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Herding in International REITs Markets around the COVID-19 Pandemic

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Abstract: This paper investigates whether investors in international Real Estate Investment Trusts (REITs) markets engage in herding behaviour due to the economic uncertainty induced by the COVID-19 pandemic in 2020. Using a comprehensive sample of 27 countries encompassing both developed and emerging markets, the results show consistent evidence of herding formation in international REITs markets based on both static and time-varying estimates. International herding is mainly driven by herding in developed market REITs. Further analysis provides a direct evidence showing that herding in REITs markets during the pandemic resulted from the economic uncertainty brought on by the global health crisis. A quantile-on-quantile regression reveals that higher uncertainty associated with COVID-19 pandemic intensifies herding.

Keywords: International REITs; Herding; COVID-19; Quantile-on-Quantile Regression; Probit Model

JEL Classification: C22, R3

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1. Introduction

Herding formation in financial markets occurs when individual investors ignore their private information and contemporaneously trade in the same direction as others or follow market consensus (Christie and Huang, 1995). Investors tend to exhibit herding behaviour during times of extreme financial market downturns, high uncertainty, and crisis events. Under these circumstances, asset prices become extremely sensitive to market sentiment and thereby subject to herding behaviour (Avery and Zemsky, 1998), which can lead to asset price bubbles and market crashes, particularly as investors usually react more to bad news than good news (Esptein and Schneider, 2008). This can jeopardizes financial stability because market crashes may be intensified via pro-cyclical market mechanisms.

The above issues are very relevant to real estate investments, not only because the 2008 Global Financial Crisis (GFC) was triggered by the collapse of the real estate market, but because the high inflationary pressure seen following the COVID-19 outbreak have made some investors to switch from conventional assets such as stocks into alternative investments, such as real estate, which are weakly affected by the level of inflation. This has led real estate investments to attract decent interest from investors and to experience a spike in prices that might not be easily explained by fundamentals, although the real estate sector experienced some interruption in the construction activities due to lockdown measures. For example, after hitting a low level around late March 2020, the US REIT recovered all of its pandemic losses and by around mid-2021 made new highs and remain at new high levels. These factors can induce a high level of herding in real estate investments that requires a better and comprehensive understanding in light of the COVID-19 pandemic. Herd behaviour in financial markets, including real estate investments, exacerbates asset price volatility, especially during crisis conditions, exposing the financial system to adverse risks (Bikhchandani and Sharma, 2000). Therefore, investigating herding during crisis conditions would be important for policymakers. It also matters to investors and policymakers. Most of the literature on herding has focused on stock markets (See Bouri et al., 2021; Ferreruela and Mallor, 2021; Clements et al., 2017; Kabir, 2018 and Economou et al., 2016 for recent examples). In this context, this paper examines the herding formation in the international REITs markets in response to the global health crisis as it unfolded.

The outbreak of the COVID-19 virus in late 2019, which was declared a pandemic on 11 March 2020 by the World Health Organisation (WHO), induced an extraordinary and unprecedented surge in economic uncertainty larger than during the 2008 Global Financial Crisis (GFC) (Baker et al., 2020; Altig et al., 2020 and Caggiano et al., 2020). To contain the spread of the virus, governments worldwide enforced lockdown, such as temporary closure of workplaces and schools, social distancing, and travel ban. These measures were not without a high economic and financial cost. In fact, the global economy contracted by around 3 percent in 2020 (IMF, 2020), exceeding the level of contraction underwent during the 2008 GFC. Furthermore, international stock market indices plunged and were subject to extreme return volatility due to the COVID-19 pandemic-induced uncertainty and associated economic costs (Zhang et al., 2020).

This paper contributes to the herding literature by studying herding formation in the international REITs market during the COVID- 19 pandemic. The importance of REITs as a portfolio asset class has grown significantly since their inception in 1960 in the US. According to the European Public Real Estate Association (2020), the market capitalization of global REITs has grown from USD 11.7 billion in 1989 to USD 2.5 trillion in 2021. REITs are securitized real estate investments that offer investors the opportunity to invest in direct real estate while circumventing the disadvantages associated with direct real estate, such as the relatively low liquidity and high transaction costs (Hoesli and Oikarinen, 2012; Yunus et al., 2012; Ngene, Sohn and Kabir, 2018). Furthermore, the portfolio diversification benefits of

REITs relative to general stocks (Chandrashekaran, 1999; Lee, 2010; Newell and Peng, 2012) and other asset classes such as fixed income (Niksanen and Falkenback, 2010), have made REITs an attractive asset class from a portfolio risk management perspective.

In the theoretical herding literature, Bikhchandani and Sharma (2000) provide three premises for herd behaviour in financial markets: information-based herding and cascades, reputation-based herding, and compensation-based herding. Information-based herding occurs when investors face similar investment decisions under uncertainty and ignore their private but incomplete information to copy the actions of other investors, inferring information signals from the actions of other investors. Reputation-based herding happens when an investors or fund managers are uncertain about their ability or skill to choose the right stock or make the correct investment decision. Therefore, they follow the investment actions of other fund managers to avoid reputational risks from making costly investment decisions. Finally, fund managers are incentivised to engage in herding or imitate the actions of other fund managers if their compensation depends on the performance of their asset portfolio relative to other fund managers. Such imitations result in an inefficient portfolio mix. Bikhchandani and Sharma (2000) describe the above-mentioned causes as "intentional herding," which should be distinguished from "spurious herding." The latter arises when investors face the same investment decision problem and publicly available information set and make similar investment decisions. In this case, the outcomes are efficient, whereas "intentional herding" leads to inefficient outcomes.

On the data front, we investigate herding in international REITs associated with the COVID-19 pandemic based on a comprehensive sample of 27 countries and daily REIT indices. Methodologically, we adopt the standard approach of Chang et al. (2000) and provide evidence for both static and dynamic estimates. We further use the Daily Disease Equity Market Volatility Tracker (EMVID) from Baker et al. (2020) to measure COVID-19-induced uncertainty and formally test, using a probit model, whether herding in international REITs markets was indeed caused by the uncertainty associated with the recent pandemic. Finally, we extend our investigation to test the dependence structure of the relationship between herding and COVID-19 uncertainty by estimating a quantile-on-quantile regression following Sim and Zhou (2015) as it could be that large increases in uncertainty linked to the pandemic could ’have made herding stronger in these markets. To the best of our knowledge, this is the first paper to study herding formation in REITs markets during the recent pandemic. The paper makes a further contribution to the existing empirical literature in that we focus on herding behaviour in international markets rather than single markets, such as in Yang et al. (2020), Akinsonmi et al. (2018), Babalos et al. (2015), Zhou and Anderson (2013) and Phillipas et al. (2013).

The rest of the paper is organised as follows. Section 2 summarises the literature review. Section 3 describes the methodology, including the cross-sectional absolute deviation and the quantile-on-quantile regression. Section 4 provides the dataset. Section 5 presents and discusses the empirical results. Section 6 concludes.

2. Literature Review

Compared to the extensive herding literature on equity markets, the literature on herding in REITs markets is thin. Zhou and Anderson (2013) employ quantile regression to test for herding in US REITs between 1980 and 2010. They use the standard return dispersion measures of Christie and Chang (1995) and Chang et al. (2000) and find that herding is more likely at higher quintiles of the dispersion of the returns in the full sample, suggesting that herding in REITs markets tends to occur during times of market turbulence or significant markets declines. Phillipas et al. (2013) also use the cross-sectional absolute deviation (CSAD) and the return dispersion measure of Chang et al. (2000), but disaggregated the US REITs by property type during 2004-2011 and incorporated macro variables such as funding conditions and market sentiment to provide further insights into underlying herding dynamics. Their results show significant herding effects in overall US REITs and US REITs property types, including industrial/office, retail, lodging/resorts, and during the period January 2004-November 2009, reflecting the effects of the burst of the housing market bubble during that sub-sample period. Phillipas et al. (2013) did not find herding evidence during November 2009-December 2011 sub-period. However, they show that the drop in investors' sentiment regarding current and future market conditions and adverse shocks to REITs funding conditions are associated with herding. Babalos et al. (2015) estimate a regime-switching Markov herding model based on the CSAD measure, focusing on the US REITs property types from 2004 to 2013. They find significant herding behaviour only during the crash regime associated with the 2008 GFC. Akinsonmi et al. (2018) also adopt the regime-switching approach but examine the herding behaviour of UK REITs during episodes of low, high and extreme volatility between 2004 and 2016. Interestingly, their evidence points to herding effects in the low volatility regime, which coincided with the bull market conditions of the London Stock Exchange, suggesting that REITs investors also herd when the market is relatively doing well. Recently, Yang et al. (2020) provide evidence that CSSD increases when the market returns increase, which is consistent with anti-herding behaviour. Their evidence is based on data spanning 2000 through 2009 for twenty US cities.

The above review of the literature on herding in the REIT markets points to a lack of evidence during the COVID-19 outbreak, although this global health crisis induced tremendous economic instability and shacked financial markets. In this paper, we provide new insights on the herding behaviour in the international REIT markets around the COVID-19 outbreak, an unexplored research topic.

3. Methodologies

3.1. The Herding Model

Our study adopts the familiar methodology of Chang et al. (2000). It consists of calculating the cross-sectional absolute deviation (CSAD), as their measure of returns dispersions, and comparing CSAD to the overall market returns to identify the presence of herding formation. The methodology of Chang et al. (2000) is an extension of the approach of Christie and Huang (1995), which uses the cross-sectional standard deviation (CSSD) as return dispersion measure, defined as the dispersion of individual asset returns from the realized market average return. The latter argue that a low return dispersion is consistent with herding behaviour during stressed market, given that individual returns do not diverge significantly from overall market returns. Alternatively, an increasing dispersion suggests individual asset returns differ in their sensitivity to market returns, which is consistent with anti-herding behaviour or the rational asset pricing theory.

Using CSAD, Chang et al. (2000) adopt a nonlinear regression specification in contrast to the linear specification of Christie and Huang (1995). The CSAD measure is shown in the below Equation (1), which is derived from the conditional version of the CAPM (Black, 1972) as:

$$CSAD_t = \frac{1}{N} \sum_{i=1}^{N} |R_{i,t} - R_{m,t}| \tag{1}$$

where $R_{i,t}$ is the return of country i at time t and $R_{m,t}$ is the overall cross-sectional returns at time t, and N is the number of countries at time t.

$$CSAD_t = \alpha + \alpha_1 |R_{m,t}| + \alpha_2 R_{m,t}^2 + \varepsilon_t \tag{2}$$

Chang et al. (2000) estimate the quadratic Equation (2) to capture possible non-linearity in the relationship between $CSAD_t$ and $R_{m,t}$, which is used to detect herding effects. They show that $CSAD_t$ is an increasing and a linear function of $R_{m,t}$, in line with rational asset pricing models.

However, when market participants ignore their beliefs and follow aggregate market consensus during extreme price movements (herding behaviour), the linear and increasing relation does not hold. Rather, the relationship becomes non-linearly increasing or decreasing. As a result, the original linear approach of Christie and Huang (1995) may fail to detect evidence of herding when it is present. Furthermore, the $CSSD$ dispersion measure used by Christie and Huang (1995) is sensitive to outliers (Zhou and Anderson, 2013).

Therefore, in this paper, we follow the approach of Chang et al. (2000) to detect herding behaviour in the international REIT markets during the COVID-19 pandemic. In Equation (2), herding effects are tested based on the following hypotheses:

H1: In the absence of herding effects, we expect α_1>0 and α_2=0 in Equation (2);

H2: If herding effects are present, we expect α_2 <0;

H3: If anti-herding exists, then α_2 >0.

We estimate both static and time-varying coefficient estimates of Equation (2) in a sample that covers both pre-pandemic and COVID-19 pandemic periods. We use a probit model to test whether the herding effects in international REITs, as suggested by coefficient estimates of Equation (2), resulted from COVID-19 pandemic uncertainty.

3.2. Quantile-On-Quantile Approach

Next, we estimate a quantile-on-quantile (QQ) regression following Sim and Zhou (2015) to investigate if an asymmetric relationship exists between herding in international REITs markets and COVID-19-induced uncertainty proxied by the EMVID index developed by Baker et al. (2020). The QQ approach combines quantile regression and local linear regression, and thus allows us to estimate the nonlinear effect of the quantiles of COVID-19-induced uncertainty on the quantiles of the estimated rolling herding coefficient from Equation (2). It could be that extreme values (higher quantiles) of uncertainty due to COVID-19 cause the estimated herding coefficient α_2 to be more negative. We briefly explain the QQ approach as follows:

Letting θ denote a quantile, Equation (3) postulates the θ-quantile of rolling herding coefficient (α_{2t}) as a function of the θ-quantile of EMVID, our measure of COVID-19 uncertainty. ε_t^θ is the error term that has a zero θ-quantile. We let $\beta^\theta(.)$ be unknown because we do not have prior knowledge about how herding and COVID-19 uncertainty are related.

$$\alpha_{2t} = \beta^\theta(EMVID_t) + \varepsilon_t^\theta \tag{3}$$

To investigate the impact of EMVID across its distribution, with its quantiles denoted by τ, on the θ-quantile of α_{2t}, we linearize $\beta^\theta(.)$ by taking the first order Taylor expansion of $\beta^\theta(.)$ around $EMVID^\tau$ which leads to the specification of Equation (4).

$$\beta^\theta(EMVID_t) \approx \beta^\theta(EMVID^\tau) + \beta^{\theta'}(EMVID^\tau)(EMVID_t - EMVID^\tau) \tag{4}$$

where, both $\beta^\theta(EMVID^\tau)$ and $\beta^{\theta'}(EMVID^\tau)$ are indexed to θ and τ such that $\beta^\theta(EMVID^\tau)$ and $\beta^{\theta'}(EMVID^\tau)$ are functions of θ, whereas $EMVID^\tau$ is a function of τ. Following Sim and Zhou (2015), we can redefine $\beta^\theta(EMVID^\tau)$ and $\beta^{\theta'}(EMVID^\tau)$ as $\beta_0(\theta,\tau)$ and $\beta_1(\theta,\tau)$. Accordingly, Equation (4) can be re-written as:

$$\beta^\theta(EMVID_t) \approx \beta_0(\theta,\tau) + \beta_1(\theta,\tau)\,(EMVID_t - EMVID^\tau) \tag{5}$$

We then substitute Equation (5) into Equation (3) to obtain:

$$\alpha_{2t} = \beta_0(\theta,\tau) + \beta_1(\theta,\tau)\,(EMVID_t - EMVID^\tau) + \varepsilon_t^\theta \tag{6}$$

Equation (6) captures the relationship between the θ-quantile of herding in international REITs markets and the τ-quantile of uncertainty stoked by COVID-19 pandemic. To obtain estimates of $\widehat{\beta_0}(\theta,\tau)$ and $\widehat{\beta_1}(\theta,\tau)$, we solve for minimization problem in the below Equation (7), where b_0 and b_1 represent the local linear regression estimates of β_0 and β_1, and $\rho\theta$ is the absolute tilted value which gives the θ-conditional quantile of the herding dependant variable (α_{2t}) as a solution :

$$\min_{b_0 b_1} \sum_{i=1}^{n} \rho_\theta \ [\alpha_{2t} - b_0 - b_1(\widehat{EMVID}_t - \widehat{EMVID}^\tau)] K\left(\frac{F_n(\widehat{EMVID}_t) - \tau}{h}\right) \quad (7)$$

A Gaussian kernel $K(\cdot)$ is used to weight observations in the neighbourhood of $\widehat{EMVID}^\tau$ with a chosen bandwidth h to assess the local effect of the τ-quantile of COVID-19 uncertainty measure. The method of Yu and Jones (1998) is used for bandwidth selection.

4. Data

The current paper uses daily REITs indices for 27 countries comprising both developed and emerging market countries and daily global as well as developed and emerging market REITs indices. The data is compiled by Standard & Poor (S&P) and sourced from the Bloomberg database. The complete list of countries is as follows: United States, United Kingdom, Germany, Netherlands, Belgium, Hong Kong, France, Singapore, Australia, Japan, New Zealand, Finland, Italy, Turkey, South Africa, Israel, Greece, Taiwan, China, Chile, Malaysia, Singapore, Mexico, India, Ireland, Spain, Thailand. The full sample period is from 7 September 2019 to 23 April 2021, so that we have equal 343 daily observation in the pre-pandemic period and during the pandemic, and therefore a total of 686 daily observations in the full sample.

Table 1: Descriptive Statistics

Sample		Mean	Median	Max	Min	SD	Obs.
Full sample	$CSAD$	1.122	0.931	7.375	0.027	0.739	686
	R_m	0.010	0.091	8.839	-16.434	1.499	686
Pre-COVID	$CSAD$	0.843	0.776	2.461	0.064	0.303	343
	R_m	0.025	0.089	2.216	-2.742	0.647	343
During-COVID	$CSAD$	1.401	1.113	7.375	0.027	0.919	343
	R_m	-0.005	0.094	8.839	-16.434	2.020	343

Note: This table reports the descriptive statistics of our herding measure CSAD and the cross-sectional average returns (R_m). Full sample 07 Sep 2018 – 23 April 2021, pre-COVID sample: 07 Sep 2018 - 31 Dec 2019, During COVID sample: 1 Jan 2020 – 23 April 2021.

Table 1 reports the descriptive statistics of the dispersion measure, CSAD, from Equation (2) and the cross-sectional average returns. The average return dispersion (CSAD) is 1.12%, with a maximum value of 7.38% and a minimum value of 0.03%. By definition, the CSAD measure decreases to near zero when individual returns converge to the overall market returns. Interestingly, the pre-COVID CSAD has an average value of 0.84%, which is lower than the COVID period average of 1.40%. The average the cross-sectional average returns (R_m) is positive in the pre-COVID period but negative during COVID period, with the latter being in line with expectations given the heightened uncertainty during COVID. The minimum cross-sectional average returns is -16.43% during COVID, markedly lower than the minimum pre-COVID R_m of 2.74%.

5. Results

5.1. Results of the CSAD Approach

Table 2 presents the static results of Equation (2), which are estimated using ordinary least squares (OLS), while providing evidence on herding for the full sample, pre-COVID and during COVID periods. We further decompose all the countries in our sample into developed and emerging market grouping.

Table 2: Estimates of the Static Herding Model

Sample	Parameters	Full sample	Pre-COVID	During COVID
All Countries	α_0	0.707***	0.706***	0.865***
	α_1	0.527***	0.137*	0.484***
	α_2	-0.009***	0.167***	-0.007*
Developed	α_0	0.750***	0.831***	0.840***
	α_1	0.457***	0.104	0.498***
	α_2	-0.011***	0.025	-0.015***
Emerging	α_0	0.920***	0.931***	1.077***
	α_1	0.354***	0.103	0.435***
	α_2	0.010**	0.063**	0.000

Note: Estimates are based on Equation (2). Full sample 07 Sep 2018 – 23 April 2021, Pre-COVID sample: 07 Sep 2018 - 31 Dec 2019, During COVID sample: 1 Jan 2020 – 23 April 2021. *** and * represent statistical significance at 1% and 10%, respectively.

We find evidence of herding behaviour by international REITs investors in both the full sample and during the COVID sub-sample, while the pre-COVID shows no evidence of herd formation. A negative and statistically significant coefficient (α_2), which is -0.009 and -0.007 for the full sample and during the COVID sub-sample, respectively, offers evidence of investor herding. Furthermore, we disaggregate our full sample of countries into developed and emerging markets based on MSCI classification as follows: developed markets (United States, United Kingdom, Germany, Netherlands, Belgium, Hong Kong, France, Singapore, Australia, Japan, New Zealand, Finland, Italy, Israel, Greece, Ireland, Spain) and emerging markets (Taiwan, China, Chile, Malaysia, Singapore, Mexico, India, Thailand, Turkey, South Africa). The disaggregated results presented in Table 2 show that herding is present during the pandemic in developed REITs markets only, and is driving herding in the full sample (All Countries) results. This can be seen from a negative and statistically significant coefficient of -0.015, whereas the coefficient (α_2) for the emerging market is zero (0.000463) and statistically immaterial, suggesting no evidence of herding. The herding coefficient for developed markets is larger than the coefficient for the full sample. The evidence is consistent with the observation that the extreme market downtown induced by the outbreak of the COVID-19 uncertainty led individual investors to discard their own prior beliefs and follow the overall market direction, but this is mainly in developed markets rather than emerging markets. The results are support evidence of herding during crisis times as shown by Babalos et al. (2015) and Phillipas et al. (2013), who found herding effects in US REITs during the 2008 GFC.

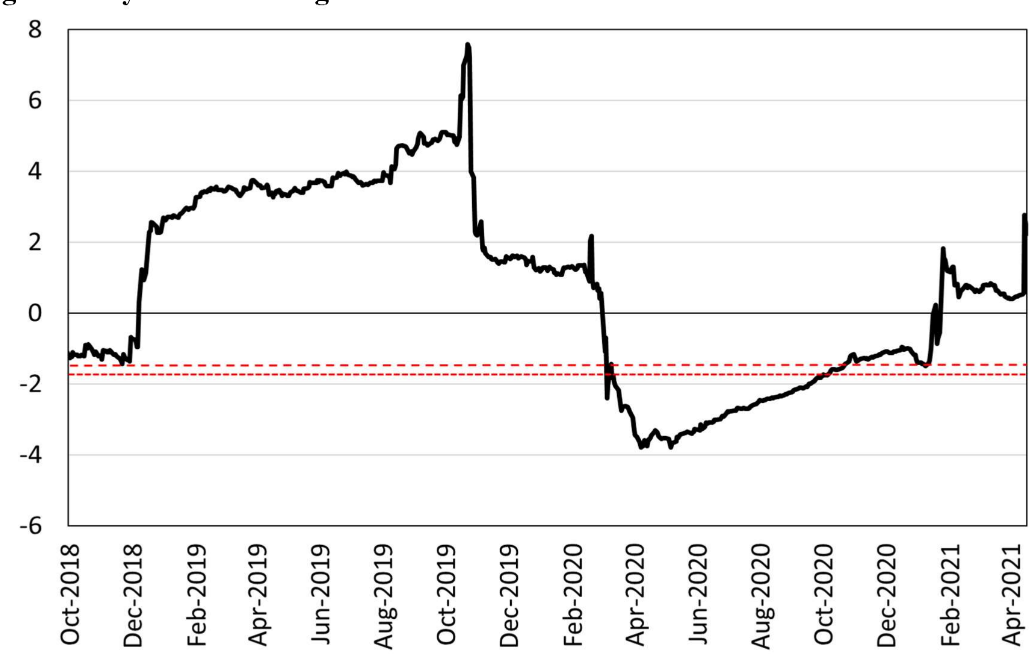
Next, we estimate rolling window herding coefficients, α_2. This approach is motivated by Balcilar et al. (2013) and Balcilar et al. (2014) who showed that herding coefficients could become time-dependent by switching from herding to anti-herding behaviour and vice versa across time. The rolling window size is 223 observations (between 31st October 2017 and 6th September 2018). As indicated the data section, the pre-COVID (07 September 2018- 31

December 2019) and COVID (01 January 2020 - 23 April 2021) sub-samples have equal observations of 343 observations each.

Figure 1 shows the time-dependant coefficient (α_2) over the full sample period. The short and longer dashed red lines indicate a 10% and 5% significance level. The dynamic coefficient is negative during the period associated with the COVID-19 pandemic in 2020, indicating herding formation in international REITs markets. The coefficient further reached its lowest point at the height of the impact of the pandemic on financial markets around late March - April 2020.

The dynamic results are consistent with the static results. Both show that REITs investors herded towards overall market consensus during the global health crisis and these findings are based on a comprehensive sample of REITs markets.

Figure 1: Dynamic Herding Coefficient



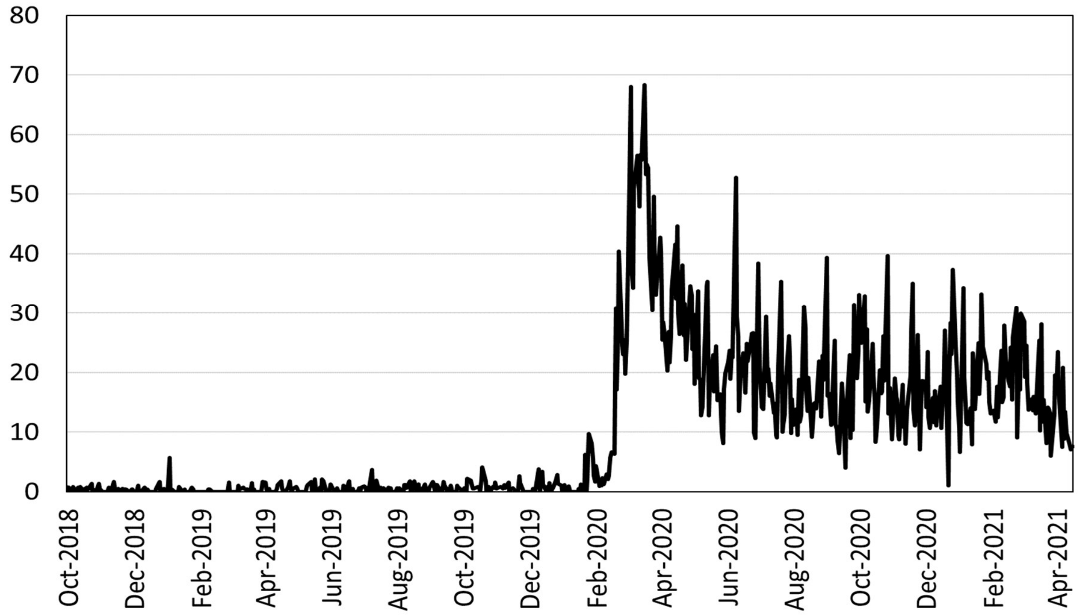
Note: Rolling window coefficients estimated from Equation (2). The long and short horizontal lines show a 10% and 5% level of significance, respectively. The estimates are based on the authors' calculations.

Furthermore, we follow Bouri et al. (2021) and estimate a probit model to formally test for herding behaviour associated with the COVID-19 pandemic using the Daily Disease Equity

Market Volatility Tracker (EMVID) from Baker et al. (2020). We define a dummy variable, D_i where $i = 1,2$, that takes the value of one during times of heightened uncertainty associated with the duration of the global health crisis and zero otherwise. Specifically, D_1 (D_2) is equal to one when α_2 (from Equation 2) is statistically significant at a 5% (10%) level and zero otherwise. Alternatively, D_1 (D_2) is equal to one when the t-statistic of α_2 (from Equation 2), is $\leq$ -1.96 ($\leq$ -1.64) and zero otherwise. The statistical significance of 5% and 10% represents a relatively strong and relatively weak herding, respectively.

Baker et al. (2020) constructed a newspaper-based index tracking stock market volatility associated with infectious disease, called the EMVID, based on a daily news count of articles, across around 3000 US newspapers, that mention at least one of the following words ("economic", "economy", "financial", "stock market", "equity", "equities", "Standard and Poors", "volatility", "volatile", "uncertain", "uncertainty", "risk", "risky", "epidemic", "pandemic", "virus", "flu", "disease", "coronavirus", "mers", "sars", "ebola", "H5N1", "H1N1"). The word counts are scaled by the count of all articles on the same day, and the resulting series is multiplicatively rescaled to mirror the volatility index (VIX) using their overall equity market volatility tracker (EMV). The EMVID is then scaled such that it is a ratio of EMVID articles to total EMV articles. For more details, refer to Baker et al. (2019).

Figure 2: Daily Disease Equity Market Volatility Index (EMVID)



Source: Baker et al. (2020): http://policyuncertainty.com/infectious_EMV.html.

Figure 2 plots the EMVID and shows that uncertainty associated with the outbreak of the COVID-19 pandemic increased substantially from 2020 to 2021, reflecting market fears as the virus evolved into new variants and associated lockdown restrictions and social distancing measures were imposed in various countries.

Table 3: Estimates of the Probit Model

Parameters	D_1	D_2
β_0	-1.653***	-1.705***
β_1	0.061***	0.073***

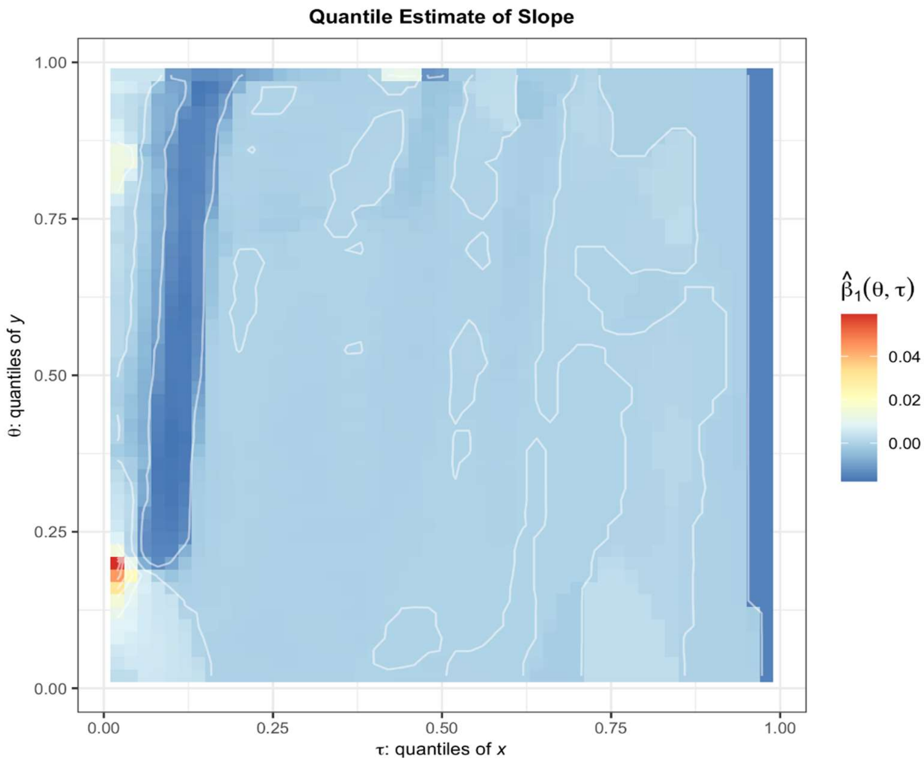
Note: Estimates are based on the probit model: $\Pr(D_i = 1|X) = \Phi(\beta_0 + \beta_1 EMVID)$. *** represents a statistical significance at a 1% level. D_1 and D_2 equal to 1 when the rolling t-statistics of α_2, from equation 2, is ≤ -1.96 and -1.645, respectively.

We then estimate the following probit model. $\Pr(D_i = 1|X) = \Phi(\beta_0 + \beta_1 EMVID)$ where i=1, 2 ; Pr is the probability, Φ is the cumulative distribution function. The dummy variables, D_1 and D_2, capture periods associated with statistically significant herding formation at a 5% and 10% significance level. The model is estimated using maximum likelihood to determine whether herding behaviour in the international REITs markets during the COVID-19 pandemic is indeed driven by COVID-19-related uncertainty. The probit model estimates are presented in Table 3. The parameter estimates for EMVID (β_1) is positive and statistically significant at both the 5% and 10% levels, indicating that COVID-19-induced uncertainty increased the probability of herding behaviour in international REITs markets. This also supports the evidence showing herding formation in the international REITs markets from estimates of Equation 2.

5.2. Results of the Q-Q approach

Figure 3 shows the QQ results. Specifically, it shows the estimated slope $\widehat{\beta_1}$(θ, τ) across the quantiles θ and τ, providing evidence of the effect of τ-quantiles of EMVID in the *x*-axis on the θ-quantile of the rolling window herding coefficient, $\widehat{\alpha_{2t}}$ on the y-axis, the latter obtained from the rolling window estimates from equation 2. The estimates of $\widehat{\beta_1}$(θ, τ) are negative across most of the quantiles of the herding coefficient, except for some extremely low values of the EMVID at relatively lower quantiles of the herding coefficient.. This is shown in the darker blue shaded area. This evidence suggests that large increases in the COVID-19-induced uncertainty cause the herding coefficient to be more negative, which is consistent with stronger herding behaviour. For median values of COVID-19 uncertainty, the effect on herding across the latter's quantiles seems to be small, as the coefficient tends to be near zero.

Figure 3: QQ Estimate of the Rolling Window Herding Coefficient and the EMVID



6. Conclusion

This research investigates whether investors in international REITs markets exhibited herding behaviour due to the uncertainty following the onset of the COVID-19 pandemic in early 2020. Our sample spans both developed and emerging economy REITs using daily data from 2018-to 2021. Using the familiar CSAD as our base dispersion measure to test this conjecture, we estimate both static and rolling window coefficients of the relationship between CSAD and the overall market returns. Both the static and time-varying results provide consistent and robust evidence supporting herding in international REITs following the outbreak of the global health crisis. The time-varying results also show that herding was most pronounced in April 2020, which was also the peak of the negative impact of the COVID-19 pandemic on financial markets in general before a gradual recovery. Furthermore, results from the probit model estimate confirm that herding behaviour in REITs during the COVID period was caused by

COVID-19-related uncertainty. In addition, we estimated a quantile-on-quantile regression to determine the asymmetric relationship between herding and COVID-19 linked uncertainty across their respective distributions and found that large increases in uncertainty cause herding to become stronger. Our findings on the relationship between herding in REITs markets and the recent pandemic is also consistent with evidence found for equity markets during crisis periods.

The evidence of herding in the international REITS around the pandemic period is relevant to policymakers, given that herding in financial markets generally stokes market volatility, thereby destabilizing markets and increasing the fragility of the financial systems. Therefore, our findings imply that periods of market uncertainty and crisis events, although related to global health events, should be analysed and monitored for the sake of market stability. Otherwise, mispricing REITs may persist and undermine market efficiency. Evidence of herding shown in our analysis is also relevant to the decisions of investors and portfolio managers, given that period of herding often shakes the volatility of REITs, the diversification ability of TREITs, and therefore their position within a portfolio or investment strategies.

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