

COVID-19 pandemic and its influence on safe havens: An examination of gold, T-bills, T-bonds, U.S. dollar, and stablecoin

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Abstract

This paper examines the role of the safe havens from both stock market and cryptocurrency losses during the COVID-19 pandemic. The results show that gold moves in tandem with both Bitcoin (BTC) and stock market indices of the five largest economies in the world; thus, gold has lost its safe haven status against stock market losses during the COVID-19 pandemic. However, S&P U.S. Treasury bill index, S&P U.S. Treasury bond index, U.S. Dollar index generally act as strong, safe havens from the stock market losses and a weak safe haven from BTC losses although U.S. Covid-19 death toll is the highest in the world. Furthermore, dollar-backed stablecoin, Tether, is uncorrelated with stock market indices and BTC that makes it a weak safe haven against stock market and BTC losses during the COVID-19 pandemic. Thus, our results suggest that investors prefer liquid assets during a pandemic rather than gold.

Introduction

The spread of COVID-19 from a regional crisis in China to a global pandemic within three months has caused severe damage to human lives and the global economy. The stock markets around the world have plummeted to their lowest levels since the 2008 Global Financial Crisis (BBC, 2020). Moreover, the negative impact of the COVID-19 pandemic on stock markets is more profound than any previous infectious disease outbreak, including the 1918 Spanish Flu (Baker et al., 2020).

Unforeseen and unanticipated events such as the 1987 stock market crash trigger flight to quality episodes where investors transfer their investments from risky to safe assets (e.g. Caballero and Krishnamurthy, 2008). It is well documented in the literature that gold (e.g. Baur and Lucey, 2010), U.S. Treasury bills and bonds (e.g. Hartmann et al., 2004, Noeth and

Sengupta, 2010, Fleming et al., 1998), and U.S. dollars (e.g. Kaul and Sapp, 2006) act as safe havens during periods of stock market turmoil. However, Baur and Lucey (2010) and Chan et al. (2011) suggest that Treasury bonds possess better properties as a safe haven rather than gold during stock market crises.

Few studies argue that cryptocurrencies act as a safe haven during market turmoil (e.g. Urquhart and Zhang, 2019, Stensås et al., 2019); however, other studies consider cryptocurrencies as a risky asset instead of a safe haven (e.g. Smales, 2018, Bouri et al., 2017). In a recent paper, Baur and Hoang (2020) suggest using stablecoins as a safe haven against Bitcoin during extreme market movements, where stablecoins are cryptocurrencies that are pegged to stable assets such as gold and U.S. dollars.

The COVID-19 crisis provides a strong motivation to examine whether the traditional safe assets such as gold, U.S Treasury bills and bonds, and U.S. dollars remain as havens from stock market and cryptocurrency losses during the pandemic. Furthermore, the COVID-19 pandemic provides an opportunity to examine whether stablecoins serve as a safe haven against traditional cryptocurrencies and stock markets since cryptocurrencies were never involved in any major market turmoil since the inception of Bitcoin in 2010. Therefore, stablecoins are included as a haven from stock market and cryptocurrency losses in this paper.

Using a regression model with the error term corrected for GARCH(1,1), we find that the safe assets provide a hedge for the daily returns of stock market indices and Bitcoin (BTC) since they are either correlated negatively or uncorrelated with stock market indices and BTC. Most importantly, we find that the safe assets except gold act as havens from stock market and cryptocurrency losses during the COVID-19 pandemic. However, the U.S. Treasury bill index (T-bill), U.S. Treasury bond index (T-bond) and U.S. dollar index, in general, act as strong, safe havens compared to Tether (stablecoin), that serves as a weak safe haven for all stock market indices and BTC. Therefore, our results indicate that U.S dollars, T-bill, T-bond have

not lost their status as safe havens, although the U.S. suffers from the highest death and infection rates of COVID-19 in the world.

This study makes two important contributions to the literature. First, we extend the existing literature on safe haven assets (e.g. Baur and Lucey, 2010, Baur and McDermott, 2010, Baur et al., 2018) by showing that gold serves as a hedge in normal markets but not a safe haven during market crises like the COVID-19 pandemic. Second, the results suggest that investors prefer liquid assets as a safe haven rather than gold during crises.

2. Data and Methods

The analysis includes stock market indices of the five largest economies in the world, namely, the U.S. S&P500 (SP500), SSE composite index of China (SSE), NIKKEI225 index of Japan, DAX of Germany, and S&P BSE SENSEX of India (BSE). The stock market index is denominated in the currency where the exchange is located. On the other hand, the prices of gold, cryptocurrencies, T-bill and T-bond are denominated in U.S. dollars. The U.S. Dollar index (DXY) represents the value of the U.S. dollar relative to a basket of foreign currencies. DataStream International provides both the stock market indices and DXY. The data of T-bill and T-bond indices come from [us.spindices.com](https://www.spindices.com).

The cryptocurrency data includes both the traditional cryptocurrencies and stablecoins from coinmarketcap.com. Following Baur and Hoang (2020), the dataset includes the six largest stablecoins based on market capitalizations, such as Tether (USDT), USD Coin (USDC), TrueUSD (TUSD), Paxos Standard Token (PAX), Dai (DAI) and Gemini Dollar (GUSD). The dataset includes the five largest, traditional cryptocurrencies by market capitalization, such as Bitcoin (BTC), Ethereum (ETH), Ripple (XRP), Bitcoin Cash (BCH) and Litecoins (LTC). The gold price comes from [gold.org](https://www.gold.org). The sample period starts 17 September 2014 and ends 16 April 2020, the longest duration for which a reliable set of cryptocurrencies are obtained.

Equation (1) tests whether safe assets serve as a haven against either the stock market or cryptocurrency losses. Equations (2) and (3) model the error term, ϵ_t , in (1) as a generalized autoregressive conditional heteroskedasticity (GARCH). Equations (1) – (3) are estimated as a GARCH(1,1) process with parameters α_0 , α_1 , and α_2 , which are widely used in the safe haven literature (e.g. Baur and McDermott, 2010, Ranaldo and Söderlind, 2010). Finally, Z_t represents the white noise process.

$$RSA_{i,t} = \beta_0 + \beta_1 \cdot RRA_{j,t} + \beta_2 \cdot D \cdot RRA_t + \epsilon_t \quad (1)$$

$$\epsilon_t = \sigma_t \cdot Z_t \quad (2)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \cdot \epsilon_{t-1}^2 + \alpha_2 \cdot \sigma_{t-1}^2 \quad (3)$$

Where RSA_i represents the log return of safe asset i such as gold, indices of T-bill, T-bond, DXY, and Tether (stablecoin). RRA_j denotes the log returns of a risky asset such as a stock market index or BTC, where $j=SP500, SSE, NIKKEI225, DAX, BSE, \text{ or } BTC$. The dummy variable D equals 1 starting on December 31, 2019, and later, and zero otherwise. The date, December 31, 2019, is when the Chinese government notified the world of the existence of COVID-19 and its associated deaths in China (Taylor, 2020).¹

Estimating Equations (1) – (3) check whether a financial asset serves as a safe haven during the COVID-19 pandemic. A nonpositive β_1 indicates that asset i is a hedge for the risky asset j over the sample period, while a nonpositive β_2 indicates that asset i acts as a safe haven from the losses of the risky asset j during the COVID-19 pandemic since β_2 represents the interaction of the pandemic and risky asset returns. Following the literature (e.g. Baur and McDermott, 2010), β_1 (β_2) is a weak hedge (haven) if not statistically different from zero, whereas, a nonpositive and significant β_1 (β_2) indicates a strong hedge (haven).

¹We tried several other dummies based on the coronavirus pandemic timeline, as reported in Taylor (2020) and find similar results as in Table 2. We do not report those results for the sake of brevity.

3. Results and Discussion

3.1. Descriptive statistics

Table 1, Panel A summarizes the descriptive statistics of the daily log returns of gold, the indices of T-bill, T-bond, DXY, Tether (stablecoin), stock market indices, and BTC. The table also includes equal-weighted returns of the largest six stablecoins and equal-weighted returns of the largest five cryptocurrencies. The full Sample shows that stablecoins exhibit the lowest daily returns; whereas, cryptocurrencies have the highest daily returns. The COVID-19 pandemic shows that the daily log returns of the safe assets are higher than the daily returns of stock market indices and cryptocurrencies, consistent with the view that safe assets earn higher returns as compared to risky assets during market crises due to the flight to quality.

Panel B of Table 1 shows the correlations between the variables in our study. The lower triangular of the panel shows that the correlations between safe and risky assets are generally negative or low over the full sample period, indicating that safe assets serve as a hedge over the sample period. The upper triangular shows the correlations between the safe assets during the COVID-19 pandemic. The correlations suggest that the safe assets except gold, in general, are negatively correlated with stock market indices and cryptocurrencies, and those safe assets serve as havens from not only stock market losses but also from cryptocurrency losses. However, it is surprising to note that gold moves in tandem with stock market indices and cryptocurrencies during the COVID-19 pandemic with correlations ranging from 0.352 to 0.611. The correlations suggest that gold might not act as a safe haven against stock market and cryptocurrency losses during a pandemic.

3.2. Estimation Results

Table 2 presents the parameter estimates of Equations (1) – (3) for the daily log returns of the five market indices and BTC², and the influence of the COVID-19 pandemic on each safe haven asset. All parameter estimates are multiplied by 100 for readability.

Starting with gold, Panel A shows the parameter estimate (β_1) is negative and significant, indicating that gold serves as a strong hedge against all the stock market indices except SSE whereas it acts as a weak hedge. However, the parameter estimate (β_1) for the BTC is positive and significant, suggesting that BTC moves in tandem with gold; thus, gold does not hedge against BTC. Most importantly, all parameter estimates (β_2) for stock market indices and BTC are positive and significant during the COVID-19 pandemic that strongly refutes the use of gold as a safe haven. Therefore, the results suggest that gold acts as a hedge in normal markets, but it could lose its safe haven status during pandemics.

Panel B shows that the T-bill index is a hedge for all stock market indices and BTC with nonpositive parameter estimates (β_1). Furthermore, all parameter estimates (β_2) for stock market indices and BTC are nonpositive during the COVID-19 pandemic. However, β_2 is statistically significant at the 10% level for SSE, NIKKEI225 and BSE which indicates that the T-bill index is a strong, safe haven for these markets and a weak safe haven for SP500, DAX and BTC during the COVID-19 pandemic.

Similar to Panels A and B, the parameter estimates (β_1) in Panel C are nonpositive, suggesting that the T-bond index is a hedge for all stock market indices and BTC. Most importantly, the parameter estimates (β_2) are nonpositive and significant at the 10% level for all stock market indices. Thus, the T-bond is a strong, safe haven for these markets during the

² The results are similar when using cryptocurrencies other than BTC, and also for the equal-weighted returns based on the five cryptocurrencies for all the panels in Table 2. Those results are not reported for the sake of brevity.

COVID-19 pandemic. The parameter estimates (β_2) for BTC is negative and not significant, suggesting that the T-bond index is a weak safe haven during the COVID-19 pandemic.

Panel D shows that DXY moves along with the stock market indices, while β_1 is significant except for SSE; therefore, DXY does not meet the criteria of a hedge for those markets except as a weak hedge against SSE. Furthermore, parameter estimate (β_1) for BTC is negative but not significant, suggesting DXY serves as a weak hedge against BTC. Moreover, the parameter estimates (β_2) are nonpositive and significant for NIKKEI225, DAX and BSE, suggesting that DXY serves as a strong, safe haven for these markets during the COVID19 pandemic, and a weak safe haven for SP500, SSE and BTC because β_2 is not statistically different from zero.

In Panel E, the parameter estimates, β_1 and β_2 , are not statistically different from zero, suggesting that Tether (stablecoin) is both a weak hedge over the sample period and a weak safe haven during the COVID-19 pandemic.³

4. Concluding Remarks

This paper examines the role of gold, indices of T-bill, T-bond, U.S. dollar and stablecoin, Tether as safe havens from both the stock market and cryptocurrency losses during the COVID-19 pandemic. Using a regression model with a GARCH(1,1) correction on the error term and a COVID-19 interaction dummy slope term, the results show that gold moves in tandem with all stock market indices and BTC and, therefore, loses its role of a safe haven from stock market and BTC losses during the COVID-19 pandemic. However, the T-bill index acts as a strong, safe haven for the SSE, NIKKEI225, and BSE, and a weak safe haven for the SP500, DAX, and BTC; whereas, the T-bill index serves as a strong, safe haven for all stock market indices and a weak safe haven for BTC during the pandemic. Furthermore, DXY serves as a strong,

³ Other stablecoins and equal-weighted returns of all stablecoins show similar results. These results are omitted for the sake of brevity.

safe haven for NIKKEI225, DAX, and BSE, and a weak safe haven for the SP500, SSE, and BTC. At last, Tether, stablecoin, serves as a weak safe haven for all the stock market indices and BTC during the COVID-19 pandemic.

The findings are useful for investors and fund managers searching for the best safe haven among gold, T-bill, T-bond, DXY and stablecoin to offset extreme negative movements in stock market indices and cryptocurrencies during a pandemic. Furthermore, the results suggest that investors prefer liquid assets during a pandemic rather than gold. Therefore, central banks, financial institutions and regulatory authorities should consider developing financial assets that remain liquid during stock markets crisis. Future research endeavours should identify other safe havens during the COVID-19 pandemic.

Table 1: Descriptive Statistics

Panel A summarizes the descriptive statistics for the daily returns of all the variables for the full sample (left panel) and COVID-19 sample (right panel). The lower triangular of Panel B shows correlations for the full sample, and the upper triangular shows the correlations during COVID-19 pandemic.

Panel A: Descriptive Statistics										
Variable	Full Sample (September 17, 2014- 16 April 2020)					COVID-19 pandemic (December 31, 2019- 16 April 2020)				
	N	Mean	Median	Minimum	Maximum	N	Mean	Median	Minimum	Maximum
Gold	1404	0.023	0.000	-5.152	5.133	74	0.167	0.137	-5.152	5.133
Tbill	1382	0.004	0.004	-0.018	0.071	74	0.009	0.004	-0.012	0.071
Tbond	1382	0.014	0.020	-1.687	1.787	74	0.103	0.081	-1.687	1.787
Dollar Index	1380	0.010	0.011	-2.399	2.032	74	0.045	0.054	-1.626	1.579
Tether	1291	-0.015	0.000	-68.714	50.050	74	-0.005	-0.059	-5.257	5.339
Stable Cryptocurrencies	1291	-0.015	0.000	-68.714	50.050	74	-0.008	0.028	-2.226	2.757
SP500 Index	1404	0.024	0.049	-12.765	8.968	74	-0.190	0.071	-12.765	8.968
SSE Composite Index	1276	0.013	0.072	-8.873	6.040	65	-0.023	0.046	-3.782	3.098
NIKKEI 225 Index	1252	0.021	0.063	-8.253	7.731	62	-0.299	-0.424	-6.274	7.731
DAX Index	1343	0.003	0.080	-13.055	10.414	70	-0.392	-0.059	-13.055	10.414
BSE Index	1251	0.009	0.051	-14.102	6.747	64	-0.531	-0.365	-14.102	6.747
Bitcoin	1404	0.196	0.199	-46.473	22.512	74	-0.033	-0.107	-46.473	16.710
Traditional Cryptocurrencies	1404	0.211	0.150	-48.497	23.461	74	-0.009	-0.062	-48.497	16.862

Panel B: correlation matrix													
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Gold (1)	1	-0.107	-0.055	-0.222	-0.354	-0.204	0.538	0.360	0.352	0.611	0.354	0.449	0.406
Tbill (2)	0.095	1	0.260	-0.121	0.030	0.047	-0.299	-0.150	-0.267	-0.299	-0.128	-0.128	-0.130
Tbond (3)	0.195	0.264	1	-0.525	0.144	0.061	-0.545	-0.226	-0.178	-0.245	-0.144	-0.096	-0.118
Dollar Index (4)	-0.318	-0.108	-0.241	1	-0.025	0.156	0.133	-0.028	-0.193	-0.035	-0.175	0.090	0.088
Tether (5)	-0.050	0.016	0.007	0.036	1	0.475	-0.427	0.006	0.076	-0.335	-0.260	-0.531	-0.508
Stable Cryptocurrencies (6)	-0.042	0.013	0.001	0.042	0.988	1	-0.078	-0.145	-0.232	-0.222	-0.316	-0.064	-0.050
SP500 Index (7)	0.071	-0.155	-0.442	0.076	-0.061	-0.036	1	0.438	0.356	0.734	0.517	0.538	0.552
SSE Composite Index (8)	-0.008	-0.046	-0.092	0.047	-0.012	-0.016	0.175	1	0.627	0.518	0.615	0.258	0.250
NIKKEI 225 Index (9)	-0.122	-0.105	-0.136	0.056	0.012	0.000	0.239	0.311	1	0.576	0.460	0.232	0.217
DAX Index (10)	-0.084	-0.161	-0.302	0.176	-0.021	-0.013	0.605	0.194	0.369	1	0.631	0.631	0.590
BSE Index (11)	0.028	-0.048	-0.119	0.038	-0.046	-0.043	0.384	0.244	0.395	0.471	1	0.343	0.346
Bitcoin (12)	0.109	-0.033	-0.030	0.003	-0.052	-0.043	0.139	0.041	-0.020	0.130	0.073	1	0.967
Traditional Cryptocurrencies (13)	0.099	-0.042	-0.025	0.004	-0.028	-0.019	0.149	0.029	-0.011	0.117	0.068	0.759	1

Table 2: Parameter Estimates

Table lists parameter estimates with t -statistics in parenthesis for gold, S&P U.S Treasury Bills index (T-bill), S&P U.S Treasury Bonds index (T-bond), U.S. Dollar Index (DXY), and Tether as safe haven asset for daily returns of S&P500 Index (SP500), SSE Composite Index (SSE), NIKKEI225 Index, DAX Index, S&P BSE SENSEX (BSE), and BTC. Equations (1) – (3) are estimated jointly as a GARCH(1,1). For the sake of brevity, the GARCH parameter estimates are omitted but available upon request. The ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

$$RSA_{i,t} = \beta_0 + \beta_1 \cdot RRA_{j,t} + \beta_2 \cdot D \cdot RRA_t + \epsilon_t \quad (1)$$

$$\epsilon_t = \sigma_t \cdot Z_t \quad (2)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \cdot \epsilon_{t-1}^2 + \alpha_2 \cdot \sigma_{t-1}^2 \quad (3)$$

Panel A: Gold	SP500	SSE	NIKKEI225	DAX	BSE	BTC
β_0	1.560 (0.74)	1.640 (0.75)	0.849 (0.39)	1.660 (0.78)	2.720 (1.22)	0.876 (0.42)
β_1	-6.680*** (-2.83)	-1.640 (-1.31)	-12.940*** (-8.65)	-16.610*** (-9.82)	-4.310* (-1.83)	0.766* (1.67)
β_2	27.410*** (8.50)	34.110*** (6.39)	32.460*** (9.22)	41.260*** (13.48)	19.900*** (6.55)	8.430*** (6.00)
Panel B: T-bill	SP500	SSE	NIKKEI225	DAX	BSE	BTC
β_0	0.201 (15.62)	0.201 (14.47)	0.200 (14.45)	0.200 (15.30)	0.200 (14.20)	0.200 (15.55)
β_1	-0.040*** (-2.80)	-0.012** (-1.98)	-0.024** (-2.39)	-0.044*** (-4.32)	-0.002 (-0.14)	-0.003 (-0.91)
β_2	-0.044 (-1.27)	-0.156*** (-3.56)	-0.103* (-1.73)	-0.051 (-1.12)	-0.069* (-1.67)	0.003 (0.08)
Panel C: T-bond	SP500	SSE	NIKKEI225	DAX	BSE	BTC
β_0	1.690 (3.46)	1.010 (1.83)	1.170 (2.08)	1.450 (2.85)	1.370 (2.50)	1.070 (2.04)
β_1	-8.840*** (-15.86)	-1.120*** (-3.13)	-1.700*** (-4.91)	-5.390*** (-13.04)	-2.200*** (-3.81)	-0.094 (-0.90)
β_2	-1.680* (-1.70)	-4.500*** (-2.85)	-3.080** (-2.34)	-2.080** (-2.24)	-1.820* (-1.76)	-0.132 (-0.21)
Panel D: DXY	SP500	SSE	NIKKEI225	DAX	BSE	BTC
β_0	0.468 (0.44)	0.109 (0.1)	0.152 (0.13)	0.446 (0.41)	0.252 (0.22)	0.602 (0.56)
β_1	2.470** (2.07)	0.819 (1.00)	2.110** (2.58)	7.930*** (9.15)	2.910** (2.10)	-0.193 (-0.83)
β_2	0.155 (0.11)	0.808 (0.40)	-4.840*** (-2.73)	-6.390** (-4.96)	-4.100** (-2.17)	0.704 (1.61)
Panel E: Tether	SP500	SSE	NIKKEI225	DAX	BSE	BTC
β_0	-1.170 (-0.08)	-1.580 (-0.17)	-1.650 (-0.07)	-1.410 (-0.14)	-6.280 (-0.29)	-0.956 (-0.07)
β_1	-12.870 (-0.49)	-2.180 (-0.08)	2.070 (0.07)	-0.786 (-0.03)	-8.290 (-0.28)	-2.000 (-0.45)
β_2	0.338 (0.01)	2.590 (0.04)	1.190 (0.03)	-10.970 (-0.41)	-0.830 (-0.03)	-5.930 (-0.92)

References

- Baker, S. R., N. Bloom, S. J. Davis, K. Kost, M. Sammon and T. Viratyosin (2020), The unprecedented stock market reaction to COVID-19. Working paper, Northwestern University.
- Baur, D. G., T. Dimpfl and K. J. F. R. L. Kuck (2018), 'Bitcoin, gold and the US dollar—A replication and extension', 25, 103-10.
- Baur, D. G. and L. T. Hoang (2020), 'A Crypto Safe Haven against Bitcoin', Finance Research Letters, 101431.
- Baur, D. G. and B. M. Lucey (2010), 'Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold', Financial Review, 45, 217-29.
- Baur, D. G. and T. K. Mcdermott (2010), 'Is gold a safe haven? International evidence', Journal of Banking & Finance, 34, 1886-98.
- Bbc, N. (2020), Global shares plunge in worst day since financial crisis. Available at <https://www.bbc.com/news/business-51796806>.
- Bouri, E., P. Molnár, G. Azzi, D. Roubaud and L. I. Hagfors (2017), 'On the hedge and safe haven properties of Bitcoin: Is it really more than a diversifier?', Finance Research Letters, 20, 192-98.
- Caballero, R. J. and A. Krishnamurthy (2008), 'Collective Risk Management in a Flight to Quality Episode', the Journal of Finance, 63, 2195-230.
- Chan, K. F., S. Treepongkaruna, R. Brooks and S. Gray (2011), 'Asset market linkages: Evidence from financial, commodity and real estate assets', Journal of Banking & Finance, 35, 1415-26.
- Fleming, J., C. Kirby and B. Ostdiek (1998), 'Information and volatility linkages in the stock, bond, and money markets', Journal of Financial Economics, 49, 111-37.
- Hartmann, P., S. Straetmans and C. D. Vries (2004), 'Asset market linkages in crisis periods', Review of Economics and Statistics, 86, 313-26.
- Kaul, A. and S. Sapp (2006), 'Y2K fears and safe haven trading of the US dollar', Journal of international money and finance, 25, 760-79.
- Noeth, B. J. and R. Sengupta (2010), 'Flight to safety and US Treasury securities', The Regional Economist, 18, 18-19.
- Ranaldo, A. and P. Söderlind (2010), 'Safe haven currencies', Review of Finance, 14, 385-407.
- Smales, L. A. (2018), 'Bitcoin as a safe haven: Is it even worth considering?', Finance Research Letters.
- Stensås, A., M. F. Nygaard, K. Kyaw and S. Treepongkaruna (2019), 'Can Bitcoin be a diversifier, hedge or safe haven tool?', Cogent Economics & Finance, 1593072.
- Taylor, D. B. (2020), A Timeline of the Coronavirus Pandemic. Available at <https://www.nytimes.com/article/coronavirus-timeline.html>.
- Urquhart, A. and H. Zhang (2019), 'Is Bitcoin a Hedge or Safe Haven for Currencies? An Intraday Analysis', International Review of Financial Analysis, 63, 49-57.