The Need for Cryptocurrency Regulation is Backed by Statistical Evidence

I. Introduction

The question of whether there should be more regulations for cryptocurrencies such as Bitcoin is an important issue. The answer to this question is complicated, especially because cryptocurrencies were created as an alternative to central institutional authority. Despite these societal and governmental implications, the added factor of Cryptocurrency mining—the process that creates new cryptocurrency coins and records transactions—which uses up a significant amount of electricity, makes the question environmental as well.

Despite these many facets, part of the answer to this question may come in determining whether cryptocurrency is a separate asset-class—that is, it is not affected by other asset-classes such as bonds, gold, and commodities.

Portfolio management theory allows us to frame this question statistically. If the monthly price return series on Bitcoin and other cryptocurrencies are independent of monthly price returns of an existing asset classes OR correlated with a low R-squared, then it is a new asset class. If returns are correlated with a high R-squared, then the respective sector(s) regulatory framework should apply. This study will focus on Bitcoin—the cryptocurrency with the highest market capitalization—specifically and whether it can be classified as a new commodity.

II. Statistical question. Is there a linear association between the monthly returns of Bitcoin and those of a major asset class (equities, bonds, currencies, gold, commodities)?

H_o: $\beta_1 = 0$. There is no linear association between the monthly returns of Bitcoin and another major asset class.

Major Liquid Asset Classes	Representative Widely Publicized Benchmarks
-Equities	-S&P 500 Index
-Bonds	-US 10-Yr Constant Maturity Treasury Note Yield
-Currencies	-US Dollar Index
-Gold	-Spot price per troy ounce
-Commodities	-Spot price per barrel of West Texas Intermediate crude oil

H_a: $\beta_1 \neq 0$. There is a linear association between the monthly returns of Bitcoin and another major asset class.

As part of this project, the level of the possible threshold R-squared will be examined as well. A significance level of alpha = 0.05 was chosen for all tests. T-intervals for the slope of the regression line were chosen for all pairs of monthly price return series.

III. Data collection procedure.

All monthly price return series available in different sections of the FRED web tool of the Federal Reserve Bank of St. Louis, Economic Research Division at https://fred.stlouisfed.org. The Bitcoin prices, however, were taken from finance.yahoo.com because it included data from the last four months of 2014 which was not available in the FRED tool. The series were downloaded and scrubbed to only include month-end prices; if the last day of the month was not a business day, the date was adjusted to the last business day of the month.

The price returns for 80 one-month periods, starting in September 30 of 2014 and ending on May 31, 2021 were computed as $(P_n/P_{n-1})-1$ where P_n represents the price on an nth month. In this way, the percentages of the price returns were calculated, which gives an accurate picture of price returns while avoiding the price discrepancies between assets and Bitcoin which may affect the analysis of the results. An exception was made for Constant Maturity Treasuries (CMT10). These series represent yield of a par-priced Treasury bond with a 10-year maturity. In order to calculate the price change on such bond, the following formula would have to be used: $(-(Yield_n - Yield_{n-1})*(Duration))$ where $Yield_n$ represents the Yield of the bond on an nth month and Duration is a multiple around 8. For the statistical part of the project, the duration multiple was dropped as the presence or absence of association would not be affected by a multiple on the series $(Yield_{n-1}-$

$Yield_n$) (notice the sign change brought into the bracket, it is there because bond prices move inversely to yields).

IV. Data display

		BTC	SP500	10yrTSY	GoldOunce	DollarIndex	WTI	BTC Px Return	SP500 Px Retur	Minus 10Yr Yld Chg	Gold Px Chg	DXY Px Ret	WTI Px Ret
17													
18	5/31/2021	35697.61	4,204.11	1.61	1899.95	111.3116	66.13	-0.3819	0.0055	0.04	0.07	-0.01	0.04
19	4/30/2021	57750.18	4181.17	1.65	1767.65	112.3765	63.5	-0.0198	0.0524	0.09	0.05	-0.02	0.07
20	3/31/2021	58918.83	3972.89	1.74	1691.05	114.1322	59.19	0.3053	0.0424	-0.30	-0.03	0.01	-0.04
21	2/28/2021	45137.77	3811.15	1.44	1742.85	113.1068	61.55	0.3631	0.0261	-0.33	-0.06	0.01	0.18
22	1/31/2021	33114.36	3714.24	1.11	1863.8	112.2242	52.16	0.1418	-0.0111	-0.18	-0.01	0.01	0.08
23	12/31/2020	29001.72	3756.07	0.93	1887.6	111.5527	48.35	0.4777	0.0371	-0.09	0.07	-0.02	0.07
24	11/30/2020	19625.84	3621.63	0.84	1762.55	113.4909	45.2	0.4241	0.1075	0.04	-0.06	-0.03	0.27
25	10/31/2020	13781	3269.96	0.88	1881.85	116.4683	35.64	0.2775	-0.0277	-0.19	0.00	-0.01	-0.11
26	9/30/2020	10787.62	3363	0.69	1886.9	117.2618	40.05	-0.0765	-0.0392	0.03	-0.04	0.01	-0.06
27	8/31/2020	11680.82	3500.31	0.72	1957.35	116.0063	42.61	0.0316	0.0701	-0.17	0.00	-0.01	0.06
28	7/31/2020	11323.47	3271.12	0.55	1964.9	117.4439	40.1	0.2392	0.0551	0.11	0.11	-0.03	0.02
29	6/30/2020	9137.993	3100.29	0.66	1768.1	120.7806	39.27	-0.0341	0.0184	-0.01	0.02	0.00	0.10
30	5/31/2020	9461.059	3044.31	0.65	1728.7	121.1961	35.57	0.0927	0.0453	-0.01	0.02	-0.01	0.85
31	4/30/2020	8658.554	2912.43	0.64	1702.75	122.6491	19.23	0.3448	0.1268	0.06	0.06	0.00	-0.06
32	3/31/2020	6438.645	2584.59	0.7	1608.95	122.8165	20.51	-0.2513	-0.1251	0.43	0.00	0.04	-0.54
33	2/29/2020	8599.509	2954.22	1.13	1609.85	117.7464	44.83	-0.0803	-0.0841	0.38	0.02	0.02	-0.13
34	1/31/2020	9350.529	3225.52	1.51	1584.2	115.7734	51.58	0.2998	-0.0016	0.41	0.05	0.01	-0.16
35	12/31/2019	7193.599	3230.78	1.92	1514.75	114.6724	61.14	-0.0497	0.0286	-0.14	0.04	-0.02	0.05
36	11/30/2019	7569.63	3140.98	1.78	1460.15	117.1249	58.12	-0.1772	0.0340	-0.09	-0.03	0.01	0.08
37	10/31/2019	9199.585	3037.56	1.69	1510.95	115.916	54.02	0.1092	0.0204	-0.01	0.02	-0.02	0.00
38	9/30/2019	8293.868	2976.74	1.68	1485.3	117.9511	54.09	-0.1388	0.0172	-0.18	-0.03	0.00	-0.02
39	8/31/2019	9630.664	2926.46	1.5	1528.4	118.1629	55.07	-0.0451	-0.0181	0.52	0.07	0.02	-0.06
40	7/31/2019	10085.63	2980.38	2.02	1427.55	115.4941	58.53	-0.0676	0.0131	-0.02	0.01	0.01	0.01
41	6/30/2019	10817.16	2941.76	2	1409	114.5854	58.2	0.2615	0.0689	0.14	0.09	-0.02	0.09
42	5/31/2019	8574.502	2752.06	2.14	1295.55	116.7296	53.49	0.6025	-0.0658	0.37	0.01	0.01	-0.16
43	4/30/2019	5350.727	2945.83	2.51	1282.3	115.3292	63.83	0.3033	0.0393	-0.10	-0.01	0.00	0.06
44	3/31/2019	4105.404	2834.4	2.41	1295.4	115.1379	60.19	0.0650	0.0179	0.32	-0.02	0.01	0.05
45	2/28/2019	3854.785	2784.49	2.73	1319.15	114.2005	57.21	0.1148	0.0297	-0.10	0.00	0.01	0.06
46	1/31/2019	3457.793	2704.1	2.63	1323.25	113.5495	53.84	-0.0761	0.0787	0.06	0.03	-0.02	0.19
47	12/31/2018	3742.7	2506.85	2.69	1279	115.5681	45.15	-0.0683	-0.0918	0.32	0.05	-0.01	-0.11
48	11/30/2018	4017.269	2760.17	3.01	1217.55	116.414	50.78	-0.3641	0.0179	0.14	0.00	0.00	-0.22
49	10/31/2018	6317.61	2711.74	3.15	1214.95	116.5271	65.31	-0.0465	-0.0694	-0.10	0.02	0.02	-0.11
50	9/30/2018	6625.56	2913.98	3.05	1187.25	113.8093	73.16	-0.0585	0.0043	-0.19	-0.01	0.00	0.05
51	8/31/2018	7037.58	2901.52	2.86	1202.45	114.2768	69.84	-0.0955	0.0303	0.10	-0.02	0.01	0.00
52	7/31/2018	7780.44	2816.29	2.96	1220.95	112.7318	69.88	0.2149	0.0360	-0.11	-0.02	0.00	-0.06
53	6/30/2018	6404	2718.37	2.85	1250.45	113.2614	74.13	-0.1455	0.0048	-0.02	-0.04	0.01	0.11
54	5/31/2018	7494.17	2705.27	2.83	1305.35	111.992	66.98	-0.1890	0.0216	0.12	-0.01	0.02	-0.02
55	4/30/2018	9240.55	2648.05	2.95	1313.2	109.3388	68.56	0.3251	0.0027	-0.21	-0.01	0.02	0.06
56	3/31/2018	6973.53	2640.87	2.74	1323.85	107.48	64.87	-0.3293	-0.0269	0.13	0.00	-0.01	0.06
57	2/28/2018	10397.9	2713.83	2.87	1317.85	108.3909	61.43	0.0173	-0.0389	-0.15	-0.02	0.02	-0.05
58	1/31/2018	10221.1	2823.81	2.72	1345.05	106.7696	64.82	-0.2780	0.0562	-0.32	0.04	-0.03	0.07

	A	B	C	D	E	F	G	I	J	K	L	M	N
59	12/31/2017	14156.4	2673.61	2.4	1291	110.0796	60.46	0.3833	0.0098	0.02	0.01	0.00	0.05
60	11/30/2017	10233.6	2647.58	2.42	1280.2	110.465	57.4	0.5821	0.0281	-0.04	0.01	-0.01	0.06
61	10/31/2017	6468.4	2575.26	2.38	1270.15	111.8051	54.36	0.4909	0.0222	-0.05	-0.01	0.02	0.05
62	9/30/2017	4338.71	2519.36	2.33	1283.1	110.0848	51.67	-0.0775	0.0193	-0.21	-0.02	0.01	0.09
63	8/31/2017	4703.39	2471.65	2.12	1311.75	109.3646	47.26	0.6358	0.0005	0.18	0.03	0.00	-0.06
64	7/31/2017	2875.34	2470.3	2.3	1267.55	109.8149	50.21	0.1590	0.0193	0.01	0.02	-0.02	0.09
65	6/30/2017	2480.84	2423.41	2.31	1242.25	111.9871	46.02	0.0850	0.0048	-0.10	-0.02	-0.01	-0.05
66	5/31/2017	2286.41	2411.8	2.21	1266.2	113.2943	48.29	0.6963	0.0116	0.08	0.00	-0.01	-0.02
67	4/30/2017	1347.89	2384.2	2.29	1266.45	114.7866	49.31	0.2576	0.0091	0.11	0.02	0.00	-0.02
68	3/31/2017	1071.79	2362.72	2.4	1244.85	114.7893	50.54	-0.0917	-0.0004	-0.04	-0.01	-0.01	-0.06
69	2/28/2017	1179.97	2363.64	2.36	1255.6	115.9997	54	0.2160	0.0372	0.09	0.04	0.00	0.02
70	1/31/2017	970.403	2278.87	2.45	1212.8	116.2226	52.75	0.0069	0.0179	0.00	0.06	-0.02	-0.02
71	12/31/2016	963.743	2238.83	2.45	1145.9	118.344	53.75	0.2924	0.0182	-0.08	-0.03	0.00	0.09
72	11/30/2016	745.691	2198.81	2.37	1178.1	117.7612	49.41	0.0638	0.0342	-0.53	-0.07	0.03	0.06
73	10/31/2016	700.972	2126.15	1.84	1272	114.0155	46.83	0.1496	-0.0194	-0.24	-0.04	0.02	-0.02
74	9/30/2016	609.735	2168.27	1.6	1322.5	112.2772	47.72	0.0595	-0.0012	-0.02	0.01	0.00	0.07
75	8/31/2016	575.472	2170.95	1.58	1309.25	112.4013	44.68	-0.0788	-0.0012	-0.12	-0.02	0.00	0.08
76	7/31/2016	624.681	2173.6	1.46	1342	111.8719	41.54	-0.0723	0.0356	0.03	0.02	0.00	-0.14
77	6/30/2016	673.337	2098.86	1.49	1320.75	112.1595	48.27	0.2671	0.0009	0.35	0.09	0.00	-0.02
78	5/31/2016	531.386	2096.95	1.84	1212.1	112.4271	49.1	0.1853	0.0153	-0.01	-0.06	0.03	0.07
79	4/30/2016	448.318	2065.3	1.83	1285.65	108.8263	45.98	0.0758	0.0027	-0.05	0.04	-0.01	0.24
80	3/31/2016	416.729	2059.74	1.78	1237	109.9181	36.94	-0.0479	0.0660	-0.04	0.00	-0.04	0.13
81	2/29/2016	437.697	1932.23	1.74	1234.9	114.2408	32.74	0.1869	-0.0041	0.20	0.11	-0.01	-0.03
82	1/31/2016	368.767	1940.24	1.94	1111.8	115.5728	33.66	-0.1435	-0.0507	0.33	0.05	0.02	-0.09
83	12/31/2015	430.567	2043.94	2.27	1060	113.3429	37.13	0.1411	-0.0175	-0.06	0.00	0.01	-0.08
84	11/30/2015	377.321	2080.41	2.21	1061.9	112.3401	40.43	0.2010	0.0005	-0.05	-0.07	0.02	-0.13
85	10/31/2015	314.166	2079.36	2.16	1142.35	110.208	46.6	0.3309	0.0830	-0.10	0.03	-0.01	0.03
86	9/30/2015	236.06	1920.03	2.06	1114	111.3311	45.06	0.0261	-0.0264	0.15	-0.02	0.01	-0.08
87	8/31/2015	230.056	1972.18	2.21	1135	110.5622	49.2	-0.1918	-0.0626	-0.01	0.03	0.02	0.04
88	7/31/2015	284.65	2103.84	2.2	1098.4	108.7819	47.11	0.0820	0.0197	0.15	-0.06	0.02	-0.21
89	6/30/2015	263.072	2063.11	2.35	1171	106.5191	59.48	0.1428	-0.0210	-0.23	-0.02	0.00	-0.01
90	5/31/2015	230.19	2107.39	2.12	1191.4	106.7387	60.25	-0.0252	0.0105	-0.07	0.01	0.01	0.01
91	4/30/2015	236.145	2085.51	2.05	1180.25	105.3118	59.62	-0.0331	0.0085	-0.11	-0.01	-0.02	0.25
92	3/31/2015	244.224	2067.89	1.94	1187	107.4394	47.72	-0.0395	-0.0174	0.06	-0.02	0.02	-0.04
93	2/28/2015	254.263	2104.5	2	1214	105.598	49.84	0.1692	0.0549	-0.32	-0.04	0.00	0.04
94	1/31/2015	217.464	1994.99	1.68	1260.25	105.5882	47.79	-0.3208	-0.0310	0.49	0.04	0.03	-0.11
95	12/31/2014	320.193	2058.9	2.17	1206	102.284	53.45	-0.1530	-0.0042	0.01	0.02	0.02	-0.19
96	11/30/2014	378.047	2067.56	2.18	1182.75	100.0716	65.94	0.1174	0.0245	0.17	0.02	0.02	-0.18
97	10/31/2014	338.321	2018.05	2.35	1164.25	98.116	80.53	-0.1257	0.0232	0.17	-0.04	0.01	-0.12
98	9/30/2014	386.944	1972.29	2.52	1216.5	97.5258	91.17						
99													

V. Data Analysis

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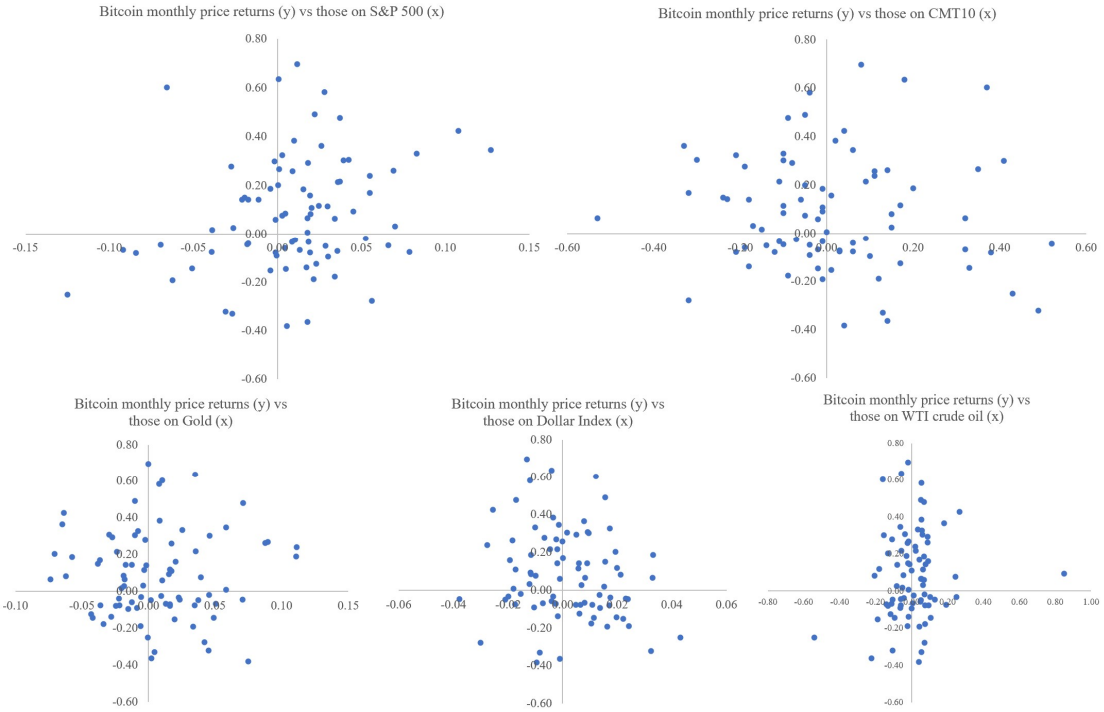
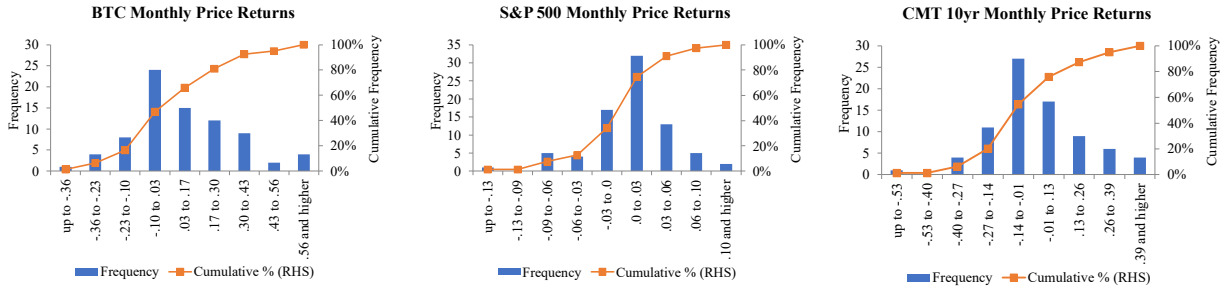
The scatterplots for pairs Bitcoin-CMT10, Bitcoin-Gold, Bitcoin-USD Index, and Bitcoin-WTI do not appear to satisfy straight enough condition to a naked eye (see Figure 1).

Figure 1 Scatterplots pairing monthly price returns on Bitcoin with those on S&P 500, CMT10, Gold, USD Index and WTI



However, the scatterplots do not appear to thicken or bend. The Bitcoin-S&P 500 scatterplot might have at least one outlier if a line is imagined from III to I quadrant.

Figure 2 Histograms for monthly price returns on the six assets appears somewhat close to symmetrical with cumulative frequency profiles resembling normal shape.



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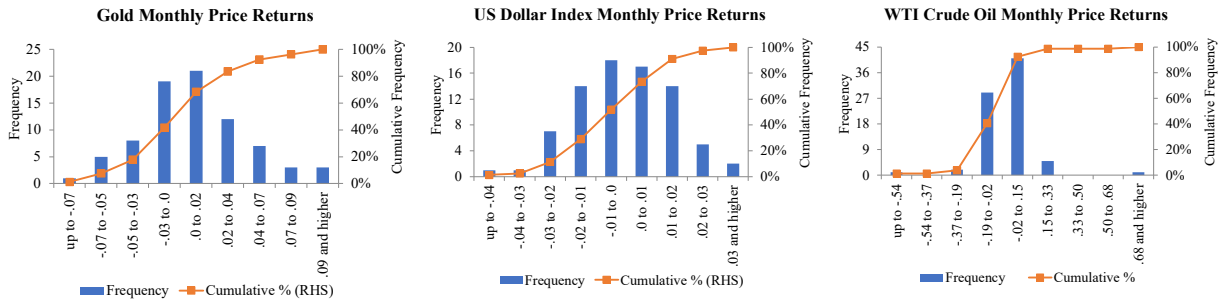
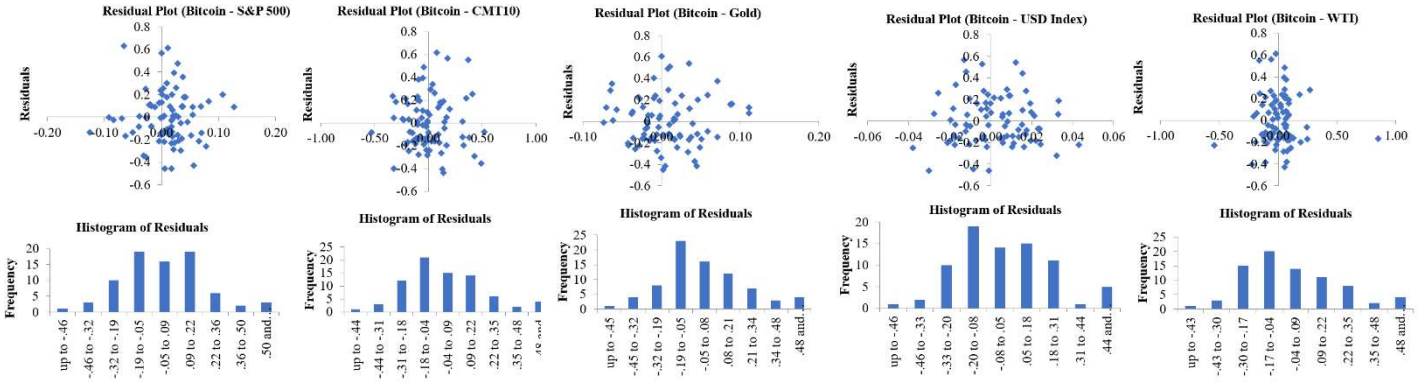


Figure 3 Residual plots and histograms of residuals were reviewed



Per Figure 2, the histograms of the residuals indicate that the price return series appear to be close to symmetrically distributed, with cumulative frequency profiles forming a roughly normal shape. Bitcoin returns exhibits a moderately strong degree of skew to the right. We will proceed carefully with the regression inference. The independence assumption is satisfied as it is safe to assume that the data is representative of the monthly prices of Bitcoin, S&P 500, CMT-10, Gold, U.S. Dollar Index, and Crude Oil. The residual plots' random scatter indicates independence as there are no clear patterns. Additionally, independence between the assets' prices is safe to assume due to the efficient market hypothesis: if these assets' moves were not independent, market vigilantes would enforce it through arbitrage. For the most part, the residual plots indicate homoscedasticity. There are the two exceptions of the Bitcoin-Gold residual plot and Bitcoin-USD index as in the first quadrants there appears to be a fan shape. We will proceed carefully with the regression inference.

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With the aforementioned conditions addressed, we can move on to creating a 95% confidence interval for the regression slope for each Bitcoin-asset pairing. The degrees of freedom was 80-2=78.

Figure 4 The 95% confidence interval for the slope does not contain 0 only for Bitcoin-S&P 500

y values	BTCPxRet	BTCPxRet	BTCPxRet	BTCPxRet	BTCPxRet
x values	SP500PxRet	CMT10YCh	DXYPxRet	GoldPxRet	WTIPxRet
n	80	80	80	80	80
r	0.261	-0.097	-0.176	-0.011	0.127
S_x	0.042	0.199	0.016	0.040	0.152
S_y	0.234	0.234	0.234	0.234	0.234
b (slope)	1.470	-0.114	-2.577	-0.065	0.196
$S_{y\text{-}x}$	0.228	0.235	0.232	0.236	0.234
S_b	0.615	0.133	1.627	0.662	0.173
t	2.389	-0.858	-1.584	-0.098	1.130
df	78	78	78	78	78
p-value	0.019	0.394	0.117	0.922	0.2621
alpha	0.05	0.05	0.05	0.05	0.05
t-crit	1.99	1.99	1.99	1.99	1.99
Significant?	Null slope rejected	Fail to reject null slope	Fail to reject null slope	Fail to reject null slope	Fail to reject null slope
Confidence interval for slope					
lower	0.245	-0.379	-5.817	-1.38	-0.149
upper	2.695	0.151	0.662	1.25	0.541

Since one slope, Bitcoin-S&P500, showed a statistically significant result, the same test was run on all other possible pairs of assets—including pairs of the main asset classes—were run for further examination. The results are shown in the table below.

Figure 5 The 95% confidence interval for the slope does not contain 0 only for Bitcoin-S&P 500

	Y values (top row)						
X values		BTCPxRet	SP500PxRet	CMT10YCh	DXYPxRet	GoldPxRet	WTIPxRet
left	BTCPxRet		Null slope rejected	Fail to reject null slope	Fail to reject null slope	Fail to reject null slope	Fail to reject null slope
column	SP500PxRet	Null slope rejected		Null slope rejected	Null slope rejected	Fail to reject null slope	Null slope rejected
	CMT10YCh	Fail to reject null slope	Null slope rejected		Fail to reject null slope	Null slope rejected	Null slope rejected
	DXYPxRet	Fail to reject null slope	Null slope rejected	Fail to reject null slope		Null slope rejected	Null slope rejected
	GoldPxRet	Fail to reject null slope	Fail to reject null slope	Null slope rejected	Null slope rejected		Fail to reject null slope
	WTIPxRet	Fail to reject null slope	Null slope rejected	Null slope rejected	Null slope rejected	Fail to reject null slope	
	FEDAssetsCh	Fail to reject null slope	Fail to reject null slope	Fail to reject null slope	Fail to reject null slope	Fail to reject null slope	Fail to reject null slope

For seven additional pairs the 95% confidence intervals for slope did not include zero. These pairs were used to examine further the R-squared of those regressions.

Figure 6 The Excel regression tool was run on the data series pairs of further interest

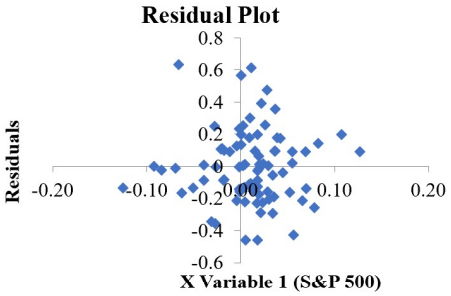
X \ Y	BTCPxRet	SP500PxRet	CMT10YCh	DXYPxRet	GoldPxRe	WTIPxRet
BTCPxRet		Null slope rejected	Fail to reject null slope	Fail to reject null slope	Null slop	Null slop
SP500PxRet	Null slope rejected		Null slope rejected	Null slope rejected	Null slop	Null slop
Slope(beta)	1.470348219	0.067778771 Intercept (alpha)				
St.Error of slope	0.615488269	0.026234727 St. Error of Intercept				
R Square	0.06817726	0.227609048				
F	5.706907583	78				
	0.295651361	4.040858531				
p-value	0.019314614					
CMT10YCh	Fail to reject null slope	Null slope rejected		Fail to reject null slope	Null slop	Null slop
Slope(beta)		-0.075683728	0.011224495 Intercept (alpha)			
		0.02212437	0.004372643			
R Square		0.130454987	0.039045274			
F		11.70208426	78			
		0.017840219	0.118913607			
p-value		0.000996321				
DXYPxRet	Fail to reject null slope	Null slope rejected	Fail to reject null slope		Null slop	Null slop
Slope(beta)		-1.335360767	0.012741837 Intercept (alpha)			
		0.251621579	0.004037632			
R Square		0.265290865	0.035890554			
F		28.16446199	78			
		0.036279541	0.100474285			
p-value		1.01672E-06				
GoldPxRet	Fail to reject null slope	Fail to reject null slope	Null slope rejected	Null slope rejected		Null slop
Slope(beta)			2.279079124	-0.003141017	-0.14685349 0.002716	Intercept (alpha)
			0.498460125	0.020092456	0.042208551 0.001701	
R Square			0.21136743	0.177454746	0.134344034 0.015026	
F			20.90537496	78	12.10507989 78	
			0.658314166	2.456234584	0.002733273 0.017612	
p-value			1.78544E-05		0.000826015	
WTIPxRet	Fail to reject null slope	Null slope rejected	Null slope rejected	Null slope rejected		Null slope not reje
Slope(beta)		0.129481782	0.009462959	-0.483543099 0.014738372	-0.047886535 0.002114	Intercept (alpha)
		0.027378517	0.004131353	0.137729172 0.020783004	0.010681608 0.001612	
R Square		0.222848048	0.036912666	0.136460269 0.185691245	0.204877023 0.014401	
F		22.36647241	78	12.32589612 78	20.09803296 78	
		0.030475323	0.106278502	0.425012162 2.689536588	0.004168289 0.016177	
p-value		9.83963E-06		0.000745766	2.49271E-05	

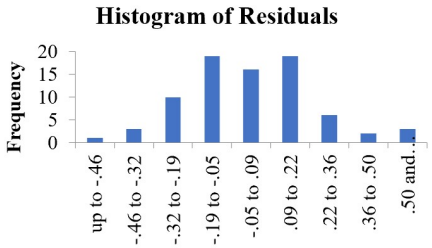
The R-squared value of the correlation of Bitcoin with the stock market was 6.8%. As shown by the heat map below, this is significantly less than the R-squared values corresponding to statistically significant correlations between established, and asset classes (Equities, Bonds), (Equities, Currencies), (Equities, Commodities), (Bonds, Gold), (Bonds, commodities), (Currencies, Gold) and (Currencies, Commodities).

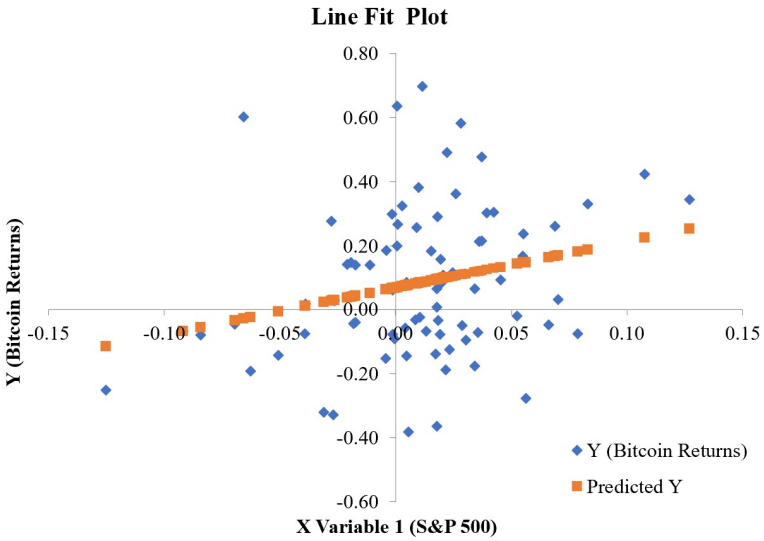
Figure 7 The heatmap color code indicates that correlations between already established asset classes have higher R-square than for Bitcoin and the S&P 500.

	Bitcoin S&P 500	S&P 500 US Treasuries	S&P 500 US Dollar	S&P 500 Commodities	US Treasuries Gold	US Treasuries Commodities (WTI)	US Dollar Gold	US Dollar Commodities (WTI)
Slope	1.47	-0.08	-0.08	0.13	2.28	-0.48	-0.15	-0.05
R-squared	6.8%	13.0%	13.0%	22.3%	21.1%	13.6%	13.4%	20.5%
p-value	0.01931	0.00100	0.00100	0.00001	0.00002	0.00075	0.00083	0.00002

Figure 8 The residuals analysis for the pair (Bitcoin, S&P 500) indicates some deviation from normality.







VI. Conclusion

We are 95% confident that Bitcoin exhibits no correlation to the following four out of five main liquid asset classes: Bonds, Currencies, Gold and Commodities. We fail to reject the null hypothesis for those four pairs. However, there is statistically significant evidence that there is a correlation between Bitcoin and equities, represented by S&P 500. The null hypothesis for this pair is rejected. However, this correlation exhibits an R-squared value lower than for correlations between existing five separate asset classes. Because these asset classes are presumed to be independent, and because Bitcoin's R-squared value is less than theirs, this indicates that the association between Bitcoin and Equities is weak. Therefore, the lower R-squared value warrants Bitcoin's standing as a separate asset class from Equities as well. The analysis of the residual plot and residuals histogram further suggest that Bitcoin does not have a strong statistical relationship with Equities.

Based on these results, we can conclude that Bitcoin is a separate asset class, which calls for a regulatory framework that is separate from frameworks covering the existing asset classes – Equities, Bonds, Currencies, Gold (Bullion), and Commodities. In other words, the risks of Bitcoin

investing were shown in this study to be statistically different from those inherent in existing assets with a high degree of confidence.

VII. Reflection

The study went well. The monthly return frequency coincides with the way many portfolio managers track and report their portfolio's performances. Using monthly periodicity avoided the issue of different assets prices being available on certain days due to different schedules or holidays. However, looking at a smaller periodicity could significantly change the results given Bitcoin's higher daily volatility compared to the other five assets.

A Classic Security Market Line analysis indicates that cryptocurrencies are undervalued based on their potential return in exchange for the financial risk they pose. Therefore, an additional study of the (beneficial) diversification effects of adding them to an investment portfolio is warranted. Regulators should consider imposing caps on the share of regulated portfolios that can be invested in cryptocurrencies.

Cryptocurrencies are not created equal: although Bitcoin is the best-known and the most liquid, other cryptocurrencies are being created to cater to certain investors. Creation of a cryptocurrency that will purposefully mimic performance of one of the five main asset class would require an additional review.

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X. APPENDIX

Figure 9 Regulators need to determine what kind of asset class are cryptocurrencies

The New York Times

What's Next for Crypto Regulation

The rules are in flux as a new U.S. administration takes over.

By Ephrat Livni

Jan. 30, 2021

Are cryptocurrencies commodities or securities? "It's a moving target," he said of one the biggest debates among crypto regulators (more on that below). In a "broad sense of what the