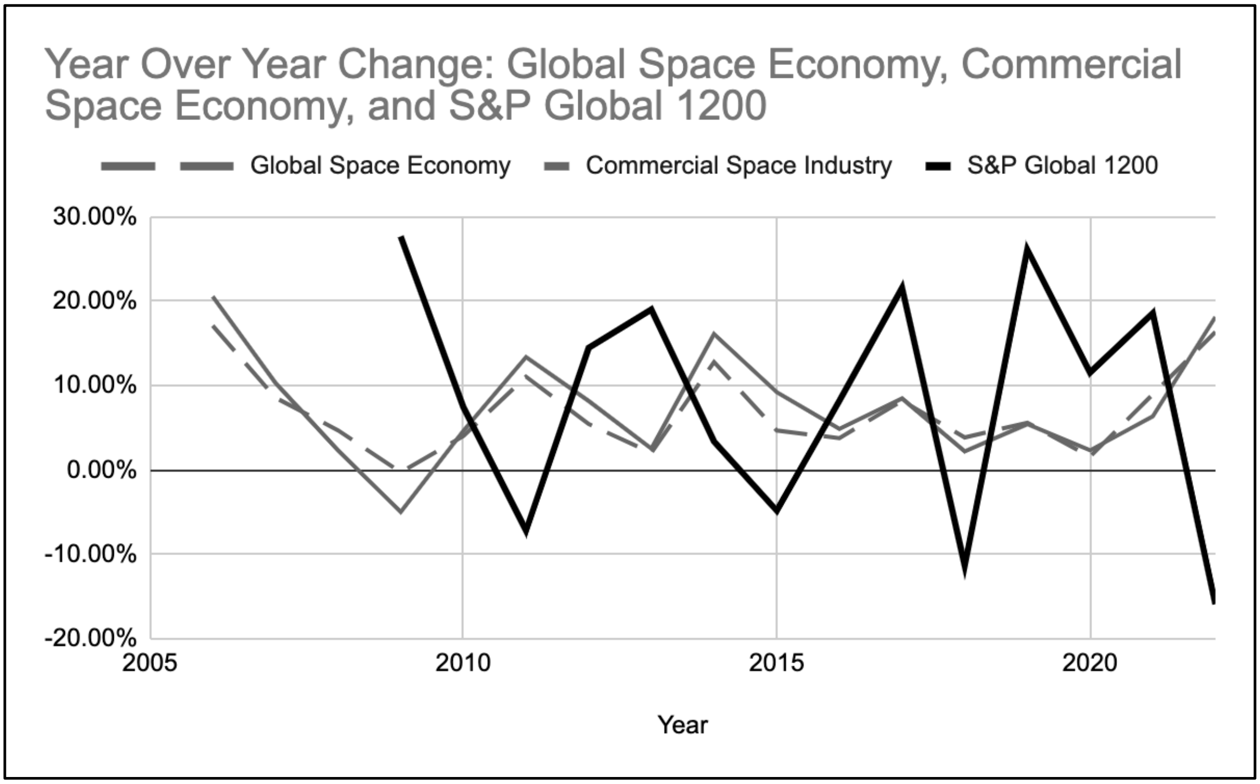
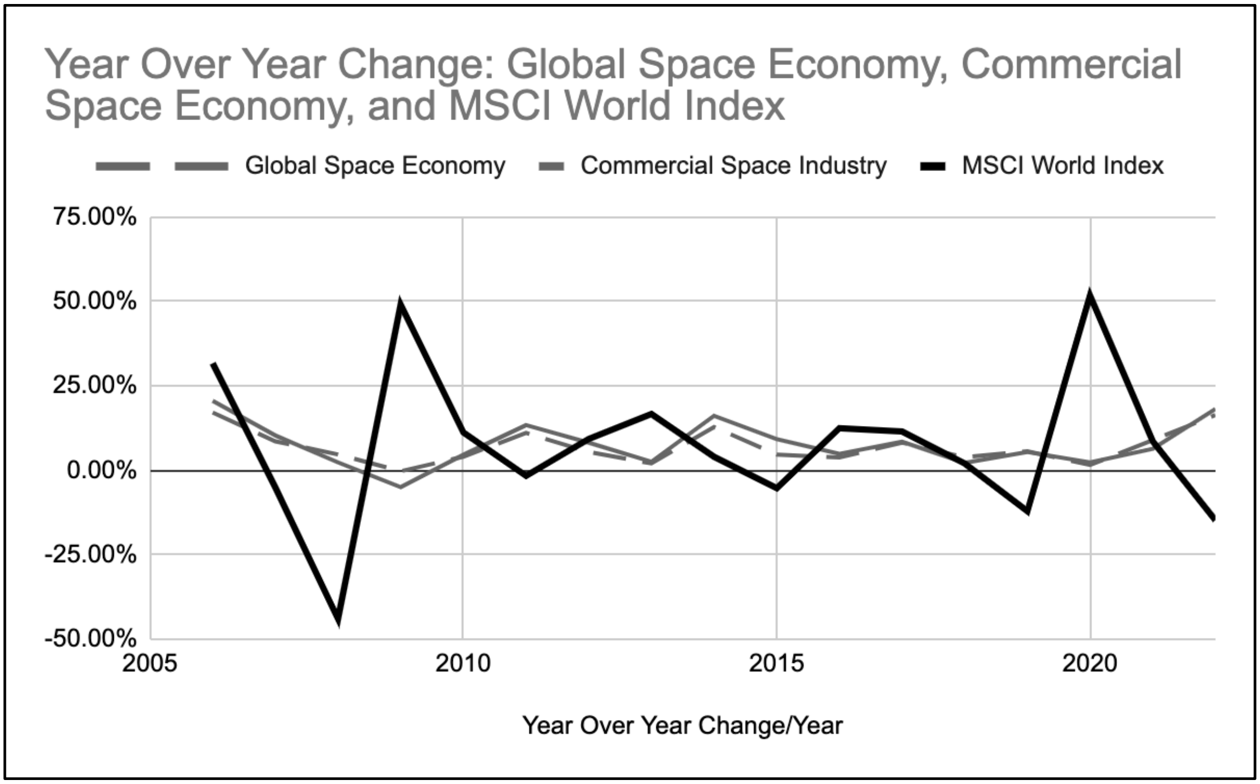
- Why do Gold and the Price of Oil have the weakest correlations to the space industry data? The authors theorized that this may be a factor of volatility, but further review and research should be conducted to determine if there are other market drivers that are causing this lack of correlation.
- Will the moderately negative correlation between both space indices and the S&P Global index continue? What are the factors that are driving this moderately negative correlation?
- How does space, as a portfolio specialization, perform within different asset classes? How have venture capital and private equity firms that specialize in space fared against their private equity colleagues? Are there any signals from the debt or public markets that this data can be compared to?
- Can the high costs and long timelines of space be congruent with the quarterly reporting requirements of public markets? What milestones do the industry in general, and space companies specifically, need to meet to be good IPO candidates?

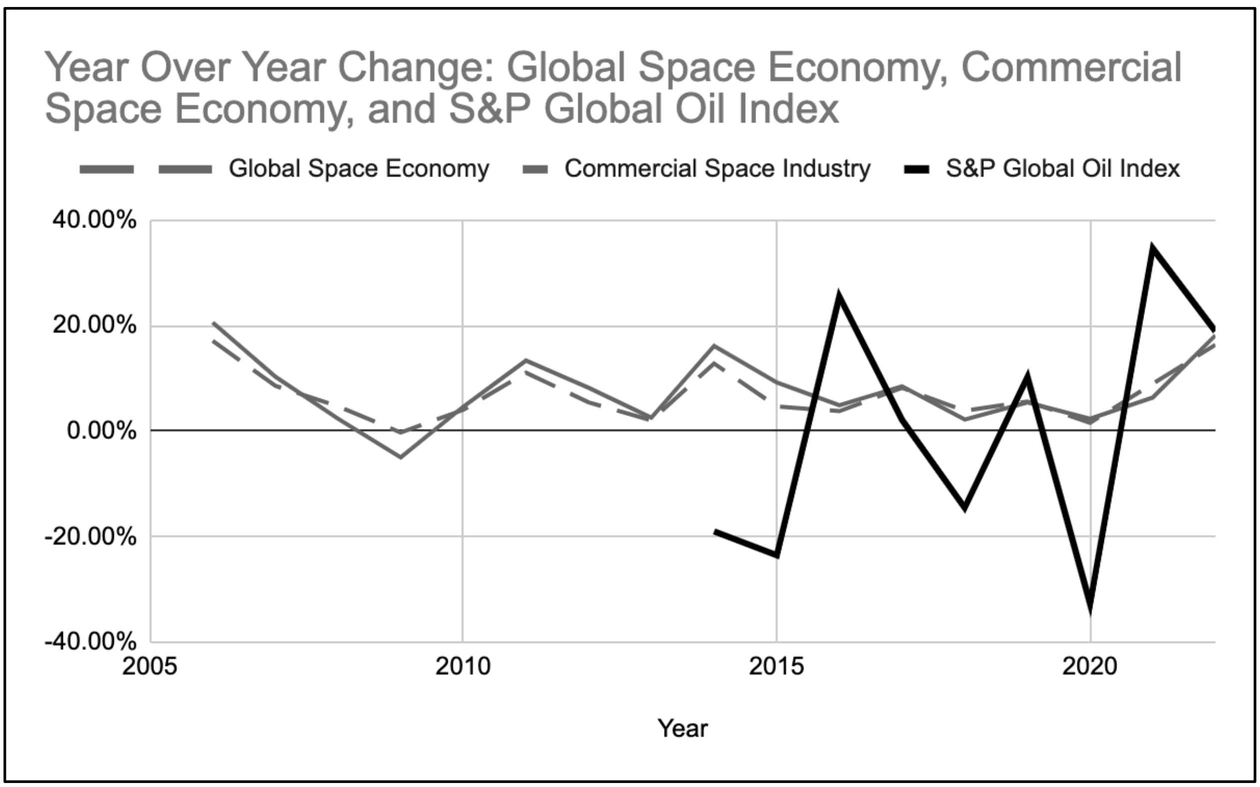
The authors welcome opportunities to collaborate with other researchers who would like to contribute to this new and growing body of academic research on the nascent commercial space ecosystem.

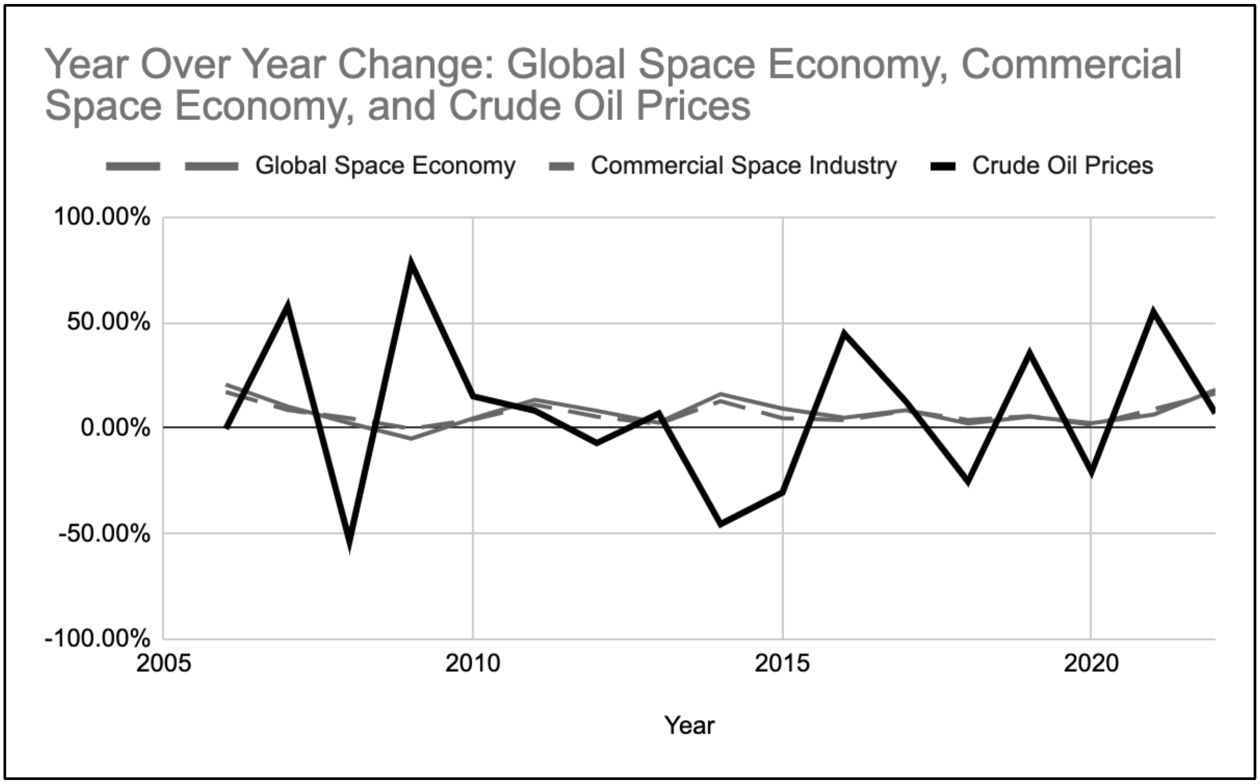
VII. Appendix

Below are charts showing the lack of correlation between the Year-Over-Year growth of two space datasets (Global Space Economy and Commercial Space Industry), shown in gray, and the various tested indices, shown in black.

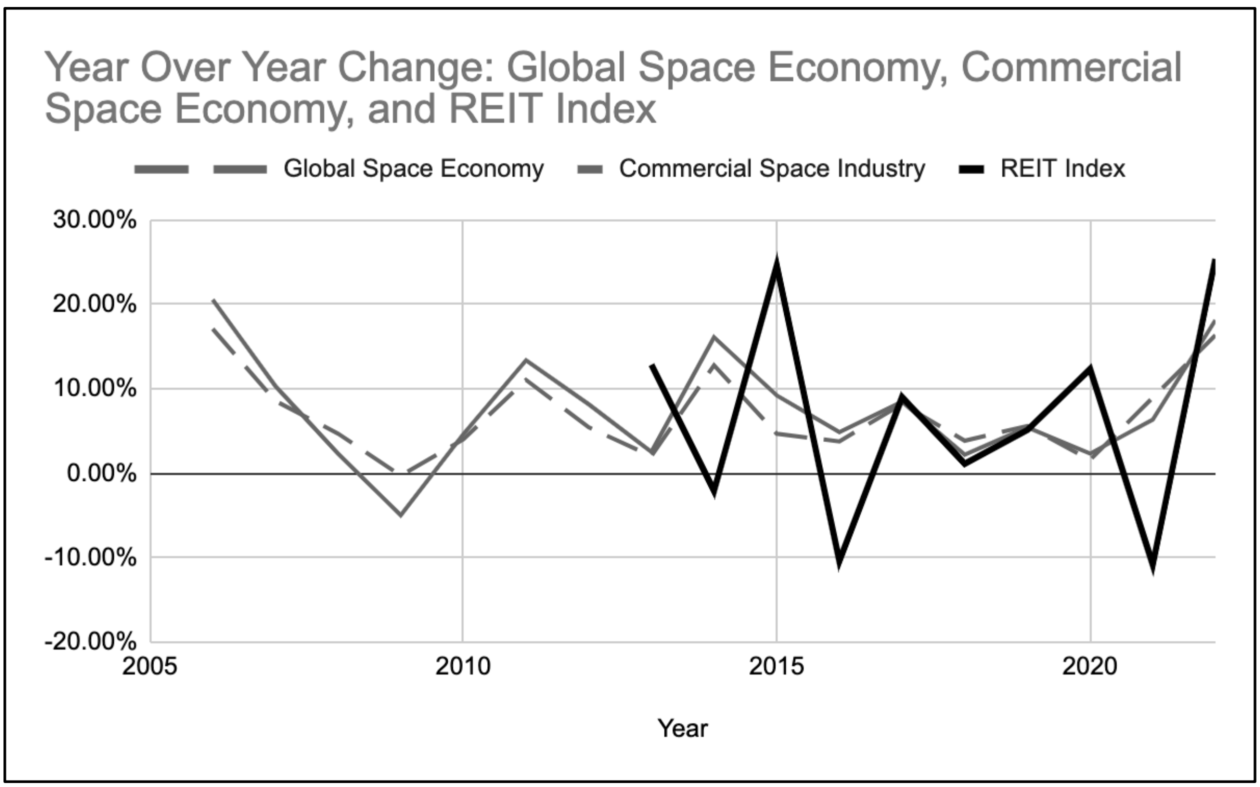



Year Over Year Change: Global Space Economy, Commercial Space Economy, and MSCI World Index
Global Space Economy
Commercial Space Industry
MSCI World Index
75.00%
50.00%
25.00%
0.00%
-25.00%
-50.00%
2005
2010
2015
2020
Year Over Year Change/Year

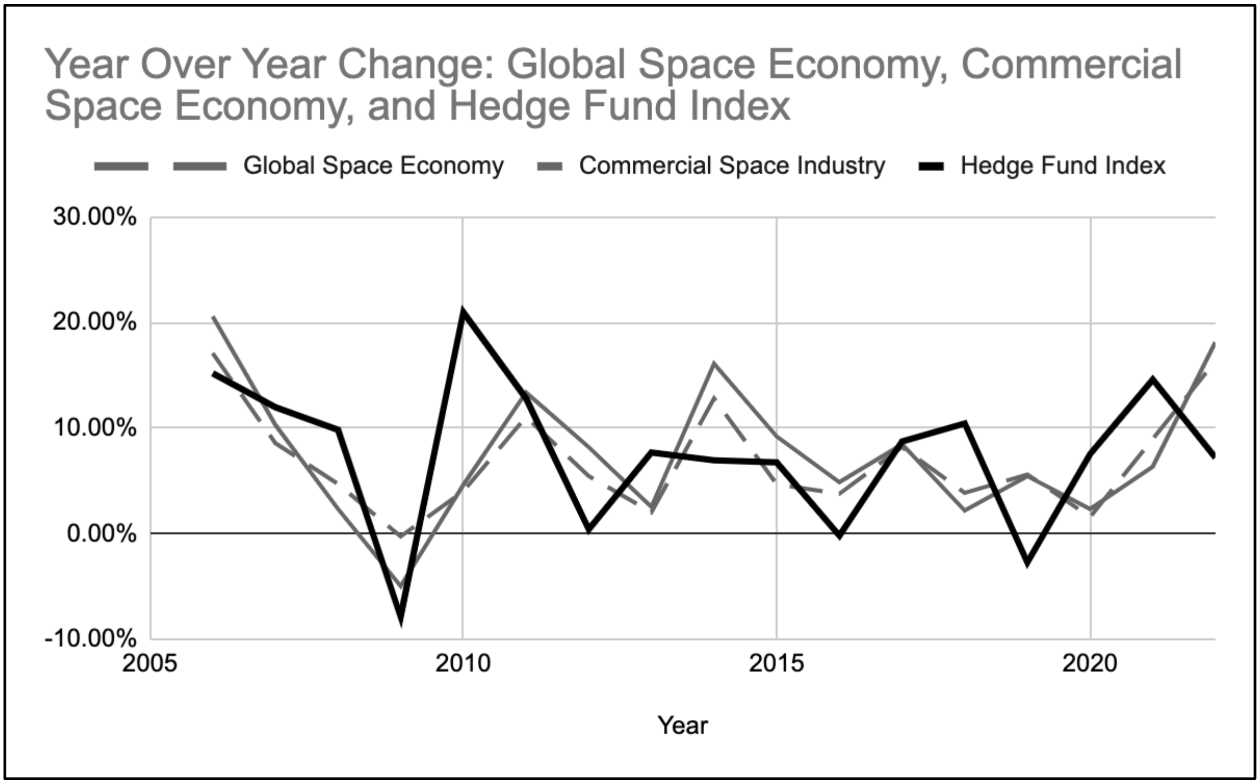

Year Over Year Change: Global Space Economy, Commercial Space Economy, and S&P Global Oil Index
Global Space Economy
Commercial Space Industry
S&P Global Oil Index
40.00%
20.00%
0.00%
-20.00%
-40.00%
2005
2010
2015
2020
Year

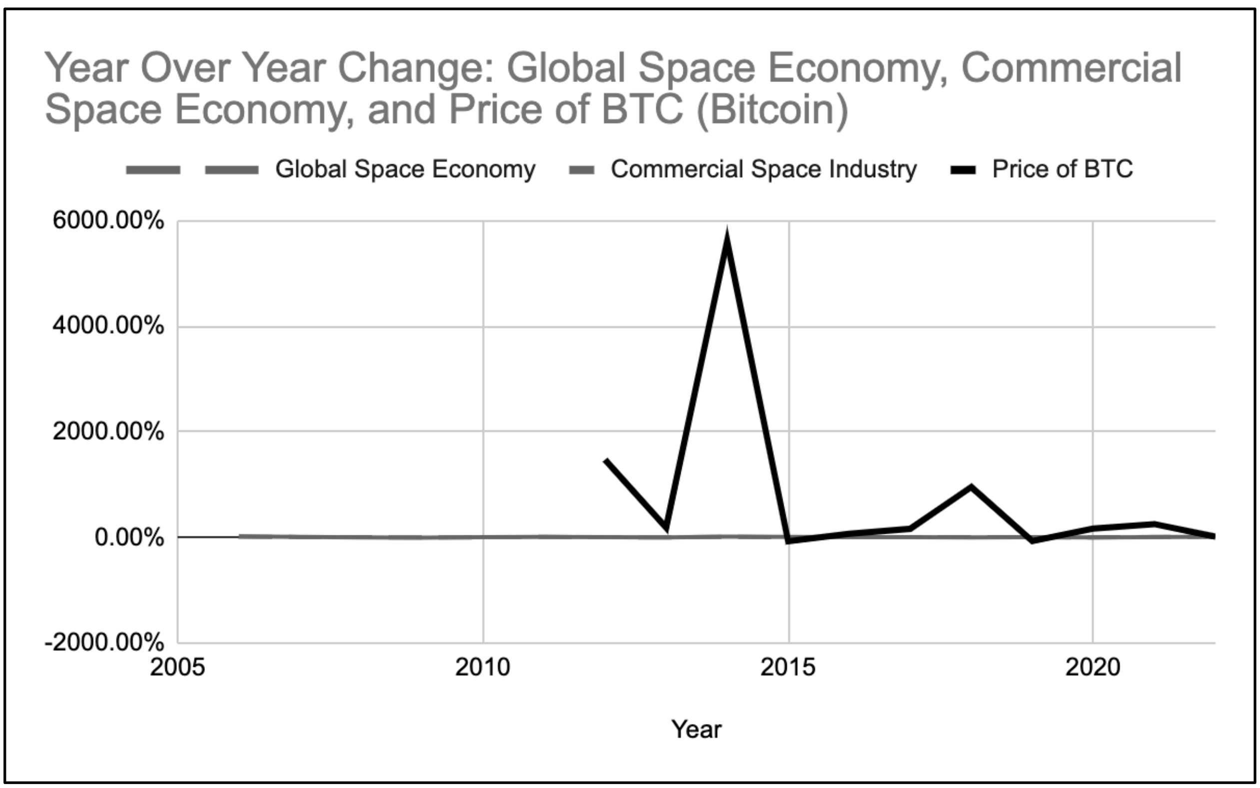


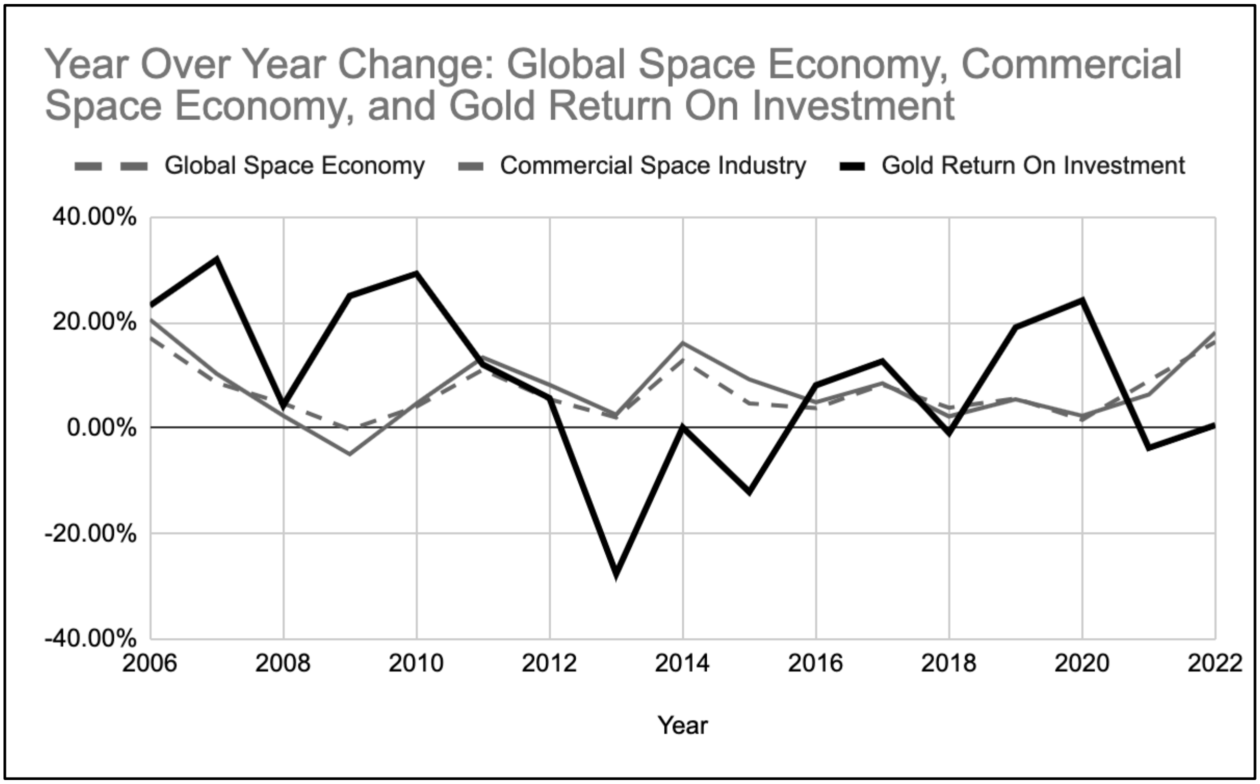
Year Over Year Change: Global Space Economy, Commercial Space Economy, and Crude Oil Prices
Global Space Economy
Commercial Space Industry
Crude Oil Prices
100.00%
50.00%
0.00%
-50.00%
-100.00%
2005
2010
2015
2020
Year



Year Over Year Change: Global Space Economy, Commercial Space Economy, and REIT Index
Global Space Economy
Commercial Space Industry
REIT Index
30.00%
20.00%
10.00%
0.00%
-10.00%
-20.00%
2005
2010
2015
2020
Year


Year Over Year Change: Global Space Economy, Commercial Space Economy, and Hedge Fund Index
Global Space Economy
Commercial Space Industry
Hedge Fund Index
30.00%
20.00%
10.00%
0.00%
-10.00%
2005
2010
2015
2020
Year


Year Over Year Change: Global Space Economy, Commercial Space Economy, and Price of BTC (Bitcoin)
Global Space Economy
Commercial Space Industry
Price of BTC
6000.00%
4000.00%
2000.00%
0.00%
-2000.00%
2005
2010
2015
2020
Year



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