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COVID-19 PANDEMIC AND HERDING BEHAVIOUR IN CRYPTOCURRENCY MARKET

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Abstract

In this paper, we examine the presence of herding in the cryptocurrency market for four distinct sub-periods (Pre and During COVID-19 period, bear and bull markets) using daily closing prices of the five largest cryptocurrencies by market capitalisation (Bitcoin, Ethereum, XRP, Stellar, and Tether) from 20 April 2019, to 31 January 2021. The study employs cross-sectional absolute deviations (CSAD) model to test for the presence of herd behaviour in the cryptocurrency market. The study results provide evidence of herd behaviour in the whole market for the selected period under study. The study also proves the presence of herding during the COVID-19 period and in the bullish market (positive market returns). These indicate that investors in the cryptocurrency market make similar trading decisions for positive market returns and during the COVID-19 pandemic period.

The study is significant to investors, regulators, and players in the cryptocurrency market to make appropriate decisions during times of uncertainty and market fears.

Keywords: COVID-19, herding behaviour, bear and bull market, cryptocurrency, cross-sectional absolute deviation

1. Introduction

As the novel coronavirus disease (COVID-19) pandemic rages across the world, the financial markets have tumbled worldwide (Khatatbeh et al., 2020; Iqbal et al., 2018). The cryptocurrency market is no exception, as the market has experienced its largest-ever Bitcoin inflow and a significant increase in price during the COVID-19 pandemic (Poyser, 2018). Moreover, when most conventional financial assets appeared to lose value freely during the COVID-19 pandemic, a considerable number of investors are closely observing the trend of cryptocurrencies. Exploring safe assets as a hedging and diversification instrument during this uncertain and adverse market crisis is a common wish of every investor. One such safe haven for investors may include cryptocurrencies (Xie et al., 2021; Mnif et al., 2020; Urquhart and Zhang, 2018).

Contrary to past financial crises where investors place their assets in safe havens such as gold, the current COVID-19 pandemic is depicted by a surge in the trading volumes of cryptocurrencies (Mnif, E. and Jarboui, A., 2021). This upward surge may be due to investors' belief in the cryptocurrency market as a safe haven or investors following the market's performance without adequate information and appreciation of the risk-reward trade-offs. Even though different macro factors such as the COVID-19 pandemic, political turmoil, economic uncertainty, and market volatility can influence the price of cryptocurrencies, their technical features based on blockchain technology give them comparative strength against

these uncertainties (Colon et al., 2021). Cryptocurrency is a financial asset that can be used to buy goods and services but uses an online ledger with strong cryptography to secure online transactions without going through a financial institution. Hence, understanding investors' behaviour on the cryptocurrency market before and during the COVID-19 pandemic is critical to researchers and practitioners. The traditional finance framework takes no account of investors' rationality, leading to booms and busts in the financial market. This paper investigates the concept of behavioural finance on an investor herding in the cryptocurrency market during the pandemic. Research on herd behaviour of cryptocurrencies in the period of the COVID-19 pandemic is of interest to investors since most investors may mimic the behaviour of other investors without adequate information and appreciation of the risk-reward trade-offs. There are limited literature studies exploring the herding behaviour in the cryptocurrency market during the COVID-19 pandemic (Yarovaya, Matkovskyy, and Jalan, 2021; Rubbaniy, 2020). Yarovaya et al. (2021) analysed herd behaviour in the crypto market from 1 January 2019 to 13 March 2020 using hourly prices of the four most traded cryptocurrency markets - USD, EUR, JPY, and KRW. They indicated the presence of herding behaviour for all markets except KRW.

Nevertheless, the authors stated that COVID-19 does not heighten herd behaviour in cryptocurrency (crypto) markets for the period under study. However, the authors were quick to indicate that their results should be explained with care since the data used was based on the early stage of the pandemic. Rubbaniy (2020) investigated herd effects in more than 100 different cryptos using daily data from 1 January 2015 to 25 June 2020. The study revealed significant evidence of herd behaviour in the crypto market. There are significant discrepancies in the results from the literature mentioned above on herd behaviour of cryptos in the period of the COVID-19 pandemic. Specifically, there are limited literature studies on herd behaviour in the crypto market during this financial contagion caused by the COVID-19 pandemic. This paper makes contributions to the literature in four aspects: to investigate the existence of herd behaviour in the crypto market; to explore the presence of herd behaviour before and during COVID-19 pandemic periods; to analyse the presence of herding in bear and bull crypto market, and to provide a reference for assessing herding behaviour in the crypto markets after the pandemic subsides.

The rest of the paper is organised as follows. In section 2, the data and methodology used for the study are presented. The empirical results are presented in Section 3 and the conclusion in Section 4.

2. Data and Methodology

2.1 Data

Data used for this research consist of daily closing prices of the five largest cryptos by market capitalisation (Bitcoin, Ethereum, XRP, Stellar, and Tether) from 20 April 2019 to 31 January 2021, corresponds to a total of 652 trading days. The data are downloaded from www.coindesk.com.

Logarithmic returns (Equation 1) are used to estimate the returns for the five selected cryptos for the period under consideration.

$$\mathrm{r_{i,t}} = \mathrm{In}\left(\frac{\mathrm{p_{i,t}}}{\mathrm{P_{i,t-1}}}\right) \tag{1}$$

where $r_{i,t}$ is the logarithmic return and $p_{i,t}$ is the closing price of Crypto i at time t and $P_{i,t-1}$ is the closing price of Crypto i at time $t-1$.

The dataset is divided into two, Pre COVID-19 (20 April 2019 - 10 March 2020) and During COVID-19 (11 March 2020 - 31 January 2021) periods. 11 March 2020 is used as the starting period because it is the day the World Health Organization (WHO) declared COVID-19 a global pandemic. Two types of markets are also considered from the dataset, bull and bear markets: positive market returns and adverse market returns, respectively.

2.2 Methodology

2.2.1 The Cryptocurrency Market

Assume a crypto market where i different cryptos, labelled from 1 to N are traded. The current trading time is 0, and the time period under analysis is T days. Let $r_{i,t}$ be the return of crypto i at time t, $0 \leq t \leq T$. Hence, we can assume that $r_{i,t} \geq 0$ for all i, where the first and second-order moments are finite. The market index consists of a linear combination of N underlying cryptos. Let the market (m) return of the index at time t be represented by $r_{m,t}$, $0 \leq t \leq T$, and hence

$$r_{m,t} = \eta_{1,t} r_{1,t} + \eta_{2,t} r_{2,t} + \cdots + \eta_{i,t} r_{i,t} = \sum_{i=1}^{N} \eta_{i,t} r_{i,t} \quad (2)$$

where $\eta_{1,t}$ is the weight of crypto i at time t calculated from the market capitalisation and $r_{i,t}$ is the return of cryptocurrency i at time t. Using the market capitalisation (cap) for the selected cryptos, we can calculate the market portfolio, which is the cap-weighted market return, $r_{m,t}$ given in Equation 2.

The calculated index $r_{m,t}$ using Equation 2 serves as a benchmark for the five selected cryptos used in this study.

2.2.2 Herding Detection

Chang et al. (2000) explained a linear association between an asset's return dispersion and the absolute value of market returns of asset pricing models; hence they constructed the cross-sectional absolute deviation (CSAD) model. The linear model predicts that during extreme market movement, the returns of any asset will drift from the market returns. Contrary, during times of stable periods, individual returns spread closer to market returns. CSAD is a typical measure used to capture the dispersion of an asset's returns from market returns. In this paper, the CSAD model is used to analyse and interpret the concept of herd behaviour in the crypto market. The CSAD is given as,

$$CSAD_t = \frac{\sum_{i=1}^{N} |r_{i,t} - r_{m,t}|}{N} \quad (3)$$

Where $CSAD_t$ is the cross-sectional absolute deviation for i_{th} crypto at time t, N is the number of crypto's, $r_{m,t}$ is the market return estimated on a day-to-day basis at t, and $r_{i,t}$ has its usual meaning. In this paper, CSAD assesses the presence of herd behaviour using the ordinary least square (OLS) regression technique. Consequently, the OLS regression is formulated as in Equation (4),

$$CSAD_t = \kappa_0 + \kappa_1 |r_{m,t}| + \kappa_2 (r_{mt}^2) + \epsilon_t \quad (4)$$

where, κ_0, κ_1, and κ_2 are the regression coefficients, $|r_{m,t}|$ is the absolute value of market return at time t, ϵ_t is the error term and $r_{m,t}$ has the usual meaning as above. Equation (4) is used in exploring the existence of herd behaviour in the crypto market. To prove the existence

of herding, κ_2 must be negative and significant. More particularly, Equation (5) is used to evaluate the effect of COVID-19 on herding,

$$CSAD_t = \kappa_0 + \kappa_1 D^{COVID}|r_{m,t}| + \kappa_2 (1 - D^{COVID})|r_{m,t}| + \kappa_3 D^{COVID} (r_{m,t})^2 + \kappa_4 (1 - D^{COVID})(r_{m,t})^2 + \epsilon_t \quad (5)$$

Here, D^{COVID} is a dummy variable and equal to 1 after 11 March 2020 (when COVID-19 was declared as a pandemic) and zero otherwise. Negative and significant values of κ_3 and κ_4 proves the presence of herd behaviour following (before) the COVID-19.

To investigate the presence of herding in the bear and bull market, the following regression equations (Equation 6 and 7) are used,

$$CSAD_t^{bull} = \kappa_0 + \kappa_1^{bull}|r_{m,t}^{bull}| + \kappa_2^{bull} r_{mt}^{2\,bull} + \epsilon_t \quad (6)$$

$$CSAD_t^{bear} = \kappa_0 + \kappa_1^{bear}|r_{m,t}^{bear}| + \kappa_2^{bear} r_{mt}^{2\,bear} + \epsilon_t \quad (7)$$

where $r_{m,t} > 0$ and $r_{m,t} < 0$ for bull and bear market respectively.

3. Empirical Analysis

3.1 Descriptive Statistics

Daily returns were computed using Equation (1) for the selected period. The price and returns dynamics of the five cryptos used in this study are presented in Figures 1 and 2, respectively. Clearly, from Figure 1, the market for these cryptos experienced volatile behaviour starting after the first three months of 2020 except for Tether for which had a sharp price increase around March 2020 and remained somehow stable. These price dynamics can create the right conditions for the emergence of herding behaviour on the crypto market.

Figure 1: Price dynamics of Bitcoin, Ethereum, XRP, Stellar and Tether from 20 April 2019 to 31 January 2021

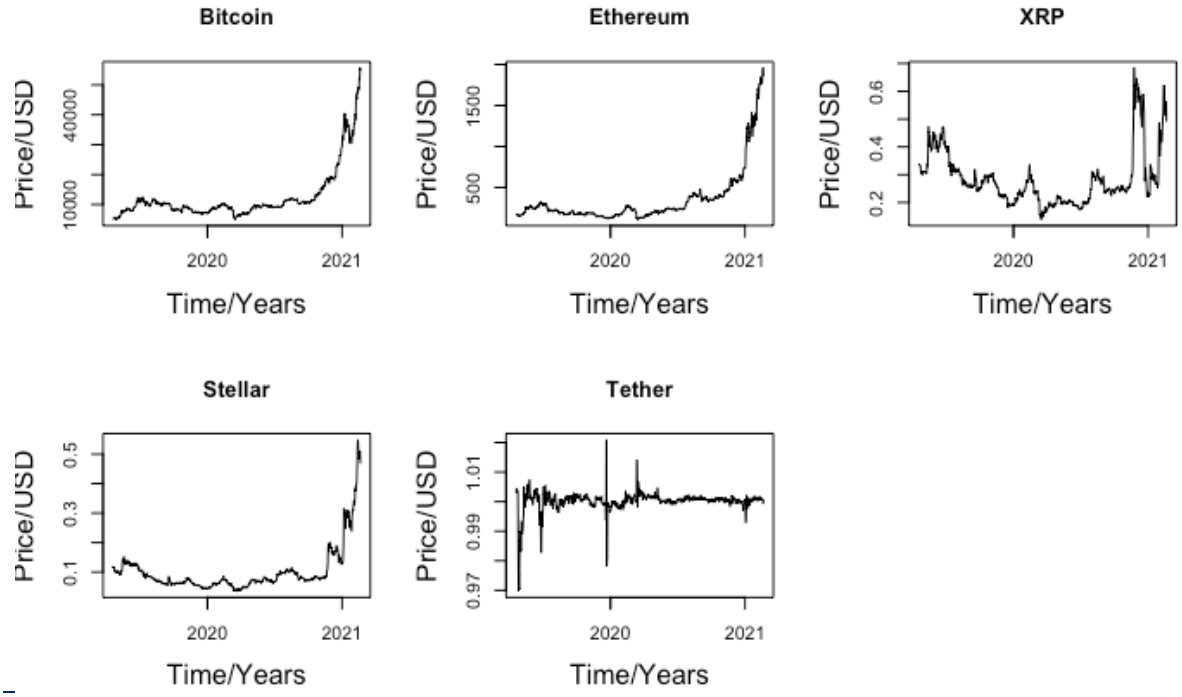

Figure 2: Returns dynamics of Bitcoin, Ethereum, XRP, Stellar and Tether from 20 April 2019 to 31 January 2021

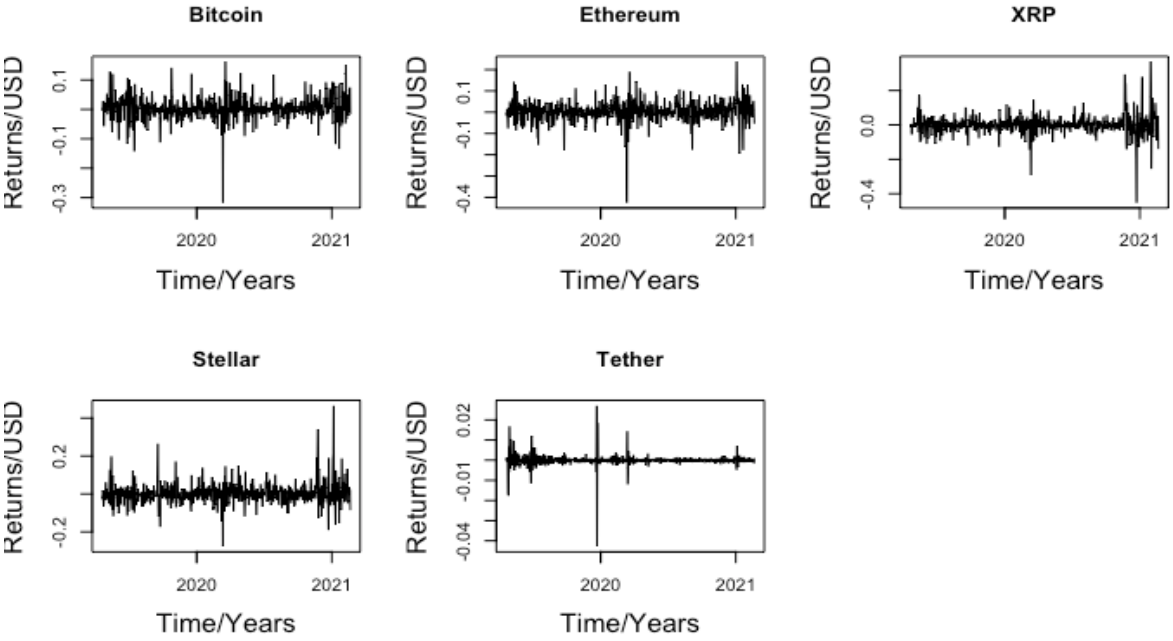

Table 1 shows the descriptive statistics for CSAD measure for daily data $CSAD_t$ and cap-weighted market return $r_{m,t}$ which is calculated using the market capitalisation of the selected cryptos. The normality tests (skewness and kurtosis) indicate that all the return series of the whole market and CSAD are non-normally distributed since the coefficient of skewness and kurtosis differ significantly from 0 and 3, respectively. This is further confirmed using the Jarque-Bera (JB) test statistics for normal distribution, which indicates the rejection of the null hypothesis of normal distribution of $CSAD_t$ and $r_{m,t}$ for the different market phases. The mean and standard deviation of $CSAD_t$ and $r_{m,t}$ are very high during the COVID-19 period. These results possibly indicate that markets have atypical cross-sectional variations attributable to unanticipated events.

Table 1: Impact of public interest and COVID-19 milestones on Bitcoin futures trading

		No. Obs.	Mean	S.D.	Skewness	Kurtosis	JB Test
Total Period	$CSAD_{i,t}$	652	0.0141	0.0123	2.6898	13.2406	3635.10
	$r_{m,t}$	652	0.2659	3.7192	-0.9765	13.3110	2991.90
Pre COVID-19	$CSAD_{i,t}$	325	0.0257	0.0192	1.9500	7.8306	521.96
	$r_{m,t}$	325	0.0878	3.5051	-0.0618	5.3188	73.0180
During COVID-19	$CSAD_{i,t}$	327	0.0309	0.0286	2.6304	11.7790	1427.20
	$r_{m,t}$	327	0.4430	3.9178	-1.6526	18.5034	3423.7
Bear Market	$CSAD_{i,t}$	291	0.0279	0.0240	3.5328	23.4399	5671
	$r_{m,t}$	291	-2.5258	3.0267	-4.2438	35.3266	13544
Bull Market	$CSAD_{i,t}$	361	0.0280	0.0239	2.2532	9.2695	896.70
	$r_{m,t}$	361	2.5163	2.5011	1.8931	7.3205	496.42

3.2 Herding behaviour for the whole market period

Table 2 shows the regression results for the top 5 cryptos by market capitalisation for the total period under study. It can be observed that the coefficient of the variable r_{mt}^2 is negative ($\kappa_2 = -3.026\text{e}-05$) at a 5% significance level. This suggests the existence of strong market-wide herding behaviour for the selected cryptos for the period under study. This means that during this period, investors trading in the top 5 cryptos followed the market's performance without adequate information and appreciation of the risk-reward trade-offs. That is to say, the distribution of the returns of the selected cryptos over the selected periods shrinks when the market returns experience a rise. This result is in congruence with the study of Bouri et al. (2019), Kaiser and Stöckl (2020), Ballis and Drakos (2020), Rubbaniy (2020), Yarovaya et al. (2021), among others who indicated the presence of herding behaviour on the crypto market but differs from the result of Stavroyiannis and Babalos (2019) who reported the absence of herding behaviour on the crypto market when ta time-varying regression model was used. As noted by Kaiser and Stöckl (2020), the presence of herding on the crypto market can be described by the influx of irrational investors in the predominantly traded cryptos like Bitcoin. It should, however, be noted that the presence of herding behaviour on the crypto market is to be overhauled, and the necessary correction may result in severe losses in wealth.

Table 2: Estimating regression coefficient of $CSAD_t$ on Equation 4

	Coeff.	S.E.	t-Stat	Prob
κ_0	7.014e-03	6.134e − 04	11.435	<2e-16***
κ_1	2.996e-03	2.438e-04	12.290	<2e-16***
κ_2	-3.026e-05	1.395e-05	-2.169	0.0304*
R-Square	0.3352			
Adj. R-Square	0.3331			
F-Statistics	163.6			

Source: The Author, *** and * indicates significance at 1% and 5%, respectively

3.3. Herding behaviour for Pre Covid-19 and During Covid-19

Table 3 reports the regression result for the Pre Covid-19 and During Covid-19 period for the selected cryptos. The table shows that herding is present during the Covid-19 period as the regression coefficient is negative (κ_2 =-7.867e-05) and statistically significant at a 5% level. From this result, it can be stated, investors in the crypto market during the COVID-19 pandemic exhibit the tendency to mimic the trading decisions of other investors without exercising due diligence over the period of the study. The results also reflect the inefficiency in the crypto market during the COVID-19 pandemic, which produces a higher level of volatility. This result is consistent with the study in Rubbaniy (2020), which confirmed the presence of herding behaviour on the crypto market during the COVID-19 pandemic. However, this result stands in contrast to the result in Yarovaya et al. (2021), who concluded that COVID-19 do not heighten herd behaviour in cryptocurrency (crypto) markets during the COVID-19 pandemic. Yarovaya et al. (2021) results were based on small sample data from 1 January 2019 to 13 March 2020. It should be noted that COVID-19 was first detected in December 2019 and the World Health Organization (WHO) declared it a pandemic on 11 March 2020. Hence, their period of study for herding behaviour during the COVID-19 pandemic was about four months from the first date COVID-19 was observed, which might have accounted for the anti-herding behaviour of investors on the crypto market. This current study, however, employs a trading period from 1 December 2019 to 31 January 2021, which indicates a significant time period. The coefficient of r_{mt}^2 i.e., κ_2 for the Pre Covid-19 period is negative and not significant. However, to prove the existence of herding behaviour in a market, κ_2 must be negative and

significant. Hence, herding is not present before the period Covid-19. The finding indicates that participants before the Covid-19 period made decisions rationally and did not follow the investment decisions of their peer investors. The R-squared values of 0.4032 and 0.3147 indicate that 40.31% and 31.48% of the variation on $CSAD_t$ can be explained by daily market returns and their square term.

Table 3: Regression Results for Pre COVID-19 and During COVID-19

	Pre- COVID-19				During COVID-19			
Variable	**Coeff**	**S. E.**	**t-Stat**	**Prob**	**Coeff**	**S. E.**	**t-Stat**	**Prob**
κ_0	1.193e-02	1.568e-03	7.606	3.14e-13***	1.550e-02	1.989e-03	7.7950	8.85e-14***
κ_1	5.964e-03	8.889e-04	6.709	8.82e-11***	6.564e-03	7.618e-04	8.6160	3.10e-16***
κ_2	-1.011e-04	8.507e-05	-1.189	0.2350	-7.867e-05	3.667e-05	-2.1450	0.0327*
R-Square	0.4032				0.3147			
Adj. R-Square	0.3995				0.3104			
F-Statistics	108.8				74.38			

Source: The Author, *** and * indicates significance at 1% and 5%, respectively

3.4. Herding behaviour for the bull and bear markets (Asymmetry in herding behaviour)

This section gives empirical results on whether crypto herding exhibits distinct behaviours under different market trends. The total period is divided into two sub-periods using the index returns, that is, negative and positive index returns. Table 4 presents the outcomes of the tests for herding behaviour in the bull (positive returns) and bear (negative returns) market. The results in the table indicate the existence of herding asymmetry in the trading behaviour of investors in the crypto market as herding during the days of positive market returns are significantly higher than the days of negative market returns of the selected crypto's. The finding is consistent with the study of Rubbaniy (2020), Stavroyiannis and Babalos (2019), and Ballis and Drakos (2020). Also, as seen in the table, the negative coefficients of the market return for the bull (κ_2 = -0.0003) and bear (κ_2 = -9.799e-06) market suggest the presence of herding in both markets. However, the latter coefficient is not statistically significant. For this reason, it can be concluded that herding only exists in the bull market. That is, at periods when the prices of cryptos are steadily increasing, investors trading in the top 5 cryptos are inclined to behave similarly.

Table 4: Regression Results for Bull and Bear market

	Bull Market				Bear Market			
Variable	**Coeff**	**S.E**	**t-Stat**	**Prob**	**Coeff**	**S. E.**	**t-Stat**	**Prob**
κ_0	0.0114	0.0019	5.9580	6.12e-09***	1.479e-02	1.665e-03	8.8840	<2e-16***
κ_1	0.0080	0.0011	7.4930	5.34e-13***	5.249e-03	6.383e-04	8.2240	6.82e-15***
κ_2	-0.0003	0.0001	-2.7630	0.00602**	-9.799e-06	2.949e-05	-0.3320	0.74
R-Square	0.3204				0.4084			
Adj. R-Square	0.3166				0.4043			
F-Statistics	84.38				99.42			

Source: The Author, *** and * indicates significance at 1% and 5%, respectively

4. Conclusion

In this paper, we study the trading behaviour for the five largest cryptocurrencies based on their market capitalisation from 20 April 2019, to 31 January 2021, for four distinct sub-periods (Pre and during the COVID-19 period, bear, and bull market). To empirically test for herd behaviour in all the sub-periods, the dispersion model of Chang et al. (2000) is used. The results using the model show evidence of herd behaviour for the entire period under study. We also find evidence that the COVID-19 pandemic increases herd behaviour in the cryptocurrency market. There was also evidence of herd behaviour in the bullish market.

The existence of herding behaviour in the whole market period, bullish market, and during Covid-19 indicates the inefficiency in the market and generates a higher level of risk and volatility. The study is significant to investors, market regulators, and policymakers in the cryptocurrency market to deepen their understanding of herding behaviour during market crisis periods like the COVID-19 pandemic.

Declarations:

Availability of data
Data for this work is available from the corresponding author upon request.

Competing Interest
The author declares that they have no competing interests.

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