Economics Bulletin

Volume 42, Issue 3

# Herding behavior in the European banking sector during the COVID-19 outbreak: The role of short-selling restrictions

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## Abstract

The purpose of the current paper is twofold: (1) to examine the impact of uncertainty induced by COVID-19 pandemic on herding behavior, and (2) to understand whether short-selling restrictions have mitigating role in herding behavior.We employ both cross-sectional market deviation (CSSD) and cross-sectional absolute standard deviation (CSAD) approaches to detect herding in European capital markets. For robustness analysis, we estimate herding behavior under different market dynamics, namely high-low volatility periods and up-down markets. We find no strong evidence regarding herding in prior to pandemic; however, herding behavior is more common in the COVID-19 period, indicating triggering role of uncertainty in herding behavior. The results are robust to the herding models whereas they are sensitive to the asymmetric effects. Regarding the short-selling restrictions, we fail to support the impact of short-selling limitations on herding behavior since there is no difference between restricted and unrestricted periods. The overall results indicate that herding behavior prevails amid the pandemic, confirming that fear and uncertainty induced by COVID-19 causes less-informed investors to follow the actions of others. Investors should consider this inefficiency when investing in capital markets. Besides, short-selling restrictions do not have significant impact on herding, suggesting regulatory authorities should employ other tools rather than short-selling bans.

**Citation:** Ibrahim Yagli and Ozkan Haykir and Emin Huseyin Cetenak, (2022) "Herding behavior in the European banking sector during the COVID-19 outbreak: The role of short-selling restrictions", *Economics Bulletin*, Volume 42, Issue 3, pages 1486-1497
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**Submitted:** December 07, 2021. **Published:** September 30, 2022.

# 1 Introduction

Herding behavior is a cognitive phenomenon and refers to the investors' tendency to pursue the transactions of other market participants putting aside their opinions (Celen and Karliv 2004; Bikhchandani and Sharma 2001). Herding behavior can impair the financial stability by inducing short-run fluctuations in stock price and excessive market volatility. Therefore, both regulatory authorities and researchers have interest to discover when herding behavior occurs in stock markets. However, there is no consensus on when the stock market exhibits herding behavior. One set of studies argue that herding behavior is prevalent especially in the time of high uncertainty and panic (Espinosa-Méndez and Arias 2021; Dhall and Singh 2020; Mertzaris and Allam 2018; Schmitt and Westerhoff 2017; Lin and Lin 2014; among others), since heightened uncertainty regarding to future predictions reduces investors' tolerance to take risk and pushes them to be sticky to market consensus to avoid possible psychological pain. Set of studies, on the other hand, predict that herding is more common in normal times because investors generally have similar predictions regarding the stock market performance as they have sufficient time to gather information (Economou et al. 2016; Bohl et al. 2014; Mobarek et al. 2014; Demirer and Kutan 2006; Hwang and Salmon 2004; among others).

The on-going COVID-19 outbreak and restrictions such as confinement measures imposed against to COVID-19 have increased uncertainty in stock markets (Altig et al. 2020). Indeed, the COVID-19 outbreak has more devastating impacts on stock markets than previous epidemics and financial crisis (Baker et al. 2020 and Choi 2020). S&P 500, for instance, drop more than 30% from February 19, 2020 to March 23, 2020, which is fastest decline of such a magnitude in its history (CNBC 2020).–Therefore, COVID-19 is called "fearsome and novel risk" that causes feverish stock price movements (Wagner 2020). To stop further decline in stock price, regulatory authorities have taken a series of measures including short-selling restrictions. Given the higher financial risk and increasing investor fear, it is expected that less-informed investors ignore their opinions and copy the actions of other investors during the outbreak (Espinosa-Méndez and Arias 2021). Nevertheless, short-selling restrictions imposed by financial authorities can mitigate herding in stock markets since such restrictions can eliminate the impact of pessimistic beliefs of investors who do not own the stocks on fundamental values. A bulk of studies have revealed that asset prices deviated upwards as a result of short-selling restrictions since they constraint further declines in asset prices (Miller 1977). In other words, short-selling restrictions can inhibit herding behavior by slowing down the pessimism in the stock market. In addition, short-selling constraints may hinder the information efficiency (Diamond and Verrecchia 1987), which, in turn, lead to higher uncertainty among investors regarding stock prices. Excluding short-sellers from the market can diminish confidence in the market consensus, and which further result in less investors' tendency to follow the others decisions.

Departing from the aforementioned situations, namely higher uncertainty and short-selling restrictions in stock markets; the aim of the current paper is twofold. First, the paper aims to investigate herding behavior during the COVID-19 turmoil in the European banking context. We concentrate on European banking sector for two reasons. First, the European financial system is largely bank-based, and Euro area banks are the most adversely affected by the COVID-19 pandemic among others global peers due to weaker profitability and rising credit risks expectations (ECB 2020). Second, financial authorities in the Euro area often apply short-selling restrictions amid the pandemic. Besides, financial markets in the Euro area have lots of common features. Therefore, analyzing the impact of short-selling bans on herding behavior in the European banking

sector provides more comprehensive outcomes. Second, it explores the impact of short-selling restrictions on herding. To address these issues, the study adopts both the cross-sectional standard deviation (CSSD) model and the cross-sectional absolute standard deviation (CSAD) model generated by Chang et al. (2000).

The study contributes related literature in three fronts. First, even though several studies have addressed the effect of COVID-19 on stock markets, these studies focus on issues such as return, volatility, and liquidity rather than herding behavior. Only a few studies address herding behavior during the COVID-19 outbreak (Espinosa-Méndez and Arias 2021; Chang et al. 2020). Our paper contributes the scant literature on herding behavior during COVID-19 but differs in several aspects. First, unlike the previous studies the current study addresses herding behavior at the sector-level. Related literature proposes that investors are confronted with similar investment issues and tend to follow transactions of others, especially for the investment in similar group of assets (Bikhcandani and Sharma 2001). Besides, investment strategy reports generated by financial analysts are generally based on sector-level information (Choi and Sias 2009). Furthermore, COVID-19 does not affect all firms in the same way; therefore, the impact of the COVID-19 outbreak on assets prices can differ across industries. For instance, the outbreak has less impact on environmental and social stocks (Albuquerque et al. 2020), and stocks more resilient to social distancing such as computer and electronic products and publishing firms (Pagano et al. 2020). In conclusion, it is more likely to capture herding behavior at the sector-level (Bui et al. 2018; Cakan and Balagyozyan 2014; Demirer et al. 2010). To that end, the current study investigates herding behavior for the European banking sectors in which sharpest price decline is recorded due to COVID-19 outbreak (ECB 2020). Second, even though literature addresses the effect of short-selling bans on the efficiency and liquidity of the stock market, studies focusing on the nexus between short-selling restrictions and herding behavior are scarce (Bohl et al. 2013). To fill this gap in the literature, our study analyzes the impact of short-selling bans on herding behavior at sector-level during the COVID-19 pandemic. Third, we analyze the possible asymmetries of herding regarding to the market return and volatility.

The rest of the paper is organized as follows. Section 2 describes the data and methodology, Section 3 provides empirical findings and robustness checks, and Section 4 gives concluding remarks.

## 2 Data and Methodology

The focus of this paper is to investigate herding behavior for banking companies listed on 12 European stock exchanges, namely Austria, Denmark, France, Germany, Greece, Italy, Norway, Poland, Spain, Sweden, Switzerland, and the United Kingdom during the COVID-19 pandemic. We impose a restriction to have at least five banking companies to include the country in our analysis. We use several identification strategies to detect the banking companies for countries. Banking firms must be classified as the SIC code is equal to 6020, the NAICS code is 522110, and the GIND code is 401010. We have 152 banking firms in our sample[1]. Our sample period covers between the January 1, 2015 and December 31, 2020. We retrieve the daily stock return data from Wharton Research Data Service (WRDS) Compustat Global Database.

[1] Sample covers seven banks from Austria, 20 firms from Denmark, 17 firms from France, seven firms from Germany, five firms from Greece, 14 firms from Italy, 31 firms from Norway, 11 firms from Poland, eight firms from Spain, five firms from Sweden, 16 firms from Switzerland and 12 firms from the United Kingdom.

Investors are affected by the overall market conditions during the investment decision-making process. In particular, during times of extreme price movements, investors make investment decisions based on collective market behavior instead of following their beliefs (Chang et al. 2000). Christie and Huang (1995) and Chang et al. (2000) propose a methodology to detect whether herding behavior exists or not. We follow the Chang et al. (2000) methodology and calculate return dispersion proxy using the cross-sectional market deviation (CSSD):

$$CSSD_t = \alpha + \gamma_1 \left| R_{m,t} \right| + \gamma_2 R_{m,t}^2 + \varepsilon_t \quad (1)$$

where $R_{m,t}$ is the equal-weighted average stock return, and $CSSD_t$ is the return dispersion proxy determined as:

$$CSSD_t = \sqrt{\frac{\sum_{i=1}^{N} (R_{i,t} - R_{m,t})^2}{N-1}} \quad (2)$$

$R_{i,t}$ is the return of stock $i$ on time $t$, $R_{m,t}$ is the equal-weighted average of stock returns in the portfolio and $N$ is the number of stocks in the portfolio. The coefficient of interest is $\gamma_2$ which should be significant and negative if herding behavior exists.

The second contribution of the paper is to explore whether short-selling restrictions imposed by regulatory authorities are effective to alleviate herding behavior in financial markets during the COVID-19 outbreak. Miller (1977) claims that short-selling restrictions will be harmful to short-sellers since the stock price only reflects the belief of investors who holds the securities, so-called overpricing-hypothesis. As a result, the stock price will be higher than its equilibrium level. Thus, short-selling restrictions during the turmoil will lower herding behavior.

As a robustness analysis, we examine whether herding behavior during COVID-19 is sensitive to market conditions, specifically potential asymmetric effects of market return, and high and low volatility states. In asymmetric effect, we compare the market rising period where $R_{m,t}$ is positive with the market declining period where $R_{m,t}$ is negative. In the high-low volatility effect, we compare the high volatility period where the 30 days moving average volatility is higher than observed volatility against the low volatility period where the 30 days moving average volatility is lower than observed volatility. The volatility is constructed as the standard deviation of market return times the square root of 252.

## 3 Empirical Results

Panel A of Table 1 presents the estimation results of equation (1) regarding the herding behavior in the prior to pandemic which covers data from January 1, 2015, to January 24, 2020, while Panel B provides results for COVID-19 period which covers data from January 24, 2020, when the first COVID-19 case in Europe is reported (ECDC 2020)[2] to December 31, 2020. Coefficients of interest ($\gamma_2$) in Panel A show that banking firms in general exhibit non-herding behavior; only the Greece seems to have herding behavior and Austria, Germany, and the United Kingdom exhibit anti-herding behavior before the COVID-19 pandemic. Overall panel result also supports the anti-herding behavior prior to pandemic although the significance level is at 10 percent. On the other hand, Panel B show that the coefficients of interest ($\gamma_2$) turn to be negative during the pandemic period for 11 out of 12 European stock markets. However, only six out of these 11 stock markets

[2] On 24 January 2020, the first European case was reported in France.

have statistically significant coefficients which indicate herding behavior amid the COVID-19 turmoil. Panel result regarding COVID-19 period also supports herding behavior during the pandemic.

**Table 1.** Regression results of Herding Behavior-CSSD

| | **Panel A: Before COVID-19** | | | | **Panel B: During COVID-19** | | | |
|---|---|---|---|---|---|---|---|---|
| | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N |
| Austria | 0.604*** | 0.654*** | 0.070* | 1259 | 0.862*** | 0.540*** | 0.022 | 236 |
| | (0.000) | (0.000) | (0.054) | | (0.000) | (0.000) | (0.126) | |
| Denmark | 1.360*** | 0.644*** | -0.006 | 1264 | 1.256*** | 0.501*** | -0.032*** | 234 |
| | (0.000) | (0.000) | (0.858) | | (0.000) | (0.000) | (0.004) | |
| France | 0.761*** | 0.601*** | 0.026 | 1294 | 1.241*** | 0.740*** | -0.038*** | 241 |
| | (0.000) | (0.000) | (0.547) | | (0.000) | (0.000) | (0.000) | |
| Germany | 0.993*** | 0.540*** | 0.092*** | 1277 | 1.210*** | 0.810*** | -0.021 | 238 |
| | (0.000) | (0.000) | (0.008) | | (0.000) | (0.000) | (0.219) | |
| Greece | 1.672*** | 0.347*** | -0.014*** | 1229 | 1.248*** | 0.237*** | -0.006 | 234 |
| | (0.000) | (0.000) | (0.000) | | (0.000) | (0.002) | (0.236) | |
| Italy | 1.220*** | 0.321*** | 0.008 | 1284 | 1.358*** | 0.372*** | -0.010* | 239 |
| | (0.000) | (0.000) | (0.284) | | (0.000) | (0.000) | (0.053) | |
| Norway | 1.323*** | 0.579*** | -0.023 | 1269 | 1.639*** | 0.693*** | -0.034*** | 236 |
| | (0.000) | (0.000) | (0.467) | | (0.000) | (0.000) | (0.010) | |
| Poland | 1.456*** | 0.361*** | 0.048 | 1262 | 1.568*** | 0.336*** | -0.006 | 237 |
| | (0.000) | (0.000) | (0.137) | | (0.000) | (0.000) | (0.191) | |
| Spain | 0.852*** | 0.167*** | 0.003 | 1294 | 1.110*** | 0.356*** | -0.015 | 241 |
| | (0.000) | (0.000) | (0.128) | | (0.000) | (0.001) | (0.104) | |
| Sweden | 0.796*** | 0.271*** | 0.027 | 1269 | 1.172*** | 0.407*** | -0.025*** | 237 |
| | (0.000) | (0.005) | (0.397) | | (0.000) | (0.000) | (0.000) | |
| Switzerland | 0.812*** | 0.370*** | 0.068 | 1269 | 0.883*** | 0.598*** | -0.011 | 237 |
| | (0.000) | (0.000) | (0.398) | | (0.000) | (0.001) | (0.758) | |
| UK | 1.096*** | 0.399*** | 0.023*** | 1280 | 1.549*** | 0.609*** | -0.021* | 238 |
| | (0.000) | (0.000) | (0.000) | | (0.000) | (0.000) | (0.052) | |
| Panel | 1.555*** | 0.487*** | 0.047* | 15250 | 1.607*** | 0.711*** | -0.030*** | 2848 |
| | (0.000) | (0.000) | (0.057) | | (0.000) | (0.000) | (0.000) | |

**Notes:** Newey-West robust standard errors are used. P-values are in the parenthesis. *, **, *** show the statistical significance at the 10, 5, and 1 percent level, respectively.

Table 2 reports the estimation results based on asymmetric effects which is defined using the average market returns following by Espinosa-Méndez and Arias (2021), Munkh-Ulzii et al. (2020), Cakan and Balagyozyan (2014). Since we focus on the herding behavior during the COVID-19 pandemic, we only present the results accordingly. Two countries exhibit herding behavior during the rising period of the stock market. On the contrary, there is only one country that shows anti-herding behavior, and three countries show herding behavior during declining period. When we compare asymmetric effect results in Table 2 with COVID-19 period results in Table 1, we capture that France and Norway continue to have same herding behavior during rising period. For the declining period, Sweden and the United Kingdom show similar pattern as in Table 1, on the other hand Spain exhibits herding behavior and Austria exhibits anti-herding in declining period. Panel result also supports the herding behavior during declining period with 10 percent significance level. The results are consistent with the earlier findings which show that investors act together during the declining period in the markets (Munkh-Ulzii et al. 2020; Yao et al. 2014; Lao and Singh 2011; Chang et al. 2000; McQueen et al. 1996).

**Table 2.** Regression Results for Up & Down Period - During COVID-19 (CSSD)

| | UP Period | | | | DOWN Period | | | |
|---|---|---|---|---|---|---|---|---|
| | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N |
| Austria | 0.799*** | 0.618*** | 0.014 | 121 | 0.948*** | 0.445*** | 0.032** | 115 |
| | (0.000) | (0.000) | (0.484) | | (0.000) | (0.000) | (0.033) | |
| Denmark | 1.314*** | 0.391** | 0.051 | 130 | 1.244*** | 0.338*** | -0.006 | 104 |
| | (0.000) | (0.028) | (0.573) | | (0.000) | (0.001) | (0.720) | |
| France | 1.347*** | 0.775*** | -0.041* | 113 | 1.448*** | 0.487*** | -0.013 | 128 |
| | (0.000) | (0.000) | (0.072) | | (0.000) | (0.000) | (0.270) | |
| Germany | 1.310*** | 0.664*** | 0.017 | 123 | 1.287*** | 0.765*** | -0.020 | 115 |
| | (0.000) | (0.001) | (0.707) | | (0.000) | (0.000) | (0.242) | |
| Greece | 1.251*** | 0.260** | -0.006 | 105 | 1.152*** | 0.227** | -0.006 | 129 |
| | (0.000) | (0.011) | (0.481) | | (0.000) | (0.025) | (0.337) | |
| Italy | 1.493*** | 0.426*** | -0.011 | 124 | 1.409*** | 0.216* | 0.001 | 115 |
| | (0.000) | (0.000) | (0.515) | | (0.000) | (0.055) | (0.839) | |
| Norway | 1.625*** | 0.903*** | -0.079* | 142 | 1.604*** | 0.537*** | -0.012 | 94 |
| | (0.000) | (0.000) | (0.089) | | (0.000) | (0.000) | (0.485) | |
| Poland | 1.693*** | 0.406*** | -0.009 | 113 | 1.495*** | 0.228*** | 0.001 | 124 |
| | (0.000) | (0.007) | (0.779) | | (0.000) | (0.001) | (0.817) | |
| Spain | 1.424*** | 0.322** | -0.006 | 110 | 1.187*** | 0.239** | -0.013* | 131 |
| | (0.000) | (0.017) | (0.461) | | (0.000) | (0.024) | (0.070) | |
| Sweden | 1.305*** | 0.352 | 0.008 | 121 | 1.240*** | 0.221** | -0.012* | 116 |
| | (0.000) | (0.112) | (0.852) | | (0.000) | (0.037) | (0.066) | |
| Switzerland | 0.897*** | 0.557** | 0.062 | 128 | 0.938*** | 0.456** | 0.009 | 109 |
| | (0.000) | (0.013) | (0.374) | | (0.000) | (0.021) | (0.832) | |
| UK | 1.792*** | 0.448*** | -0.002 | 111 | 1.486*** | 0.656*** | -0.029** | 127 |
| | (0.000) | (0.000) | (0.833) | | (0.000) | (0.000) | (0.026) | |
| Panel | 1.797*** | 0.542*** | 0.028 | 1441 | 1.650*** | 0.574*** | -0.017* | 1407 |
| | (0.000) | (0.000) | (0.400) | | (0.000) | (0.000) | (0.099) | |

**Notes:** Up period regression is $CSSD_t^{UP} = \alpha + \gamma_1^{UP}\left|R_{m,t}^{UP}\right| + \gamma_2^{UP}\left(R_{m,t}^{UP}\right)^2 + \varepsilon_t \,; if\ R_{m,t} > 0$ and down period regression is $CSSD_t^{DOWN} = \alpha + \gamma_1^{DOWN}\left|R_{m,t}^{DOWN}\right| + \gamma_2^{DOWN}\left(R_{m,t}^{DOWN}\right)^2 + \varepsilon_t \,; if\ R_{m,t} < 0$. Newey-West robust standard errors are used. P-values are in the parenthesis. *, **, *** show the statistical significance at the 10, 5, and 1 percent level, respectively.

Table 3 presents the results of the high-low volatility states during the pandemic. In the high-volatility period, the coefficient of interest shows that anti-herding behavior exists for Norway, Spain, and Switzerland. In the low-volatility state, eleven out of twelve countries exhibit herding behavior (except Austria) as in COVID-19 period in Table 1, but only three of them are statistically significant as well as panel. Austria has anti-herding behavior during the low-volatility states as before the COVID-19 period. The results show that herding behavior is evident during the low-volatility states compare to high-volatility states.

**Table 3.** Regression Results for High & Low Volatility Period - During COVID-19 (CSSD)

| | HIGH Volatility Period | | | | LOW Volatility Period | | | |
|---|---|---|---|---|---|---|---|---|
| | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N |
| Austria | 0.599*** | 0.463*** | 0.079 | 74 | 1.157*** | 0.410*** | 0.035** | 162 |
| | (0.000) | (0.005) | (0.179) | | (0.000) | (0.000) | (0.023) | |
| Denmark | 1.209*** | 0.163 | 0.108 | 122 | 1.487*** | 0.416*** | -0.025* | 112 |
| | (0.000) | (0.386) | (0.395) | | (0.000) | (0.000) | (0.076) | |
| France | 1.202*** | 0.818** | -0.151 | 80 | 1.558*** | 0.558*** | -0.021** | 161 |
| | (0.000) | (0.019) | (0.255) | | (0.000) | (0.000) | (0.046) | |
| Germany | 1.011*** | 0.770*** | -0.020 | 80 | 1.527*** | 0.702*** | -0.013 | 158 |
| | (0.000) | (0.000) | (0.777) | | (0.000) | (0.000) | (0.491) | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Greece | 1.149*** | 0.117 | -0.0001 | 123 | 1.485*** | 0.271*** | -0.009 | 111 |
| | (0.000) | (0.128) | (0.998) | | (0.000) | (0.009) | (0.154) | |
| Italy | 1.249*** | 0.577** | -0.102 | 104 | 1.589*** | 0.306*** | -0.006 | 135 |
| | (0.000) | (0.016) | (0.155) | | (0.000) | (0.001) | (0.346) | |
| Norway | 1.649*** | 0.116 | 0.378* | 121 | 1.898*** | 0.536*** | -0.018 | 115 |
| | (0.000) | (0.753) | (0.073) | | (0.000) | (0.000) | (0.295) | |
| Poland | 1.629*** | 0.217 | -0.003 | 47 | 1.559*** | 0.352*** | -0.008 | 190 |
| | (0.000) | (0.584) | (0.980) | | (0.000) | (0.000) | (0.145) | |
| Spain | 1.225*** | -0.325 | 0.120** | 31 | 1.385*** | 0.298*** | -0.012 | 210 |
| | (0.000) | (0.149) | (0.025) | | (0.000) | (0.000) | (0.184) | |
| Sweden | 1.101*** | -0.111 | 0.243 | 75 | 1.458*** | 0.297*** | -0.018*** | 162 |
| | (0.000) | (0.778) | (0.156) | | (0.000) | (0.004) | (0.004) | |
| Switzerland | 0.939*** | -0.009 | 0.319** | 102 | 0.970*** | 0.605*** | -0.018 | 135 |
| | (0.000) | (0.967) | (0.038) | | (0.000) | (0.004) | (0.671) | |
| UK | 1.348*** | 0.574* | -0.063 | 38 | 1.757*** | 0.543*** | -0.017 | 200 |
| | (0.000) | (0.086) | (0.539) | | (0.000) | (0.000) | (0.130) | |
| Panel | 1.708*** | 0.204 | 0.078 | 997 | 1.847*** | 0.633*** | -0.024*** | 1851 |
| | (0.000) | (0.175) | (0.116) | | (0.000) | (0.000) | (0.008) | |

**Notes:** High volatility regression is $CSSD_t^{HIGH} = \alpha + \gamma_1^{HIGH}\left|R_{m,t}^{HIGH}\right| + \gamma_2^{HIGH}\left(R_{m,t}^{HIGH}\right)^2 + \varepsilon_t$ ; $if$ 30 $days\ moving\ average\ volatility > observed\ volatility$ and low volatility period is $CSSD_t^{LOW} = \alpha + \gamma_1^{LOW}\left|R_{m,t}^{LOW}\right| + \gamma_2^{LOW}\left(R_{m,t}^{LOW}\right)^2 + \varepsilon_t$ ; $if$ 30 $days\ moving\ average\ volatility < observed\ volatility$. Newey-West robust standard errors are used. P-values are in the parenthesis. *, **, *** show the statistical significance at the 10, 5, and 1 percent level, respectively.

Although CSSD model is one of the common measures to detect herding behavior in finance literature, it imposes several restrictions and can be easily affected by outliers (Chang et al. 2020). Given these drawbacks, we also employ cross-sectional absolute standard deviations (CSAD) model developed by Chang et al. (2000) to check the robustness of the results.

$$CSAD_t = \frac{1}{N}\sum_{i=1}^{N}|R_{it} - R_{mt}| \tag{4}$$

$$CSAD_t = \alpha + \gamma_1\left|R_{m,t}\right| + \gamma_2 R_{m,t}^2 + \varepsilon_t \tag{5}$$

Table 4 provides estimation results of Equation (5). Panel A of Table 4 shows results for herding behavior before the COVID-19 pandemic while panel B presents results during the pandemic. According the results in Panel B, Austria exhibits anti-herding behavior. On the other hand, eleven countries have herding behavior however, only five of them are statistically significant. Overall panel results also indicate herding behavior during the COVID-19 turmoil. Therefore, we can conclude that using CSSD or CSAD do not affect our results.

**Table 4.** Regression results of Herding Behavior (CSAD)

| | **Panel A: Before COVID-19** | | | **Panel B: During COVID-19** | | |
|---|---|---|---|---|---|---|
| | $\alpha$ | $\gamma_1$ | $\gamma_2$ | $\alpha$ | $\gamma_1$ | $\gamma_2$ |
| Austria | 0.419*** | 0.566*** | 0.037 | 0.625*** | 0.437*** | 0.023* |
| | (0.000) | (0.000) | (0.173) | (0.000) | (0.000) | (0.064) |
| Denmark | 0.965*** | 0.436*** | 0.001 | 0.914*** | 0.414*** | -0.024*** |
| | (0.000) | (0.000) | (0.958) | (0.000) | (0.000) | (0.003) |
| France | 0.524*** | 0.535*** | -0.009 | 0.891*** | 0.598*** | -0.027*** |
| | (0.000) | (0.000) | (0.670) | (0.000) | (0.000) | (0.000) |
| Germany | 0.703*** | 0.464*** | 0.067*** | 0.841*** | 0.691*** | -0.020 |
| | (0.000) | (0.000) | (0.005) | (0.000) | (0.000) | (0.130) |
| Greece | 1.240*** | 0.266*** | -0.011*** | 0.921*** | 0.175*** | -0.004 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.333) |
| Italy | 0.893*** | 0.229*** | 0.010** | 0.988*** | 0.271*** | -0.004 |
| | (0.000) | (0.000) | (0.037) | (0.000) | (0.000) | (0.299) |
| Norway | 0.907*** | 0.426*** | -0.009 | 1.027*** | 0.570*** | -0.029*** |
| | (0.000) | (0.000) | (0.657) | (0.000) | (0.000) | (0.002) |
| Poland | 1.044*** | 0.298*** | 0.026 | 1.159*** | 0.258*** | -0.003 |
| | (0.000) | (0.000) | (0.235) | (0.000) | (0.000) | (0.364) |
| Spain | 0.626*** | 0.128*** | 0.001 | 0.826*** | 0.276*** | -0.011 |
| | (0.000) | (0.000) | (0.240) | (0.000) | (0.001) | (0.108) |
| Sweden | 0.583*** | 0.206*** | 0.018 | 0.858*** | 0.304*** | -0.018*** |
| | (0.000) | (0.006) | (0.447) | (0.000) | (0.000) | (0.000) |
| Switzerland | 0.574*** | 0.299*** | 0.035 | 0.634*** | 0.494*** | -0.019 |
| | (0.000) | (0.000) | (0.489) | (0.000) | (0.000) | (0.519) |
| UK | 0.795*** | 0.276*** | 0.028*** | 1.070*** | 0.501*** | -0.020** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.021) |
| Panel | 0.963*** | 0.440*** | 0.035** | 1.032*** | 0.638*** | -0.027*** |
| | (0.000) | (0.000) | (0.048) | (0.000) | (0.000) | (0.000) |

**Notes:** Newey-West robust standard errors are used. P-values are in the parenthesis. *, **, *** show the statistical significance at the 10, 5, and 1 percent level, respectively.

Table 5 presents the results of asymmetric effects. Estimation results show similar pattern especially in down period. Germany in down period and Switzerland in up period have significant coefficients in CSAD variables compare to CSSD. The outliers may cause these different results in these countries.

**Table 5.** Regression Results for Up & Down Period - During COVID-19 (CSAD)

| | **UP Period** | | | **DOWN Period** | | |
|---|---|---|---|---|---|---|
| | $\alpha$ | $\gamma_1$ | $\gamma_2$ | $\alpha$ | $\gamma_1$ | $\gamma_2$ |
| Austria | 0.569*** | 0.502*** | 0.016 | 0.701*** | 0.357*** | 0.032** |
| | (0.000) | (0.000) | (0.391) | (0.000) | (0.000) | (0.011) |
| Denmark | 0.952*** | 0.314*** | 0.049 | 0.918*** | 0.301*** | -0.007 |
| | (0.000) | (0.006) | (0.361) | (0.000) | (0.000) | (0.573) |
| France | 0.988*** | 0.598*** | -0.026 | 1.028*** | 0.430*** | -0.011 |
| | (0.000) | (0.000) | (0.151) | (0.000) | (0.000) | (0.157) |
| Germany | 0.943*** | 0.504*** | 0.027 | 0.907*** | 0.670*** | -0.210* |
| | (0.000) | (0.000) | (0.361) | (0.000) | (0.000) | (0.099) |
| Greece | 0.913*** | 0.200*** | -0.004 | 0.857*** | 0.168** | -0.003 |
| | (0.000) | (0.004) | (0.431) | (0.000) | (0.032) | (0.496) |
| Italy | 1.038*** | 0.357*** | -0.012 | 1.032*** | 0.149* | 0.005 |
| | (0.000) | (0.000) | (0.365) | (0.000) | (0.054) | (0.286) |
| Norway | 1.025*** | 0.666*** | -0.053* | 1.028*** | 0.503*** | -0.020 |
| | (0.000) | (0.000) | (0.086) | (0.000) | (0.000) | (0.102) |
| Poland | 1.244*** | 0.298*** | -0.002 | 1.126*** | 0.172*** | 0.003 |
| | (0.000) | (0.006) | (0.926) | (0.000) | (0.001) | (0.414) |
| Spain | 1.040*** | 0.261** | -0.004 | 0.896*** | 0.181** | -0.009* |
| | (0.000) | (0.011) | (0.466) | (0.000) | (0.021) | (0.063) |
| Sweden | 0.985*** | 0.211 | 0.019 | 0.911*** | 0.161** | -0.009* |
| | (0.000) | (0.201) | (0.599) | (0.000) | (0.025) | (0.055) |
| Switzerland | 0.668*** | 0.350** | 0.086* | 0.666*** | 0.424*** | -0.013 |
| | (0.000) | (0.022) | (0.074) | (0.000) | (0.006) | (0.704) |
| UK | 1.201*** | 0.399*** | -0.005 | 1.059*** | 0.520*** | -0.025** |
| | (0.000) | (0.000) | (0.398) | (0.000) | (0.000) | (0.013) |
| Panel | 1.150*** | 0.515*** | 0.020 | 1.104*** | 0.510*** | -0.015** |
| | (0.000) | (0.000) | (0.402) | (0.000) | (0.000) | (0.043) |

**Notes:** Up period regression is $CSAD_t^{UP} = \alpha + \gamma_1^{UP}\left|R_{m,t}^{UP}\right| + \gamma_2^{UP}\left(R_{m,t}^{UP}\right)^2 + \varepsilon_t \; ; if \; R_{m,t} > 0$ and down period regression is $CSAD_t^{DOWN} = \alpha + \gamma_1^{DOWN}\left|R_{m,t}^{DOWN}\right| + \gamma_2^{DOWN}\left(R_{m,t}^{DOWN}\right)^2 + \varepsilon_t \; ; if \; R_{m,t} < 0$. Newey-West robust standard errors are used. P-values are in the parenthesis. *, **, *** show the statistical significance at the 10, 5, and 1 percent level, respectively.

Lastly, the asymmetric effect of volatility has been examined using CSAD. Table 6 shows the estimation results. In the high-volatility states the results are similar to CSSD analysis in Table 3. Norway, Spain and Switzerland have anti-herding behavior in the high volatility periods during the COVID-19 pandemic. In the low-volatility states, Austria has anti-herding behavior whereas Denmark, France, Sweden, and the United Kingdom have herding behavior. Panel result also favors herding behavior during the low-volatility period.

**Table 6.** Regression Results for High & Low Volatility Period - During COVID-19 (CSAD)

| | **HIGH Volatility Period** | | | **LOW Volatility Period** | | |
|---|---|---|---|---|---|---|
| | $\alpha$ | $\gamma_1$ | $\gamma_2$ | $\alpha$ | $\gamma_1$ | $\gamma_2$ |
| Austria | 0.411*** | 0.451*** | 0.043 | 0.837*** | 0.338*** | 0.033** |
| | (0.001) | (0.001) | (0.396) | (0.000) | (0.000) | (0.013) |
| Denmark | 0.882*** | 0.165 | 0.085 | 1.080*** | 0.357*** | -0.020** |
| | (0.000) | (0.188) | (0.372) | (0.000) | (0.000) | (0.045) |
| France | 0.846*** | 0.632** | -0.071 | 1.146*** | 0.441*** | -0.012* |
| | (0.000) | (0.014) | (0.462) | (0.000) | (0.000) | (0.096) |
| Germany | 0.717*** | 0.666*** | -0.022 | 1.052*** | 0.620*** | -0.015 |
| | (0.000) | (0.000) | (0.655) | (0.000) | (0.000) | (0.316) |
| Greece | 0.850*** | 0.085 | 0.001 | 1.106*** | 0.199** | -0.006 |
| | (0.000) | (0.118) | (0.784) | (0.000) | (0.010) | (0.214) |
| Italy | 0.906*** | 0.353* | -0.042 | 1.187*** | 0.212*** | -0.001 |
| | (0.000) | (0.055) | (0.483) | (0.000) | (0.001) | (0.916) |
| Norway | 1.017*** | 0.242* | 0.140** | 1.262*** | 0.466*** | -0.020 |
| | (0.000) | (0.089) | (0.048) | (0.000) | (0.000) | (0.114) |
| Poland | 1.171*** | 0.195 | -0.004 | 1.171*** | 0.261*** | -0.003 |
| | (0.000) | (0.467) | (0.959) | (0.000) | (0.000) | (0.365) |
| Spain | 0.929*** | -0.246 | 0.085** | 1.023*** | 0.239*** | -0.010 |
| | (0.000) | (0.178) | (0.043) | (0.000) | (0.004) | (0.165) |
| Sweden | 0.822*** | -0.116 | 0.188 | 1.068*** | 0.225*** | -0.014*** |
| | (0.000) | (0.675) | (0.110) | (0.000) | (0.004) | (0.005) |
| Switzerland | 0.692*** | -0.064 | 0.337*** | 0.692*** | 0.504*** | -0.025 |
| | (0.000) | (0.633) | (0.000) | (0.000) | (0.003) | (0.471) |
| UK | 1.011*** | 0.339* | -0.025 | 1.202*** | 0.468*** | -0.018** |
| | (0.000) | (0.071) | (0.645) | (0.000) | (0.000) | (0.035) |
| Panel | 1.059*** | 0.353*** | 0.021 | 1.256*** | 0.549*** | -0.020*** |
| | (0.000) | (0.000) | (0.447) | (0.000) | (0.000) | (0.004) |

**Notes:** High volatility regression is $CSAD_t^{HIGH} = \alpha + \gamma_1^{HIGH}\left|R_{m,t}^{HIGH}\right| + \gamma_2^{HIGH}\left(R_{m,t}^{HIGH}\right)^2 + \varepsilon_t$ ; $if$ 30 $days\ moving\ average\ volatility > observed\ volatility$ and low volatility period is $CSAD_t^{LOW} = \alpha + \gamma_1^{LOW}\left|R_{m,t}^{LOW}\right| + \gamma_2^{LOW}\left(R_{m,t}^{LOW}\right)^2 + \varepsilon_t$ ; $if$ 30 $days\ moving\ average\ volatility < observed\ volatility$. Newey-West robust standard errors are used. P-values are in the parenthesis. *, **, *** show the statistical significance at the 10, 5, and 1 percent level, respectively.

During the COVID-19 pandemic, regulatory authorities in Austria, France, Greece, Italy, Spain, and the United Kingdom have imposed a short-selling restriction for a limited time[3]. The limitation on short-selling allows us to explore the effect of the stock market intervention on herding behavior during COVID-19 turmoil. Table 7 shows the results of the impact of short-selling restrictions on herding behavior. Since our goal is to analyze the nexus between short-selling limitation and herding during uncertainty period, our sample period covers only January 24, 2020 to December 31, 2020. The restricted period covers the period that applied short-selling

[3] Short-selling is prohibited for Italy, Spain and UK on March 13, 2020, short-selling prohibited for Italy, France, Spain and UK on March 17, 2020 and short-selling prohibited for Austria, France, Greece, Italy and Spain from March 18 to May 18, 2020 (Nunn and Kulam 2021).

restriction and the unrestricted period consists same countries with no short-selling restriction periods. The findings show that only banks in France exhibit herding behavior when the short-selling restriction is imposed. Contrary, Austria has anti-herding and Greece has herding behavior in the unrestricted period. The results show that during the pandemic short-selling restriction have no effect on investors behavior.

**Table 7.** Regression Results for Short Selling Restriction vs. Unrestricting Period

| **PANEL A: CSSD** | **RESTRICTED Period** | | | | **UNRESTRICTED Period** | | | |
|---|---|---|---|---|---|---|---|---|
| | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N |
| Austria | 1.627*** | 0.445* | 0.012 | 40 | 0.823*** | 0.463*** | 0.036*** | 196 |
| | (0.000) | (0.059) | (0.666) | | (0.000) | (0.000) | (0.008) | |
| France | 1.636*** | 1.032** | -0.174* | 41 | 1.368*** | 0.553*** | -0.017 | 200 |
| | (0.000) | (0.023) | (0.053) | | (0.000) | (0.000) | (0.108) | |
| Greece | 1.673*** | 0.110 | 0.006 | 37 | 1.159*** | 0.244*** | -0.007* | 197 |
| | (0.000) | (0.609) | (0.681) | | (0.000) | (0.000) | (0.096) | |
| Italy | 1.951*** | 0.230 | 0.002 | 42 | 1.394*** | 0.319*** | -0.006 | 197 |
| | (0.000) | (0.206) | (0.899) | | (0.000) | (0.000) | (0.238) | |
| Spain | 1.931*** | 0.128 | 0.043 | 42 | 1.290*** | 0.184** | -0.005 | 199 |
| | (0.000) | (0.663) | (0.262) | | (0.000) | (0.022) | (0.547) | |
| Panel | 2.028*** | 0.588* | -0.012 | 202 | 1.669*** | 0.420*** | -0.004 | 989 |
| | (0.000) | (0.057) | (0.800) | | (0.000) | (0.000) | (0.437) | |
| **PANEL B: CSAD** | **RESTRICTED Period** | | | | **UNRESTRICTED Period** | | | |
| | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N | $\alpha$ | $\gamma_1$ | $\gamma_2$ | N |
| Austria | 1.192*** | 0.359* | 0.014 | 40 | 0.592*** | 0.386*** | 0.035*** | 196 |
| | (0.000) | (0.065) | (0.547) | | (0.000) | (0.000) | (0.005) | |
| France | 1.176*** | 0.822*** | -0.133** | 41 | 0.983*** | 0.463*** | -0.012 | 200 |
| | (0.000) | (0.009) | (0.038) | | (0.000) | (0.000) | (0.103) | |
| Greece | 1.178*** | 0.098 | 0.004 | 37 | 0.863*** | 0.181*** | -0.004 | 197 |
| | (0.002) | (0.519) | (0.692) | | (0.000) | (0.000) | (0.172) | |
| Italy | 1.450*** | 0.185 | 0.001 | 42 | 0.994*** | 0.238*** | -0.001 | 197 |
| | (0.000) | (0.212) | (0.970) | | (0.000) | (0.000) | (0.715) | |
| Spain | 1.576*** | 0.021 | 0.044 | 42 | 0.949*** | 0.152** | -0.004 | 199 |
| | (0.000) | (0.933) | (0.241) | | (0.000) | (0.014) | (0.507) | |
| Panel | 1.551*** | 0.401* | 0.013 | 202 | 1.131*** | 0.395*** | -0.005 | 989 |
| | (0.000) | (0.055) | (0.679) | | (0.000) | (0.000) | (0.176) | |

**Notes:** Restricted period includes only the countries that have short-selling restrictions and unrestricted period includes same countries. The sample period is between January 24, 2020 and December 31, 2020. Newey-West robust standard errors are used. P-values are in the parenthesis. *, **, *** show the statistical significance at the 10, 5, and 1 percent level, respectively.

# 4 Conclusion

The pandemic has had devastating impact on the economies of the countries as well as the stock markets. During the unprecedented circumstances, central banks and governments intervene in the economy using tools that directly related to the banking sector such as the intervention of the credit market or cutting the target interest rates. Given the banking sector is one of the sectors mostly affected by the COVID-19 pandemic, the paper focuses on the banking sector and aims to investigate herding behavior in European stock exchanges. We address the link between herding and COVID-19 in three ways. First, we analyze the herding behavior during pandemic; second,

we examine the asymmetric effect of market return and volatility; and third we investigate the effect of the short-selling limitation on herding during pandemic.

The results show that five out of twelve countries (Denmark, France, Norway, Sweden and the United Kingdom) exhibit herding behavior during the COVID-19 pandemic, indicating that fear and uncertainty induced by COVID-19 causes less-informed investors to follow the actions of others. Panel result also favors herding behavior during pandemic. The results are robust to approaches used to detect herding behavior. On the other hand, herding is more likely occur in down markets and low-volatility periods, suggesting that results are sensitive to the asymmetric effects. Therefore, investors and regulators should consider market conditions when analyzing herding behavior in stock markets. Furthermore, short-selling restriction does not have significant impact on herding behavior, suggesting regulatory authorities should employ other tools rather than short-selling bans to mitigate herding.

Future research can address different sectors to analyze the herding behavior. Besides, the association between short-selling bans and herding can be analyzed for various sectors. Furthermore, the role of restrictions on herding behavior can be examined for developing economies since dynamics of stock price in emerging markets differ from developed economies.

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