National Culture and Banks' Stock Market Volatility

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Abstract

We conduct a cross-country analysis to examine the impact of national culture on the vulnerability of European banks during the Covid-19 pandemic. Analyzing the stock market volatility of major banks, we explore differences in uncertainty avoidance and individualism levels across multiple European countries. Our results reveal that low uncertainty avoidance reduces the influence of Covid-19-related cases on bank volatility during the crisis peak. Even as the pandemic progresses and vaccinations become widespread, the effect of uncertainty avoidance remains significant. We also find that high individualism has a stabilizing effect on bank volatility, particularly after the start of vaccinations. This study contributes to understanding the role of national culture in shaping bank vulnerability to common stocks, such as the pandemic.

Keywords: Banks, Stocks volatility, National culture, Covid-19, Uncertainty avoidance, Individualism

JEL classification: G12, G21, Z10

1. Introduction

Banks play a crucial role in macroeconomic growth and overall well-being (Levine, 1997, 2005; Wachtel, 2001; Fink, Haiss, and Vukšić, 2005), but they are particularly vulnerable during times of extreme crises (Goodell, 2020). Banks hold long-term, illiquid assets such as loans and illiquid securities, which are financed by highly liquid liabilities like demand deposits and short-term debt. Negative shocks can lead to reduced credit availability or the need for banks to raise equity to maintain capital adequacy. If market participants perceive increased bank risks, it may trigger bank runs or regulatory intervention (Diamond and Dybvig, 1983). Financial stress in banks can also have a contagion effect on other industries, posing a threat to the broader economic system. Consequently, banks' riskiness is closely monitored by regulators, and banks are subject to heavy regulation.

One commonly used measure of banks' riskiness is their stock volatility, which is an important indicator of a firm's asset volatility according to contingent claims theory (Black and Scholes, 1973; Merton, 1974). Stock volatility is often used as a proxy for banks' total asset risk in many studies. For instance, Stiroh (2006) demonstrates that banks with greater reliance on activities generating non-interest income tend to have higher stock volatility. Anginer, Demirguc-Kunt, and Zhu (2014) examine the relationship between banks' stock volatility and deposit insurance during crisis and non-crisis periods.

Notable events over the past few decades, such as the October 1987 Monday crash, the Dot.com bubble of the 1990s, the global financial crisis of 2008, and the COVID-19 outbreak, have resulted in significant fluctuations in stock prices, challenging the conventional understanding of rational investors and standard financial models (Ball, 2009). The complexity of explaining market behavior during crises within the framework of rational investors has led researchers to seek behavioral explanations in the literature.

Differences in cultural values across countries have been linked to various behavioral biases and emotions (Schmeling, 2009) that influence investor preferences

regarding investment risks and profitability (Shefrin & Statman, 1985). Moreover, an extensive body of literature suggests that cultural differences shape investors' responses to new information (Dou et al., 2016) and may elucidate their preferences and tolerance for risk (Anderson et al., 2011; Chui and Kwok, 2008; Li et al., 2013).

This study examines the impact of national culture on the vulnerability of banks to global financial shocks. We analyze banks' stock volatility (referred to as bank volatility) during the Covid-19 outbreak and show that the association between bank volatility and Covid-19 cases depends on the national culture dimensions of the banks' home countries. To achieve this, we utilize a sample of 48 largest listed banks from 19 developed and emerging EU countries, along with Switzerland, the UK, and Turkey, which collectively account for approximately 60% of European banking assets as of 2019.

The choice to focus our analysis on European banks is motivated by several factors. Firstly, European banks experienced significant adverse effects during the Covid-19 outbreak (between December 1, 2019, and April 30, 2020). The Euro STOXX banks index dropped by 40.18%, followed by the STOXX North America 600 banks index (31.23%) and the STOXX Asia/Pacific 600 Banks Index (26.09%). This contraction in economic activity resulted in increased loan loss provisions and had an adverse impact on the credit quality of European banks, with some posting significant losses in Q1 2020 to address a potential surge in bad loans. Batten et al. (2022) demonstrate that the relationship between European stock returns and the fear index was higher during the Covid-19 period compared to the global financial crisis. Moreover, banks in European countries are more prone to shock transfers (Daly et al., 2019).

Secondly, while previous literature has explored the influence of national culture on a global scale, clusters of countries, such as those in Europe, may share common pan-regional cultural traits (Ronen and Shenkar, 1985; Smith and Schwartz, 1997). Additionally, combining the dimensions of Hofstede and Schwartz reveals culturally distinct regions (Steenkamp, 2001). Therefore, it is intriguing to examine whether cross-country cultural variations in Europe have a significant influence on bank risks (volatility). We hypothesize that national culture affects the stability of Europe's banking system and the sensitivity of banks to crises.

Finally, European banks are a suitable choice for this study due to the reliability of Covid-19 data in these countries. Our daily data analysis requires not only accurate Covid case numbers but also their correct reporting timing and investor confidence in the reported data. Sambridge and Jackson (2020) reported that Covid cases in most European countries are trustworthy, whereas in some other countries, they are not. Therefore, focusing on European banks provides a robust data sample for our empirical investigation.

We believe that the Covid-19 pandemic is well suited to our analysis due to its dynamic nature, including several waves of infections and the introduction of vaccinations. Using daily changes in Covid cases as an identification instrument, we investigate the effect of national culture on bank volatility. Additionally, we examine the level of heterogeneity in bank volatility in relation to national culture during the upswing and downswing of the pandemic crisis.

Our findings suggest that national culture plays a significant role in moderating volatility across different European markets, with varying effects during the peak of the crisis and in the vaccination period. Specifically, we find that individualism does not have a significant influence on volatility until the vaccination period, whereas uncertainty avoidance has a strong effect on volatility with respect to the growth in confirmed cases. These results indicate that during times of crisis, it may be safer to invest in banks from countries with lower uncertainty avoidance tendencies. However, during the vaccination period, bank volatilities are scaled down by the vaccination drive, and individualism exerts a strong effect on the sensitivity of European banks to the pandemic. This change in effect may be attributed to overconfidence and optimism biases. Our results are robust to several factors that could impact bank stock returns and are consistent with recent literature on the impact of national culture during crises.

The remainder of this paper is structured as follows: Section 2 provides a review of the related literature and outlines our research hypotheses. Section 3 describes the methodology, data, and descriptive statistics. Section 4 presents the empirical results. Finally, Section 5 provides concluding remarks.

2. Literature Review and Hypothesis Development

The Covid-19 pandemic has generated a growing body of literature exploring the various factors that impact stock markets and industries worldwide. However, while research on the non-banking sector has been abundant, studies on the banking sector's response to the pandemic have been scarce. Existing research has primarily focused on the general impact of Covid-19 on banks, with only a few studies investigating their specific response to the pandemic. For example, Demir and Danisman (2021) analyzed bank stock responses to government policies, while Mirzaei, Saad, and Emrouznejad (2020) investigated the link between the efficiency and stock performance of Islamic banks. van der Cruijsen et al. (2022) demonstrated that the COVID-19 pandemic did not significantly affect public trust in banks in the US and the Netherlands. Contagion between asset returns and volatilities were found to be higher during the pandemic (Maghyereh et al., 2022). Korzeb and Niedziółka (2020) investigated the importance of banks' financial standing, but their results were limited to a single emerging market. Therefore, to the best of our knowledge, no study has examined the impact of cultural norms and beliefs on banks' resilience to the Covid-19 pandemic.

Our goal is to fill this gap in the literature by examining the financial resilience of banks during the initial phase of the Covid-19 crisis (prior to the approval of the Pfizer vaccine) and throughout a longer period that includes vaccinations against Covid-19. Additionally, we aim to investigate any heterogeneity in bank responses to the crisis following the introduction of vaccinations. We designate the vaccination period as the downswing of the crisis because vaccinations have been demonstrated to have a positive effect on the economy. Qulici et al. (2015) conducted research on the connection between vaccinations and economic growth in Europe and concluded that effective vaccination programs in Europe contribute to the European Union's economy by reducing mortality and morbidity, resulting in increased consumption and gross domestic product. Furthermore, Ganslmeier et al. (2022) recently demonstrated that even at low vaccination rates, the deployment of COVID-19 vaccines has substantial benefits for both health and economic outcomes.

In traditional financial theory, investors are assumed to be rational, and changes in relevant risk are thought to result from movement in fundamental factors. However, cultural norms and beliefs can significantly influence people's values, attitudes, selective attention, and behaviors (Adler, 1997; Markus and Kitayama, 1991; Tse et al., 1988; Homer and Kahle, 1988). Two frameworks developed by Hofstede (1980, 1991, 2010) and Schwartz (1994, 1997) provide comprehensive measures of national culture. Hofstede's framework, which identifies six dimensions of cultural variation - uncertainty avoidance, individualism/collectivism, large/small power distance, masculinity/femininity, long/short-term orientation, and indulgence/restraint - is the most influential and widely cited (Hofstede, 2010). This study focuses on Hofstede's cultural dimensions of uncertainty avoidance and individualism/collectivism, which are the most commonly used parameters in the literature.

The first cultural dimension of Hofstede assesses how people handle uncertainty, given that future events cannot be predicted perfectly. Literature in psychology shows that an individual's perception of uncertainty and coping mechanisms are significantly influenced by the national culture in which the individual resides. For example, Hofstede (1983) found significant variation in the perceived level of uncertainty and the extent of uncertainty avoidance behavior (UAI) across national cultures. Investors from high UAI countries are more likely to reduce their exposure to riskier markets (Inklaar and Yang, 2012) and are less likely to invest in foreign markets (Anderson et al., 2011). In high UAI cultures, individuals consume more life insurance (Chui and Kwok, 2008), firms have more conservative cash-holding policies (Chen et al., 2015), engage less in risk-taking (Li et al., 2013), and require higher takeover premiums (Frijns et al., 2013). Therefore, there is ample evidence that members of societies with strong UAI are more sensitive to uncertainty and ambiguity and will tend to avoid facing stressful situations, leading to high fluctuations in security prices. Conversely, members of societies with weak uncertainty avoidance are relatively more tolerant of changes and willing to take risks. Thus, a country's financial markets and banks may be significantly affected by the degree of risk tolerance prevalent in that country's national culture. Based on this, the following hypotheses are proposed:

Hypothesis 1: European countries characterized by higher levels of cultural uncertainty avoidance are expected to exhibit greater bank volatility during the Covid-19 crisis compared to countries with lower uncertainty avoidance.

Hypothesis 2: The positive effect of Covid-19 cases on the volatility of European banks is mitigated by lower levels of cultural uncertainty avoidance.

Hofstede's second cultural dimension compares autonomy and collectivity. Autonomy describes cultures in which individuals are unique and independent in their thinking and actions, while collectivity emphasizes the solidarity of the group and the maintenance of the existing order. Social psychology studies (e.g., Shupp and Williams, 2008; Chui et al., 2010) argue that high individualism leads to overconfidence and a greater inclination for risk-taking activities. Empirical studies by Li et al. (2013), Mihet (2013), Kanagaretnam et al. (2014), Ashraf et al. (2016), and Boubakri et al. (2017) support this argument. Thus, we propose that in cultures characterized by strong individualism, investors may exhibit greater resilience to panic selling and maintain their financial position. Conversely, in cultures characterized by strong collectivism, we would expect herd buying and/or selling to amplify financial gains and losses.

Hypothesis 3: During the Covid-19 crisis, European countries characterized by stronger collectivism (weaker individualism) are expected to exhibit higher bank volatility compared to countries characterized by stronger individualism (weaker collectivism).

Hypothesis 4: The positive effect of Covid-19 cases on the volatility of European banks is mitigated by higher levels of individualism**.**

3. Methodology and Data

We collected daily data on confirmed Covid-19 cases and vaccination statistics from the Oxford Covid-19 Government Response Tracker database (OxCGRT) (Hale et al., 2020b) for the period from January 1, 2020, to September 21, 2021. To account for potential delays in data publication and their impact on capital markets, we applied a one-day lag. The daily returns of bank equities for the corresponding dates were obtained from the Investing.com database. We measured the cultural dimensions of uncertainty avoidance and individualism using Hofstede et al.'s (2010) scales (Ashraf et al., 2016; Ashraf and Arshad, 2017). Our sample consists of 20,653 bank-day

observations across 19 countries, with available banking data and the necessary scores for uncertainty avoidance and individualism.

Figure 2. Uncertainty Avoidance across European Countries
The figure depicts the uncertainty avoidance scores of Hofstede (2010) for 19 European countries. The highest score is 112 for Greece and the lowest score is 23 for Denmark.

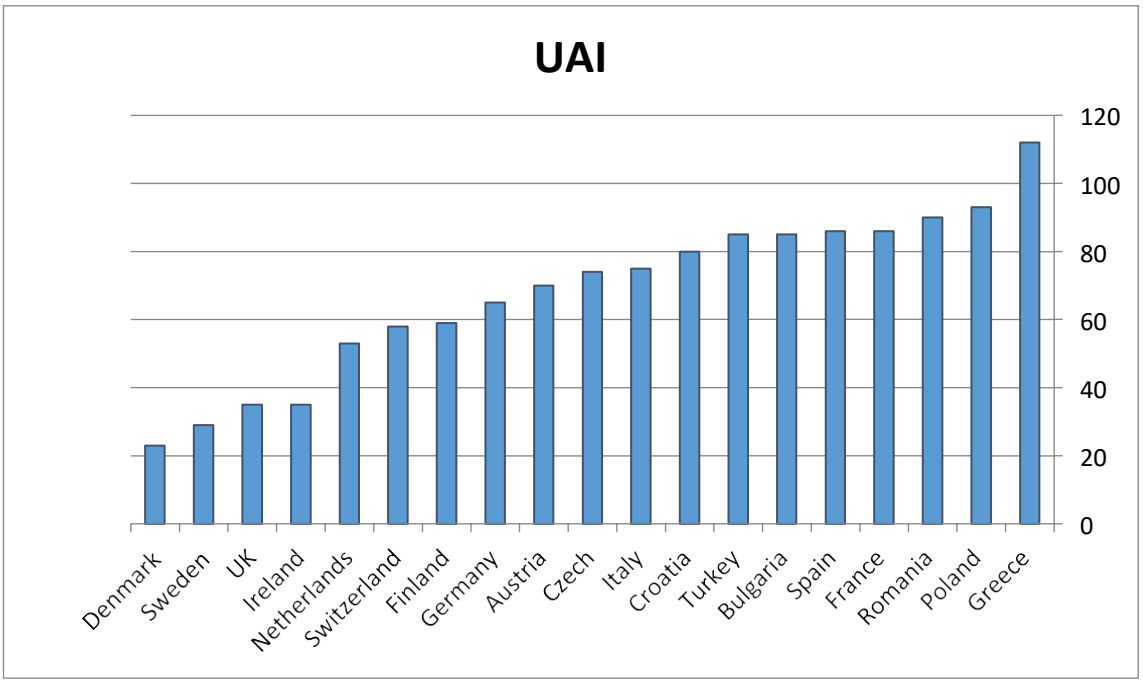
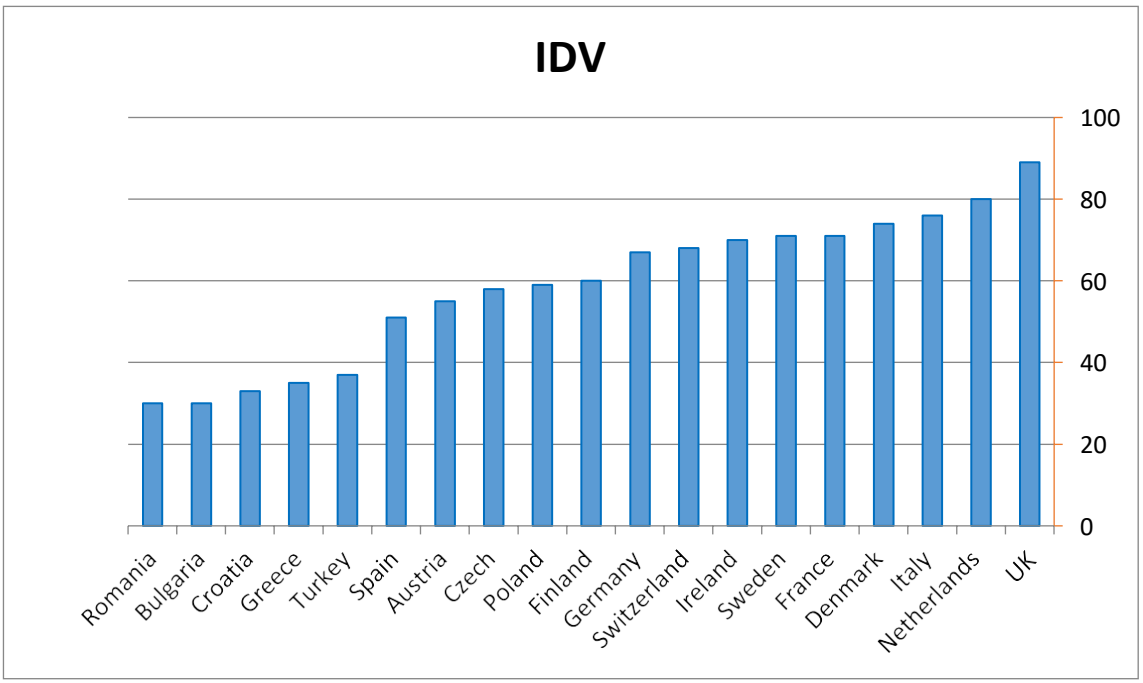


Figure 3. Individualism across European Countries
The figure depicts the individualism scores of Hofstede (2010) for 19 European countries. The highest score is 89 for UK and the lowest score is 30 for Romania.



Our sample includes 16 EU countries, along with the United Kingdom, Switzerland, and Turkey. As depicted in Figures 2 and 3, there are substantial variations in Hofstede's (2010) national cultural dimensions of uncertainty avoidance (UAI) and individualism (IDV) among the 19 countries. However, the deviation is more pronounced in UAI compared to IDV. Furthermore, emerging European economies tend to exhibit higher levels of uncertainty avoidance and lower levels of individualism, while developed European countries tend to demonstrate greater tolerance for risk and uncertainty (low UAI) and higher levels of individualism.

Cultural dimensions are considered invariant over time; hence, fixed-effect regressions cannot be used. To account for this, we specify a random-effects panel regression model to explain $VV_{ii,tt}$ which is the volatility for bank ii on day tt, while controlling for time fixed effects:

$$WW_{ii,tt} = \alpha\alpha + \beta\beta_1 \cdot CCCCCttCCCCee_{ii} + \beta\beta_2 \cdot GGCCGGGGtt\boldsymbol{h}CCaaaaee_{ii,tt-1} + \beta\beta_3 \cdot GGCCGGGGtt\boldsymbol{h}CCaaaaee_{ii,tt-1} \times CCCCCCttCCCCee_{ii} + \beta\beta_4 \cdot SSttCCiirrrreerrrryy_{ii,tt} + \sum_{kk=5}^{kk=9} \beta\beta_{kk} RR_{ii}^{kk} + \sum_{mm=10}^{mm=11} \beta\beta_{mm} II_{ii}^{mm} + \sum_{nn=12}^{nn=13} \beta\beta_{nn} MM_{ii}^{nn} + vv_{tt} + CC_{ii} + \varepsilon\varepsilon_{ii,tt} \quad (1)$$

$$WW_{ii,tt} = \alpha\alpha + \beta\beta_1 \cdot CCCCCttCCCCee_{ii} + \beta\beta_2 \cdot GGCCGGGGtt\boldsymbol{h}CCaaaaee_{ii,tt-1} + \beta\beta_3 \cdot GGCCGGGGtt\boldsymbol{h}CCaaaaee_{ii,tt-1} \times CCCCCCttCCCCee_{ii} + \beta\beta_4 \cdot GGCCGGGGtt\boldsymbol{h}CCaaaaee_{ii,tt-1} \times VVaarr_{ii,tt} + \beta\beta_5 \cdot GGCCGGGGtt\boldsymbol{h}CCaaaaee_{ii,tt-1} \times VVaarr_{ii,tt} \times CCCCCCttCCCCee_{ii} + \beta\beta_6 \cdot SSttCCiirrrreerrrryy_{ii,tt} + \sum_{kk=7}^{kk=11} \beta\beta_{kk} RR_{ii}^{kk} + \sum_{mm=12}^{mm=13} \beta\beta_{mm} II_{ii}^{mm} + \sum_{nn=14}^{nn=15} \beta\beta_{yy} MM_{ii}^{nn} + vv_{tt} + CC_{ii} + \varepsilon\varepsilon_{tt} \quad (2)$$

In this study, we utilize two equations. The first equation (Equation 1) examines the impact of national culture on the relationship between bank volatility and the Covid-19 crisis, while controlling for time fixed effects. To do so, we introduce interaction terms, specifically $GGCCGGGGtt\boldsymbol{h}CCaaaaee_{ii,tt-1} \times CCCCCttCCCCee_{ii}$ into the random-effects panel regression model. The term $GGCCGGGGtt\boldsymbol{h}CCaaaaee_{ii,tt-1}$ represents the percentage change in confirmed cases in the country of bank ii, on the previous day. $CCCCCttCCCCee_{ii}$ refers to the level of uncertainty avoidance or individualism in the bank's country, as measured by two alternative indices developed by Hofstede et al. (2010). Given their high correlation

(-0.71, sig 1%), the culture parameters are analyzed in separate regressions.[1] Our primary measure of volatility ($VV_{ii,tt}$) is the natural logarithm of absolute daily returns, which are calculated by taking the percentage change of daily market prices for each bank, to account for both systematic and unsystematic risk (Rouatbi et al., 2021). To ensure the robustness of our findings, we employ two alternative measures of volatility: the absolute logarithm of market-adjusted excess returns (MacKinlay, 1997) and the absolute logarithm of mean-adjusted excess returns. In line with the market model proposed by MacKinlay (1997), we calculate daily bank returns in excess of the market returns using the STOXX 600 European Banking Index as the benchmark for the market portfolio. Additionally, we compute mean-adjusted returns by taking the difference between the daily bank returns and the average daily pre-crisis returns of 2019 for each bank.

The second equation (equation 2) includes the vaccination period, where $VVaarr_{ii,tt}$ is a dummy variable that takes a value of 1 during the vaccination period in the country of bank i and 0 otherwise. In this equation, we use the additional interaction terms, $GGCCGGGGttCCaaaaee_{ii,tt-1} \times VVaarr_{ii,tt}$ to capture the percentage change in confirmed Covid-19 cases from the previous day during the vaccination period and $GGCCGGGGttCCaaaaee_{ii,tt-1} \times VVaarr_{ii,tt} \times CCCCCCttCCCCee_{ii}$ to examine how national culture influences the reaction of banks to the volatility caused by the Covid-19 crisis during the vaccination period.

$SSttCCiirrrreerrrryy_{ii,tt}$ represents the percentage change in the stringency index (source: OxCGRT) which measures the level of social distancing measures implemented by governments in each country, such as the closure of schools, workplaces, public places, and travel restrictions. We also include several control variables, including the primary year-end 2019 financial ratios (CAMEL) of sample banks denoted by RR_{ii}^{kk}, where k is the number of explanatory variables. CAMEL ratios are a uniform financial rating system widely used in literature to anticipate the financial distress of individual banks (Boubakri et al., 2017; Betz et al., 2014, Galil et al. 2022). Specifically, capital adequacy is measured by the ratio of stockholders' equity to total assets, which provides a measure of the bank's ability to withstand financial losses and insolvency. Asset quality

[1] On the other hand, we did not find a high correlation between the growth in cases and cultural parameters, which were included in the same regressions as per previous research.

is represented by the ratio of nonperforming loans to total average loans, where a weaker asset quality increases the likelihood of bank distress and failure. Management quality is measured by the cost-to-income ratio, which reflects the operational efficiency of the bank. Profitability is represented by the ratio of net income to total assets (ROE). Lastly, liquidity is represented by the ratio of cash and cash equivalents to total assets.

In the same model, the term II_{ii}^{mm} represents the ZSCORE, a measure of sector-level risk-taking culture, and banking sector concentration (share of largest 3 banks) ratios per country obtained from the World Bank financial structure database, which respectively indicate financial stability (available as of 2017). According to Beck, Demirguc-Kunt, and Levine (2003), crises are less likely in more concentrated banking systems, consistent with the concentration-stability argument that banking systems characterized by a few large banks are more stable than less concentrated banking markets. The term MM_{it}^{nn} includes macroeconomic control variables such as per capita GDP and inflation.

Finally, the term vv_{tt} represents the time effect, CC_{ii} represents bank-specific random effects, and $\varepsilon\varepsilon_{ii,tt}$ represents observation-specific errors clustered by country. Our findings are also robust to country-level heteroscedasticity.

Table 1 shows the summary statistics for the main variables used in the regressions during the sample period from January 1, 2020, to September 21, 2021. The dependent variable Log |R|, Log |Rmarket| and Log |Rmeanadj| (volatility) in Table 1 yield consistent results with those of Zaremba et al. (2020), with mean values of -4.45, -4.89 and -4.56, and medians of -4.34, -4.73, -4.38, respectively. The minimum and maximum values of -9.2 (or -13.7, -13.7) and -1.2 (or -0.98, -1.0) also suggest large fluctuations in the log of daily market returns (or abnormal returns).

We observe a significant range in the values of both uncertainty avoidance (UAI) and individualism (IDV) indices across countries, spanning from 21 to 112 for UAI and from 30 to 89 for IDV. Higher values indicate greater nationwide risk aversion or stronger individualism, which are expected to have a negative or positive impact on volatility, respectively. Furthermore, we note a substantial standard deviation for the growth in confirmed cases across countries, with a mean value of 3% (median 0.5%) and

a standard deviation of 17.5%. To eliminate potential outliers, we winsorized the growth in cases at the 1st and 99th percentiles.

Lastly, the percentage change to the Stringency index has a mean value of 0.45%, with the highest value at 200% and the lowest at -52%. This suggests that the stringency measures were likely more severe in the early stages of the crisis compared to later periods, indicating a lack of consistency in the application of these measures across European countries.

Table 1. Summary Statistics of 48 European banks

(Jan 2020-sep2021)	**Median**	**Mean**	**Std. Dev**	**Min**	**Max**
Volatility Log|R|	-4.335	-4.452	1.120	-9.210	-1.204
Volatility Log|Rmarket|	-4.733	-4.890	1.302	-13.720	-.9799
Volatility Log|Rmeanadj|	-4.378	-4.561	1.310	-13.652	-1.007
Growth cases	.0052	.0311	.1725	-.2649	7
UAI	74	68.88	23.95	23	112
IDV	60	59.41	17.15	30	89
Loss Prov.	.0027	.0068	.0093	.0002	.0450
Manag. Eff	.8447	.8060	.1100	.0057	1.070
ROE	.0783	.0843	.0395	.0124	.2017
Liquidity	.0956	.1144	.0664	.0152	.3107
Capital Adeq	.0685	.0787	.0292	.0355	.1408
Sector ZSCORE	12.06	13.77	6.352	5.244	26.40
Largest 3/ total	65.26	66.66	16.19	39.35	94.17
Stringency	0	.0045	.0714	-.520	2
GDP per Capita	38605.6	37797.59	11470.47	18563.3	67335.3
Inflation	.013	.023	.034	.003	.152

Table 2 provides a comparison of three volatility measures as the dependent variable and the growth in confirmed cases as the primary independent variable for countries with UAI scores above and below the median. The analysis encompasses two periods: the first period from January 2020 to November 9, 2020 (the date of the third stage Pfizer vaccine approval), and the subsequent period until September 21, 2021. The results indicate that banks' volatility was relatively high prior to the third stage Pfizer vaccine approval, potentially due to increased uncertainty at the onset of the pandemic.

However, the percentage growth in cases declined following the commencement of vaccinations, suggesting that vaccines may have contributed to a reduction in financial turmoil in the markets.

Furthermore, the analysis reveals that the volatility of banks in countries with low UAI scores (below the median) is relatively lower compared to that in countries with high UAI scores, both before and after the vaccination period. Low UAI countries also exhibit a lower rate of growth in cases in comparison to high UAI countries, which may explain the disparities in volatility. However, when adjusting the cases for population per million, it becomes evident that until the vaccination period, low UAI countries had a higher number of new cases than high UAI countries. These findings suggest that the relatively higher resilience to risk in low UAI countries may contribute to the stabilization of their markets. For example, during the vaccination period and in countries with UAI scores below the median, all of the volatility parameters (Log |R|, Log |Rmarket|, and Log |Rmeanadj|) exhibit minimum mean values of -4.8, -5.2, and -4.9 (median: -4.7, -5.0, -4.7) respectively. In contrast, prior to vaccinations and in countries with UAI scores above the median, these parameters display maximum mean values of -4.2, -4.6, and -4.4 (median: -4.1, -4.5, and -4.2) respectively.

Table 2. Summary Statistics, before& after vaccination period

	Before vaccination period		**After vaccination period**	
UAI> median	**Median**	**Mean**	**Median**	**Mean**
Volatility Log|R|	-4.122	-4.218	-4.431	-4.539
Volatility Log|Rmarket|	-4.480	-4.640	-4.753	-4.906
Volatility Log|Rmeanadj|	-4.152	-4.351	-4.486	-4.696
Growth cases	.0141	.0660	.0037	.0063
UAI< median	**Median**	**Mean**	**Median**	**Mean**
Volatility Log|R|	-4.186	-4.315	-4.667	-4.790
Volatility Log|Rmarket|	-4.689	-4.857	-5.023	-5.197
Volatility Log|Rmeanadj|	-4.211	-4.391	-4.701	-4.881
Growth cases	. 0093	.0591	.0035	.0062

4. Results

Our primary objective is to examine the influence of national culture on the volatility of banks' stock prices across different European markets during the Covid-19 pandemic, specifically from January 2020 to September 2021, and how this influence changes after the introduction of vaccinations. To achieve this, we utilize the uncertainty avoidance (UAI) and individualism (IDV) indices as key explanatory variables in our regression models. We commence by analyzing the period before the positive news of the third stage approval of the Pfizer vaccine on November 9, which had a favorable impact on financial markets. Our empirical findings are presented in Columns 1 and 2 of Table 3. Additionally, we examine the initial stage of the crisis (from January 1 to April 30, 2020) in Columns 3 and 4 to ensure the consistency of our results with prior research (Ashraf, 2021).

The results reveal that the coefficients on uncertainty avoidance (UAI) are positive and statistically significant at the 1% level, indicating that bank stock investments are riskier in countries with higher uncertainty avoidance. Furthermore, we find a significant and negative association between volatility and individualism in Column 2. Although the effect of individualism in Column 4 for the period between January and April 2020 is not statistically significant, it is negative, suggesting that the decline in banks' volatility was greater in countries with higher individualism. This implies that in countries characterized by more independent thinking and decision-making, investors are more self-confident and resilient to risks, leading to lower price fluctuations and reduced investment risk in bank equities.

Our results suggest that cultural differences can result in significant variations in banks' volatility over the long term (January to November). For instance, banks in Denmark, with the lowest level of uncertainty avoidance in our sample, exhibit 56% less volatility compared to banks in Greece, which has the highest uncertainty avoidance index. Similarly, banks in the UK, which has the highest level of individualism, demonstrate 37% less volatility than banks in Romania, which has the lowest individualism index (refer to summary statistics Table 1 for minimum and maximum UAI and IDV figures).

Table 3. The effect of national culture on European banks' volatility during the Covid-19 crisis (before 3rd stage approval of Pfizer vaccine)

The table reports the results of the impact of uncertainty avoidance (UAI) and individualism (IDV) on the volatility of European banks during the Covid-19 crisis using the random-effects panel regression model controlling for time fixed effects. The dependent variable is the volatility of stock market returns of banks from 19 major European countries, defined as the natural logarithm of changes in daily stock prices. The main independent variables are the uncertainty avoidance and individualism indices of Hofstede et al. (2010), daily percentage change of Covid-19 confirmed cases for each country concerned and the interaction term, Growth cases×UAI (or Growth cases ×IDV). The control variables are sample banks' primary year-end 2019 financial ratios (CAMEL). We use the per capita GDP and inflation as macro control variables and for banking sector control variables; we employ sector banking concentration (largest 3/ total) and ZSCORE ratios, which respectively indicate efficiency and bank risk taking culture (available as of 2017). In addition, we check the effect of changes in stringency index, which represents government social distancing measures in each country. The coefficient estimates for each variable have corresponding heteroscedasticity-robust t-values in parentheses, **,*** indicate significance at the 5 and 1 percent significance levels, respectively.

	Jan-Nov		Jan-Apr	
Volatility Log|R|	**(1)**	**(2)**	**(3)**	**(4)**
Growth cases	.0115	**.8703****	.0384	**1.241*****
	(0.22)	**(2.11)**	(0.75)	**(2.61)**
UAI	**.0063*****		**.0041*****	
	(7.76)		**(2.51)**	
IDV		**-.0064*****		-.0034
		(-5.22)		(-1.42)
Growth cases × UAI	**.0079*****		**.0087*****	
	(3.06)		**(3.20)**	
Growth cases × IDV		-.0091		-.0130
		(-1.45)		(-1.72)
Loss Prov.	**12.99*****	**12.29*****	**18.80*****	**17.10*****
	(4.46)	**(4.11)**	**(3.72)**	**(3.35)**
Manag. Eff	.1269	.2258	.4083	.5060
	(0.81)	(1.45)	(1.50)	(1.87)
ROE	**-1.704*****	**-2.175*****	-1.464	**-1.852****
	(-3.83)	**(-4.83)**	(-1.88)	**(-2.37)**
Liquidity	-.1762	**-.4731*****	-.1429	-.4627
	(-1.05)	**(-2.71**)	(-0.42)	(-1.33)
Capital Adeq	-.9367	-.8849	-.4726	-.4265
	(-1.47)	(-1.30)	(-0.36)	(-0.31)
Sector ZSCORE	-.0026	**.0056*****	.0018	**.0079****
	(-1.12)	**(2.74)**	(0.39)	**(2.01)**
Largest 3/ total	**-0046*****	**-0084*****	-0011	-0037
	(-4.77)	**(-8.09)**	(-0.57)	(-1.82)
Stringency	1247	. .1369	.0366	.0568
	(1.18)	(1.30)	(0.32)	(0.50)

Time fixed effects	Yes	Yes	Yes	Yes
Observations	8350	8350	2321	2321
Banks	48	48	48	48
R-squared	0.33	0.33	0.40	0.39

The interaction terms between uncertainty avoidance and individualism, which represent the moderating impact of culture on bank volatility, yield varied results. The interaction coefficient for uncertainty avoidance is positive and significant at the 1% level, indicating that the increase in bank volatility due to the daily rise in confirmed COVID-19 cases is mitigated or amplified by a decrease or increase in UAI. However, the impact of the growth in confirmed cases on volatility does not appear to be sensitive to individualism, as the interaction coefficient estimate for IDV is not significant in both periods. Our findings underscore the importance of culture, more specifically, uncertainty avoidance in mitigating the contagion risk during extreme shocks in the European banking environment. This is despite the strong correlations observed in shock transfers between European countries' banking systems (Daly et al., 2019).

We also conducted a "placebo test" by using the number of COVID-19 cases without a one-day lag. The coefficients of the interaction variables became statistically non-significant, suggesting that the reporting of COVID-19 cases is responsible for the observed changes in volatility. Due to brevity, the results are not presented.

Furthermore, the regression results indicate significant associations between certain financial ratios, such as asset quality and profitability ratios, and bank concentration ratios at the sector level, with the risks related to bank stock performance, in line with previous research. For instance, Bekaert et al. (2012) argue that corporate variables are among the most crucial determinants of aggregate idiosyncratic volatility, alongside index composition and business cycle variables. The "concentration-stability" hypothesis posits that banking systems with fewer banks are more efficient and possess greater resources, serving as a buffer during financial crises (Beck, Demirgüç-Kunt, & Levine, 2003). Additionally, higher bank concentration contributes to improved access to loans and deposits, enhancing financial stability (Owen & Pereira, 2018).

Table 4. The effect of UAI on the relationship between the sample banks' volatility and the Covid-19 crisis (incl. vaccination period, Jan2020-Sep 2021)

The table reports the results of the impact of UAI on the volatility of European banks before and after vaccinations using the random-effects panel regression model controlling for time fixed effects. Three volatility parameters are used as dependent variable namely; Log[R], Log[Rmarket] and Log[Rmeanadj] (see appendix1 for the definitions). Growth cases × Vaccination denotes the daily percentage change of Covid-19 confirmed cases during the period of vaccinations, whereas Vaccination is a dummy variable that takes the value of 1 in the days with vaccinations or otherwise zero. The interaction term, Growth cases × UAI shows the moderating impact of culture for the whole analysis period. The interaction term, Growth cases × Vaccination × UAI indicates the same for the period of vaccinations, The control variables are sample banks' primary year-end 2019 financial ratios (CAMEL). We use the per capita GDP and inflation as macro control variables and for banking sector control variables; we employ sector banking concentration and ZSCORE ratios, which respectively indicate efficiency and bank risk taking culture (available as of 2017). In addition, we check the effect of changes in stringency index, which represents government social distancing measures in each country. The coefficient estimates for each variable have corresponding heteroscedasticity-robust t-values in parentheses, **,*** indicate significance at the 5 and 1 percent significance levels, respectively.

	Log[R]		**Log[Rmarket]**		**Log[Rmeanadj]**	
	(1)	(2)	(3)	(4)	(5)	(6)
UAI	**.0049*** (8.22)**	**.0047*** (7.71)**	**.0030*** (4.13)**	**.0027*** (3.68)**	**.0052*** (7.79)**	**.0052*** (7.41)**
Growth cases	**-.**3941 (-1.08)	**-.**4539 (-1.24)	-.4348 (-0.97)	**-.**5464 (-1.22)	-.7688 (1.87)	**-.8168** (-1.98)**
Growth cases × UAI	**.0094** (2.10)**	**.0099** (2.19)**	**.0118** (2.16)**	**.0127** (2.31)**	**.0161*** (3.19)**	**.0164*** (3.22)**
Growth cases × Vaccination		2.733 (0.59)		.2636 (0.48)		3.553 (0.71)
Growth cases × UAI × Vaccination		.0516 (0.70)		.1628 (1.35)		.0351 (0.42)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Control variables: CAMEL, Sector and Country ratios						
Observations	18102	18102	18861	18861	18871	18871
Banks	48	48	48	48	48	48
R-squared	0.30	0.30	0.17	0.17	0.27	0.27

We expanded our analysis to include the vaccination period and examined how the relationship between volatility and the growth in confirmed cases is influenced by national-level culture in light of positive news regarding the pandemic.

The UAI and IDV results are presented in Tables 4 and 5, respectively. To ensure the robustness of our findings, we used three volatility parameters (Log|R|, Log|Rmarket|, and Log|Rmeanadj|) as dependent variables. We introduced a dummy variable called "Vaccination," which takes a value of 1 on days with vaccinations and 0 otherwise, to explore the moderating effect of national culture on volatility during both the vaccination and non-vaccination periods. The interaction term Growth cases × UAI (or Growth cases × IDV) represents the overall moderating impact of culture, while Growth cases × UAI × Vaccination (or Growth cases × IDV × Vaccination) indicates the change in this effect during the vaccination period.

The UAI coefficients in Table 4 validate our initial findings from Table 3, as they remain statistically significant at the 1% level in all regressions. Additionally, the positive and significant interaction coefficients for the entire period confirm that lower UAI helps mitigate the increase in banks' volatility resulting from the growth in confirmed cases. However, the interaction terms during the vaccination period are not statistically significant, suggesting that the moderating role of UAI on the crisis's effect persists even during days of vaccination.

Table 5 demonstrates that IDV coefficients are consistently negatively associated with the volatility of bank returns, consistent with the findings in Table 3. However, the impact of the growth in confirmed cases on volatility does not appear to be sensitive to individualism, as the Growth cases × IDV coefficients are not statistically significant in four out of six regressions. The non-significant interaction terms of individualism for the overall period align with the results in Table 3, indicating that individualism may have played a minor role in controlling the influence of the pandemic on volatility during the peak of the crisis. However, we observe a significantly moderating impact of higher individualism on the relationship between the growth in cases and volatility during the period of positive news and vaccinations. The Growth cases × Vaccination × IDV interaction term is consistently negative and significant at the 1% level for all volatility parameters. These findings support social studies by Shupp and Williams (2008) and Chui et al. (2010), suggesting that high individualism leads to

overconfidence and a greater incentive for risk-taking activities, particularly during periods of positive expectations.

Table 5. The effect of IDV on the relationship between the sample banks' volatility and the Covid-19 crisis (incl. vaccination period, Jan2020-Sep 2021)

The table reports the results of the impact of IDV on the volatility of European banks before and after vaccinations using the random-effects panel regression model controlling for time fixed effects. Three volatility parameters are used as dependent variable namely; Log[R], Log[Rmarket] and Log[Rmeanadj] (see appendix1 for the definitions). Growth cases × Vaccination denotes the daily percentage change of Covid-19 confirmed cases during the period of vaccinations, whereas Vaccination is a dummy variable that takes the value of 1 in the days with vaccinations or otherwise zero. The interaction term, Growth cases × IDV shows the moderating impact of culture for the whole analysis period. The interaction term, Growth cases × Vaccination × IDV indicates the same for the period of vaccinations, The control variables are sample banks' primary year-end 2019 financial ratios (CAMEL). We use the per capita GDP and inflation as macro control variables and for banking sector control variables; we employ sector banking concentration and ZSCORE ratios, which respectively indicate efficiency and bank risk taking culture (available as of 2017). In addition, we check the effect of changes in stringency index, which represents government social distancing measures in each country. The coefficient estimates for each variable have corresponding heteroscedasticity-robust t-values in parentheses, **,*** indicate significance at the 5 and 1 percent significance levels, respectively..

	Log[R]		**Log[Rmarket]**		**Log[Rmeanadj]**	
	(1)	(2)	(3)	(4)	(5)	(6)
IDV	**-.0075*** **	**-.0067*** **	**-.0098*** **	**-.0089*** **	**-.0029*** **	**-.0020** **
	(-9.08)	**(-7.43)**	**(-9.29)**	**(-8.07)**	**(-2.94)**	**(-1.97)**
Growth cases	**-.**1109	**.**0436	**1.403*** **	**1.496*** **	.7104	**.**8129
	(-0.27)	(0.11)	**(2.73)**	**(2.90)**	(1.43)	(1.63)
Growth cases × IDV	.0063	.0032	**-.0177** **	**-.0202*** **	-.0065	-.0087
	(1.00)	(0.50)	**(-2.22)**	**(-2.51)**	(-0.86)	(-1.14)
Growth cases × Vaccination		**39.11*** **		**37.71*** **		**29.66*** **
		(4.42)		**(3.37)**		**(2.81)**
Growth cases × IDV × Vaccination		**-.5273*** **		**-.4455*** **		**-.3796*** **
		(-4.02)		**(-2.71)**		**(-2.46)**
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Control variables: CAMEL, Sector and Country ratios						
Observations	18102	18102	18861	18861	18871	18871
Banks	48	48	48	48	48	48
R-squared	0.30	0.30	0.17	0.17	0.27	0.27

Our results indicate that the influence of national-level culture, as captured by uncertainty avoidance (UAI) and individualism (IDV), on the relationship between

COVID-19 cases and volatility is not uniform across the entire pandemic period. Specifically, we find that UAI has a stronger impact during the height of the crisis, whereas IDV becomes more influential during the vaccination period, when positive events are taking place. These findings suggest that the role of cultural factors in shaping the dynamics between cases and volatility varies depending on the stage of the pandemic.

5. Conclusion

This study examines the impact of national culture on the volatility of European banks during the Covid-19 crisis. It is the first study to investigate the influence of national culture on the riskiness of publicly traded banks during a global crisis. The results reveal a statistically significant difference in volatility among European banks based on varying levels of uncertainty avoidance and individualism, indicating the importance of culture from a regional perspective. These findings remain robust even after controlling for firm-specific, sector-related, and macroeconomic factors. The results are consistent with behavioral literature, which emphasizes the role of attitudes and beliefs in explaining large market movements beyond rational investor behavior.

Additionally, the study finds that low uncertainty avoidance moderates the impact of adverse shocks on the volatility of European banks during the crisis peak, while ongoing vaccinations mitigate the pandemic's effects in later stages. In this sense, the observed interconnectedness between banking entities operating in different countries and the systemic risk spill over mechanism are influenced by culture. In contrast, high individualism contributes to stability in volatility following the vaccination drive, but it is not significantly effective in moderating the impact of Covid-19 on bank volatilities during the financial turmoil.

This research provides valuable insights into the behavior of equity investors in the banking sector during economic and financial crises and highlights behavioral differences based on two key cultural dimensions. Portfolio managers and financial advisers can leverage these findings to enhance their understanding of trading decisions in European banking equities and develop improved policies for including banking stocks

or related indices in investment portfolios. Overall, this study offers comprehensive insights into the impact of national culture on banks' volatility, enabling policymakers to make more informed decisions.

Appendix-Definition and source of variables.

Variable	Definition	Source
Log[R]	The logarithm of absolute daily returns of 48 European banks	investing.com
Log[Rmarket]	The logarithm of residual daily returns of 48 European banks from the market model using STOXX® Europe 600 banks index	investing.com and STOXX
Log[Rmeanadj]	The logarithm of mean adjusted residual daily returns, computed by subtracting daily stock market returns by the mean of returns during the entire year of 2019.	investing.com
Growth cases	Percentage growth in cumulative cases in t-1 between 1st of January 2020 and 21st of September 2021	OxCGRT
Vaccination period	Vaccination days of each country between 1st of January 2020 and 21st of September 2021	IVADO, Canada
UAI	Hofstede's cultural index on uncertainty avoidance.	Hofstede(2010)
ROE	Return on equity, which is defined as net profit as a percentage of equity of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
Capital Adeq	The capital adequacy, which is measured by stockholders' equity to total assets ratio of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
Loss Prov.	The asset quality, which is represented by the share of nonperforming loans to total average loans. of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
Manag. Eff	Management quality, which is defined by cost to income ratio of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
Liquidity	Liquidity, represented by the ratio of cash and cash equivalents to total assets. of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
GDP per Capita	Gross Domestic Product (GDP) of a country divided by its total population as of 2019, before the start of the covid crisis	OxCGRT
Inflation	Annual growth rate of the consumer price index of a country as of 2019	Statista
Stringency	The percentage change in daily stringency index, which shows the level of government social distancing measures in each country, such as closure of schools, work places, public places and travel restrictions.	OxCGRT
Z- score	Banking sector risk taking culture of each country (as of 2017)	World Bank
Largest 3/ total	The percentage share of the largest 3 banks in the total banking sector assets of each country (available as of 2017)	World Bank

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National Culture and Banks' Stock Market Volatility

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National Culture and Banks' Stock Market Volatility

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Abstract

We conduct a cross-country analysis to examine the impact of national culture on the vulnerability of European banks during the Covid-19 pandemic. Analyzing the stock market volatility of major banks, we explore differences in uncertainty avoidance and individualism levels across multiple European countries. Our results reveal that low uncertainty avoidance reduces the influence of Covid-19-related cases on bank volatility during the crisis peak. Even as the pandemic progresses and vaccinations become widespread, the effect of uncertainty avoidance remains significant. We also find that high individualism has a stabilizing effect on bank volatility, particularly after the start of vaccinations. This study contributes to understanding the role of national culture in shaping bank vulnerability to common stocks, such as the pandemic.

Keywords: Banks, Stocks volatility, National culture, Covid-19, Uncertainty avoidance, Individualism

JEL classification: G12, G21, Z10

1. Introduction

Banks play a crucial role in macroeconomic growth and overall well-being (Levine, 1997, 2005; Wachtel, 2001; Fink, Haiss, and Vukšić, 2005), but they are particularly vulnerable during times of extreme crises (Goodell, 2020). Banks hold long-term, illiquid assets such as loans and illiquid securities, which are financed by highly liquid liabilities like demand deposits and short-term debt. Negative shocks can lead to reduced credit availability or the need for banks to raise equity to maintain capital adequacy. If market participants perceive increased bank risks, it may trigger bank runs or regulatory intervention (Diamond and Dybvig, 1983). Financial stress in banks can also have a contagion effect on other industries, posing a threat to the broader economic system. Consequently, banks' riskiness is closely monitored by regulators, and banks are subject to heavy regulation.

One commonly used measure of banks' riskiness is their stock volatility, which is an important indicator of a firm's asset volatility according to contingent claims theory (Black and Scholes, 1973; Merton, 1974). Stock volatility is often used as a proxy for banks' total asset risk in many studies. For instance, Stiroh (2006) demonstrates that banks with greater reliance on activities generating non-interest income tend to have higher stock volatility. Anginer, Demirguc-Kunt, and Zhu (2014) examine the relationship between banks' stock volatility and deposit insurance during crisis and non-crisis periods.

Notable events over the past few decades, such as the October 1987 Monday crash, the Dot.com bubble of the 1990s, the global financial crisis of 2008, and the COVID-19 outbreak, have resulted in significant fluctuations in stock prices, challenging the conventional understanding of rational investors and standard financial models (Ball, 2009). The complexity of explaining market behavior during crises within the framework of rational investors has led researchers to seek behavioral explanations in the literature.

Differences in cultural values across countries have been linked to various behavioral biases and emotions (Schmeling, 2009) that influence investor preferences

regarding investment risks and profitability (Shefrin & Statman, 1985). Moreover, an extensive body of literature suggests that cultural differences shape investors' responses to new information (Dou et al., 2016) and may elucidate their preferences and tolerance for risk (Anderson et al., 2011; Chui and Kwok, 2008; Li et al., 2013).

This study examines the impact of national culture on the vulnerability of banks to global financial shocks. We analyze banks' stock volatility (referred to as bank volatility) during the Covid-19 outbreak and show that the association between bank volatility and Covid-19 cases depends on the national culture dimensions of the banks' home countries. To achieve this, we utilize a sample of 48 largest listed banks from 19 developed and emerging EU countries, along with Switzerland, the UK, and Turkey, which collectively account for approximately 60% of European banking assets as of 2019.

The choice to focus our analysis on European banks is motivated by several factors. Firstly, European banks experienced significant adverse effects during the Covid-19 outbreak (between December 1, 2019, and April 30, 2020). The Euro STOXX banks index dropped by 40.18%, followed by the STOXX North America 600 banks index (31.23%) and the STOXX Asia/Pacific 600 Banks Index (26.09%). This contraction in economic activity resulted in increased loan loss provisions and had an adverse impact on the credit quality of European banks, with some posting significant losses in Q1 2020 to address a potential surge in bad loans. Batten et al. (2022) demonstrate that the relationship between European stock returns and the fear index was higher during the Covid-19 period compared to the global financial crisis. Moreover, banks in European countries are more prone to shock transfers (Daly et al., 2019).

Secondly, while previous literature has explored the influence of national culture on a global scale, clusters of countries, such as those in Europe, may share common pan-regional cultural traits (Ronen and Shenkar, 1985; Smith and Schwartz, 1997). Additionally, combining the dimensions of Hofstede and Schwartz reveals culturally distinct regions (Steenkamp, 2001). Therefore, it is intriguing to examine whether cross-country cultural variations in Europe have a significant influence on bank risks (volatility). We hypothesize that national culture affects the stability of Europe's banking system and the sensitivity of banks to crises.

Finally, European banks are a suitable choice for this study due to the reliability of Covid-19 data in these countries. Our daily data analysis requires not only accurate Covid case numbers but also their correct reporting timing and investor confidence in the reported data. Sambridge and Jackson (2020) reported that Covid cases in most European countries are trustworthy, whereas in some other countries, they are not. Therefore, focusing on European banks provides a robust data sample for our empirical investigation.

We believe that the Covid-19 pandemic is well suited to our analysis due to its dynamic nature, including several waves of infections and the introduction of vaccinations. Using daily changes in Covid cases as an identification instrument, we investigate the effect of national culture on bank volatility. Additionally, we examine the level of heterogeneity in bank volatility in relation to national culture during the upswing and downswing of the pandemic crisis.

Our findings suggest that national culture plays a significant role in moderating volatility across different European markets, with varying effects during the peak of the crisis and in the vaccination period. Specifically, we find that individualism does not have a significant influence on volatility until the vaccination period, whereas uncertainty avoidance has a strong effect on volatility with respect to the growth in confirmed cases. These results indicate that during times of crisis, it may be safer to invest in banks from countries with lower uncertainty avoidance tendencies. However, during the vaccination period, bank volatilities are scaled down by the vaccination drive, and individualism exerts a strong effect on the sensitivity of European banks to the pandemic. This change in effect may be attributed to overconfidence and optimism biases. Our results are robust to several factors that could impact bank stock returns and are consistent with recent literature on the impact of national culture during crises.

The remainder of this paper is structured as follows: Section 2 provides a review of the related literature and outlines our research hypotheses. Section 3 describes the methodology, data, and descriptive statistics. Section 4 presents the empirical results. Finally, Section 5 provides concluding remarks.

2. Literature Review and Hypothesis Development

The Covid-19 pandemic has generated a growing body of literature exploring the various factors that impact stock markets and industries worldwide. However, while research on the non-banking sector has been abundant, studies on the banking sector's response to the pandemic have been scarce. Existing research has primarily focused on the general impact of Covid-19 on banks, with only a few studies investigating their specific response to the pandemic. For example, Demir and Danisman (2021) analyzed bank stock responses to government policies, while Mirzaei, Saad, and Emrouznejad (2020) investigated the link between the efficiency and stock performance of Islamic banks. van der Cruijsen et al. (2022) demonstrated that the COVID-19 pandemic did not significantly affect public trust in banks in the US and the Netherlands. Contagion between asset returns and volatilities were found to be higher during the pandemic (Maghyereh et al., 2022). Korzeb and Niedziółka (2020) investigated the importance of banks' financial standing, but their results were limited to a single emerging market. Therefore, to the best of our knowledge, no study has examined the impact of cultural norms and beliefs on banks' resilience to the Covid-19 pandemic.

Our goal is to fill this gap in the literature by examining the financial resilience of banks during the initial phase of the Covid-19 crisis (prior to the approval of the Pfizer vaccine) and throughout a longer period that includes vaccinations against Covid-19. Additionally, we aim to investigate any heterogeneity in bank responses to the crisis following the introduction of vaccinations. We designate the vaccination period as the downswing of the crisis because vaccinations have been demonstrated to have a positive effect on the economy. Qulici et al. (2015) conducted research on the connection between vaccinations and economic growth in Europe and concluded that effective vaccination programs in Europe contribute to the European Union's economy by reducing mortality and morbidity, resulting in increased consumption and gross domestic product. Furthermore, Ganslmeier et al. (2022) recently demonstrated that even at low vaccination rates, the deployment of COVID-19 vaccines has substantial benefits for both health and economic outcomes.

In traditional financial theory, investors are assumed to be rational, and changes in relevant risk are thought to result from movement in fundamental factors. However, cultural norms and beliefs can significantly influence people's values, attitudes, selective attention, and behaviors (Adler, 1997; Markus and Kitayama, 1991; Tse et al., 1988; Homer and Kahle, 1988). Two frameworks developed by Hofstede (1980, 1991, 2010) and Schwartz (1994, 1997) provide comprehensive measures of national culture. Hofstede's framework, which identifies six dimensions of cultural variation - uncertainty avoidance, individualism/collectivism, large/small power distance, masculinity/femininity, long/short-term orientation, and indulgence/restraint - is the most influential and widely cited (Hofstede, 2010). This study focuses on Hofstede's cultural dimensions of uncertainty avoidance and individualism/collectivism, which are the most commonly used parameters in the literature.

The first cultural dimension of Hofstede assesses how people handle uncertainty, given that future events cannot be predicted perfectly. Literature in psychology shows that an individual's perception of uncertainty and coping mechanisms are significantly influenced by the national culture in which the individual resides. For example, Hofstede (1983) found significant variation in the perceived level of uncertainty and the extent of uncertainty avoidance behavior (UAI) across national cultures. Investors from high UAI countries are more likely to reduce their exposure to riskier markets (Inklaar and Yang, 2012) and are less likely to invest in foreign markets (Anderson et al., 2011). In high UAI cultures, individuals consume more life insurance (Chui and Kwok, 2008), firms have more conservative cash-holding policies (Chen et al., 2015), engage less in risk-taking (Li et al., 2013), and require higher takeover premiums (Frijns et al., 2013). Therefore, there is ample evidence that members of societies with strong UAI are more sensitive to uncertainty and ambiguity and will tend to avoid facing stressful situations, leading to high fluctuations in security prices. Conversely, members of societies with weak uncertainty avoidance are relatively more tolerant of changes and willing to take risks. Thus, a country's financial markets and banks may be significantly affected by the degree of risk tolerance prevalent in that country's national culture. Based on this, the following hypotheses are proposed:

Hypothesis 1: European countries characterized by higher levels of cultural uncertainty avoidance are expected to exhibit greater bank volatility during the Covid-19 crisis compared to countries with lower uncertainty avoidance.

Hypothesis 2: The positive effect of Covid-19 cases on the volatility of European banks is mitigated by lower levels of cultural uncertainty avoidance.

Hofstede's second cultural dimension compares autonomy and collectivity. Autonomy describes cultures in which individuals are unique and independent in their thinking and actions, while collectivity emphasizes the solidarity of the group and the maintenance of the existing order. Social psychology studies (e.g., Shupp and Williams, 2008; Chui et al., 2010) argue that high individualism leads to overconfidence and a greater inclination for risk-taking activities. Empirical studies by Li et al. (2013), Mihet (2013), Kanagaretnam et al. (2014), Ashraf et al. (2016), and Boubakri et al. (2017) support this argument. Thus, we propose that in cultures characterized by strong individualism, investors may exhibit greater resilience to panic selling and maintain their financial position. Conversely, in cultures characterized by strong collectivism, we would expect herd buying and/or selling to amplify financial gains and losses.

Hypothesis 3: During the Covid-19 crisis, European countries characterized by stronger collectivism (weaker individualism) are expected to exhibit higher bank volatility compared to countries characterized by stronger individualism (weaker collectivism).

Hypothesis 4: The positive effect of Covid-19 cases on the volatility of European banks is mitigated by higher levels of individualism**.**

3. Methodology and Data

We collected daily data on confirmed Covid-19 cases and vaccination statistics from the Oxford Covid-19 Government Response Tracker database (OxCGRT) (Hale et al., 2020b) for the period from January 1, 2020, to September 21, 2021. To account for potential delays in data publication and their impact on capital markets, we applied a one-day lag. The daily returns of bank equities for the corresponding dates were obtained from the Investing.com database. We measured the cultural dimensions of uncertainty avoidance and individualism using Hofstede et al.'s (2010) scales (Ashraf et al., 2016; Ashraf and Arshad, 2017). Our sample consists of 20,653 bank-day

observations across 19 countries, with available banking data and the necessary scores for uncertainty avoidance and individualism.

Figure 2. Uncertainty Avoidance across European Countries

The figure depicts the uncertainty avoidance scores of Hofstede (2010) for 19 European countries. The highest score is 112 for Greece and the lowest score is 23 for Denmark.

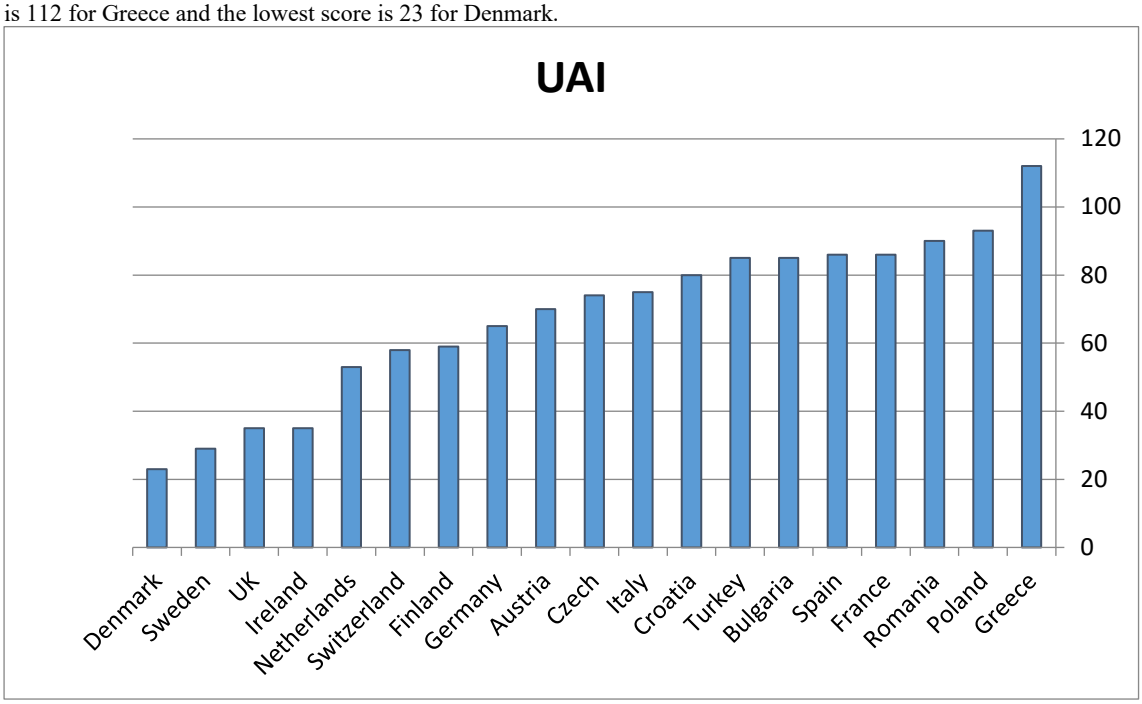
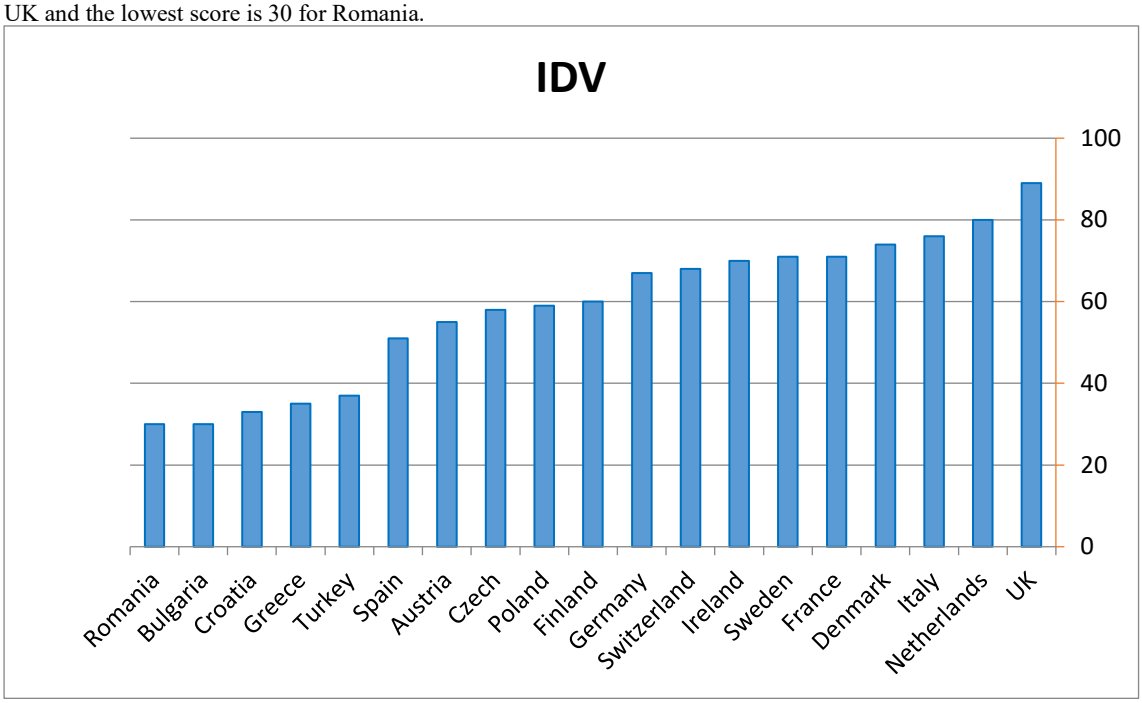


Figure 3. Individualism across European Countries

The figure depicts the individualism scores of Hofstede (2010) for 19 European countries. The highest score is 89 for UK and the lowest score is 30 for Romania.



Our sample includes 16 EU countries, along with the United Kingdom, Switzerland, and Turkey. As depicted in Figures 2 and 3, there are substantial variations in Hofstede's (2010) national cultural dimensions of uncertainty avoidance (UAI) and individualism (IDV) among the 19 countries. However, the deviation is more pronounced in UAI compared to IDV. Furthermore, emerging European economies tend to exhibit higher levels of uncertainty avoidance and lower levels of individualism, while developed European countries tend to demonstrate greater tolerance for risk and uncertainty (low UAI) and higher levels of individualism.

Cultural dimensions are considered invariant over time; hence, fixed-effect regressions cannot be used. To account for this, we specify a random-effects panel regression model to explain $V_{i,t}$ which is the volatility for bank i on day t, while controlling for time fixed effects:

$$V_{i,t} = \alpha + \beta_1 \cdot Culture_i + \beta_2 \cdot GrowthCase_{i,t-1} + \beta_3 \cdot GrowthCase_{i,t-1} \times Culture_i + \beta_4 \cdot Stringency_{i,t} + \sum_{k=5}^{k=9} \beta_k R_i^k \sum_{m=10}^{m=11} \beta_m I_i^m + \sum_{n=12}^{n=13} \beta_n M_i^n + v_t + u_i + \varepsilon_{i,t} \quad (1)$$

$$V_{i,t} = \alpha + \beta_1 \cdot Culture_i + \beta_2 \cdot GrowthCase_{i,t-1} + \beta_3 \cdot GrowthCase_{i,t-1} \times Culture_i + \beta_4 \cdot GrowthCase_{i,t-1} \times Vac_{i,t} + \beta_5 \cdot GrowthCase_{i,t-1} \times Vac_{i,t} \times Culture_i + \beta_6 \cdot Stringency_{i,t} + \sum_{k=7}^{k=11} \beta_k R_i^k + \sum_{m=12}^{m=13} \beta_n I_i^m + \sum_{n=14}^{n=15} \beta_y M_i^n + v_t + u_i + \varepsilon_t \quad (2)$$

In this study, we utilize two equations. The first equation (Equation 1) examines the impact of national culture on the relationship between bank volatility and the Covid-19 crisis, while controlling for time fixed effects. To do so, we introduce interaction terms, specifically $GrowthCase_{i,t-1} \times Culture_i$ into the random-effects panel regression model. The term $GrowthCase_{i,t-1}$ represents the percentage change in confirmed cases in the country of bank i, on the previous day. $Culture_i$ refers to the level of uncertainty avoidance or individualism in the bank's country, as measured by two alternative indices developed by Hofstede et al. (2010). Given their high correlation

(-0.71, sig 1%), the culture parameters are analyzed in separate regressions.[1] Our primary measure of volatility ($V_{i,t}$) is the natural logarithm of absolute daily returns, which are calculated by taking the percentage change of daily market prices for each bank, to account for both systematic and unsystematic risk (Rouatbi et al., 2021). To ensure the robustness of our findings, we employ two alternative measures of volatility: the absolute logarithm of market-adjusted excess returns (MacKinlay, 1997) and the absolute logarithm of mean-adjusted excess returns. In line with the market model proposed by MacKinlay (1997), we calculate daily bank returns in excess of the market returns using the STOXX 600 European Banking Index as the benchmark for the market portfolio. Additionally, we compute mean-adjusted returns by taking the difference between the daily bank returns and the average daily pre-crisis returns of 2019 for each bank.

The second equation (equation 2) includes the vaccination period, where $Vac_{i,t}$ is a dummy variable that takes a value of 1 during the vaccination period in the country of bank i and 0 otherwise. In this equation, we use the additional interaction terms, $GrowthCase_{i,t-1} \times Vac_{i,t}$ to capture the percentage change in confirmed Covid-19 cases from the previous day during the vaccination period and $GrowthCase_{i,t-1} \times Vac_{i,t} \times Culture_i$ to examine how national culture influences the reaction of banks to the volatility caused by the Covid-19 crisis during the vaccination period.

$Stringency_{i,t}$ represents the percentage change in the stringency index (source: OxCGRT) which measures the level of social distancing measures implemented by governments in each country, such as the closure of schools, workplaces, public places, and travel restrictions. We also include several control variables, including the primary year-end 2019 financial ratios (CAMEL) of sample banks denoted by R_i^k, where k is the number of explanatory variables. CAMEL ratios are a uniform financial rating system widely used in literature to anticipate the financial distress of individual banks (Boubakri et al., 2017; Betz et al., 2014, Galil et al. 2022). Specifically, capital adequacy is measured by the ratio of stockholders' equity to total assets, which provides a measure of the bank's ability to withstand financial losses and insolvency. Asset quality

[1] On the other hand, we did not find a high correlation between the growth in cases and cultural parameters, which were included in the same regressions as per previous research.

is represented by the ratio of nonperforming loans to total average loans, where a weaker asset quality increases the likelihood of bank distress and failure. Management quality is measured by the cost-to-income ratio, which reflects the operational efficiency of the bank. Profitability is represented by the ratio of net income to total assets (ROE). Lastly, liquidity is represented by the ratio of cash and cash equivalents to total assets.

In the same model, the term I_i^m represents the ZSCORE, a measure of sector-level risk-taking culture, and banking sector concentration (share of largest 3 banks) ratios per country obtained from the World Bank financial structure database, which respectively indicate financial stability (available as of 2017). According to Beck, Demirguc-Kunt, and Levine (2003), crises are less likely in more concentrated banking systems, consistent with the concentration-stability argument that banking systems characterized by a few large banks are more stable than less concentrated banking markets. The term M_i^n includes macroeconomic control variables such as per capita GDP and inflation.

Finally, the term v_t represents the time effect, u_i represents bank-specific random effects, and $\varepsilon_{i,t}$ represents observation-specific errors clustered by country. Our findings are also robust to country-level heteroscedasticity.

Table 1 shows the summary statistics for the main variables used in the regressions during the sample period from January 1, 2020, to September 21, 2021. The dependent variable Log |R|, Log |Rmarket| and Log |Rmeanadj| (volatility) in Table 1 yield consistent results with those of Zaremba et al. (2020), with mean values of -4.45, -4.89 and -4.56, and medians of -4.34, -4.73, -4.38, respectively. The minimum and maximum values of -9.2 (or -13.7, -13.7) and -1.2 (or -0.98, -1.0) also suggest large fluctuations in the log of daily market returns (or abnormal returns).

We observe a significant range in the values of both uncertainty avoidance (UAI) and individualism (IDV) indices across countries, spanning from 21 to 112 for UAI and from 30 to 89 for IDV. Higher values indicate greater nationwide risk aversion or stronger individualism, which are expected to have a negative or positive impact on volatility, respectively. Furthermore, we note a substantial standard deviation for the growth in confirmed cases across countries, with a mean value of 3% (median 0.5%) and

a standard deviation of 17.5%. To eliminate potential outliers, we winsorized the growth in cases at the 1st and 99th percentiles.

Lastly, the percentage change to the Stringency index has a mean value of 0.45%, with the highest value at 200% and the lowest at -52%. This suggests that the stringency measures were likely more severe in the early stages of the crisis compared to later periods, indicating a lack of consistency in the application of these measures across European countries.

Table 1. Summary Statistics of 48 European banks

(Jan 2020-sep2021)	**Median**	**Mean**	**Std. Dev**	**Min**	**Max**
Volatility Log|R|	-4.335	-4.452	1.120	-9.210	-1.204
Volatility Log|Rmarket|	-4.733	-4.890	1.302	-13.720	-.9799
Volatility Log|Rmeanadj|	-4.378	-4.561	1.310	-13.652	-1.007
Growth cases	.0052	.0311	.1725	-.2649	7
UAI	74	68.88	23.95	23	112
IDV	60	59.41	17.15	30	89
Loss Prov.	.0027	.0068	.0093	.0002	.0450
Manag. Eff	.8447	.8060	.1100	.0057	1.070
ROE	.0783	.0843	.0395	.0124	.2017
Liquidity	.0956	.1144	.0664	.0152	.3107
Capital Adeq	.0685	.0787	.0292	.0355	.1408
Sector ZSCORE	12.06	13.77	6.352	5.244	26.40
Largest 3/ total	65.26	66.66	16.19	39.35	94.17
Stringency	0	.0045	.0714	-.520	2
GDP per Capita	38605.6	37797.59	11470.47	18563.3	67335.3
Inflation	.013	.023	.034	.003	.152

Table 2 provides a comparison of three volatility measures as the dependent variable and the growth in confirmed cases as the primary independent variable for countries with UAI scores above and below the median. The analysis encompasses two periods: the first period from January 2020 to November 9, 2020 (the date of the third stage Pfizer vaccine approval), and the subsequent period until September 21, 2021. The results indicate that banks' volatility was relatively high prior to the third stage Pfizer vaccine approval, potentially due to increased uncertainty at the onset of the pandemic.

However, the percentage growth in cases declined following the commencement of vaccinations, suggesting that vaccines may have contributed to a reduction in financial turmoil in the markets.

Furthermore, the analysis reveals that the volatility of banks in countries with low UAI scores (below the median) is relatively lower compared to that in countries with high UAI scores, both before and after the vaccination period. Low UAI countries also exhibit a lower rate of growth in cases in comparison to high UAI countries, which may explain the disparities in volatility. However, when adjusting the cases for population per million, it becomes evident that until the vaccination period, low UAI countries had a higher number of new cases than high UAI countries. These findings suggest that the relatively higher resilience to risk in low UAI countries may contribute to the stabilization of their markets. For example, during the vaccination period and in countries with UAI scores below the median, all of the volatility parameters (Log |R|, Log |Rmarket|, and Log |Rmeanadj|) exhibit minimum mean values of -4.8, -5.2, and -4.9 (median: -4.7, -5.0, -4.7) respectively. In contrast, prior to vaccinations and in countries with UAI scores above the median, these parameters display maximum mean values of -4.2, -4.6, and -4.4 (median: -4.1, -4.5, and -4.2) respectively.

Table 2. Summary Statistics, before& after vaccination period

	Before vaccination period		**After vaccination period**	
UAI> median	**Median**	**Mean**	**Median**	**Mean**
Volatility Log|R|	-4.122	-4.218	-4.431	-4.539
Volatility Log|Rmarket|	-4.480	-4.640	-4.753	-4.906
Volatility Log|Rmeanadj|	-4.152	-4.351	-4.486	-4.696
Growth cases	.0141	.0660	.0037	.0063
UAI< median	**Median**	**Mean**	**Median**	**Mean**
Volatility Log|R|	-4.186	-4.315	-4.667	-4.790
Volatility Log|Rmarket|	-4.689	-4.857	-5.023	-5.197
Volatility Log|Rmeanadj|	-4.211	-4.391	-4.701	-4.881
Growth cases	. 0093	.0591	.0035	.0062

4. Results

Our primary objective is to examine the influence of national culture on the volatility of banks' stock prices across different European markets during the Covid-19 pandemic, specifically from January 2020 to September 2021, and how this influence changes after the introduction of vaccinations. To achieve this, we utilize the uncertainty avoidance (UAI) and individualism (IDV) indices as key explanatory variables in our regression models. We commence by analyzing the period before the positive news of the third stage approval of the Pfizer vaccine on November 9, which had a favorable impact on financial markets. Our empirical findings are presented in Columns 1 and 2 of Table 3. Additionally, we examine the initial stage of the crisis (from January 1 to April 30, 2020) in Columns 3 and 4 to ensure the consistency of our results with prior research (Ashraf, 2021).

The results reveal that the coefficients on uncertainty avoidance (UAI) are positive and statistically significant at the 1% level, indicating that bank stock investments are riskier in countries with higher uncertainty avoidance. Furthermore, we find a significant and negative association between volatility and individualism in Column 2. Although the effect of individualism in Column 4 for the period between January and April 2020 is not statistically significant, it is negative, suggesting that the decline in banks' volatility was greater in countries with higher individualism. This implies that in countries characterized by more independent thinking and decision-making, investors are more self-confident and resilient to risks, leading to lower price fluctuations and reduced investment risk in bank equities.

Our results suggest that cultural differences can result in significant variations in banks' volatility over the long term (January to November). For instance, banks in Denmark, with the lowest level of uncertainty avoidance in our sample, exhibit 56% less volatility compared to banks in Greece, which has the highest uncertainty avoidance index. Similarly, banks in the UK, which has the highest level of individualism, demonstrate 37% less volatility than banks in Romania, which has the lowest individualism index (refer to summary statistics Table 1 for minimum and maximum UAI and IDV figures).

Table 3. The effect of national culture on European banks' volatility during the Covid-19 crisis (before 3rd stage approval of Pfizer vaccine)

The table reports the results of the impact of uncertainty avoidance (UAI) and individualism (IDV) on the volatility of European banks during the Covid-19 crisis using the random-effects panel regression model controlling for time fixed effects. The dependent variable is the volatility of stock market returns of banks from 19 major European countries, defined as the natural logarithm of changes in daily stock prices. The main independent variables are the uncertainty avoidance and individualism indices of Hofstede et al. (2010), daily percentage change of Covid-19 confirmed cases for each country concerned and the interaction term, Growth cases×UAI (or Growth cases ×IDV). The control variables are sample banks' primary year-end 2019 financial ratios (CAMEL). We use the per capita GDP and inflation as macro control variables and for banking sector control variables; we employ sector banking concentration (largest 3/ total) and ZSCORE ratios, which respectively indicate efficiency and bank risk taking culture (available as of 2017). In addition, we check the effect of changes in stringency index, which represents government social distancing measures in each country. The coefficient estimates for each variable have corresponding heteroscedasticity-robust t-values in parentheses, **,*** indicate significance at the 5 and 1 percent significance levels, respectively.

	Jan-Nov		Jan-Apr	
Volatility Log|R|	**(1)**	**(2)**	**(3)**	**(4)**
Growth cases	.0115	**.8703****	.0384	**1.241*****
	(0.22)	**(2.11)**	(0.75)	**(2.61)**
UAI	**.0063*****		**.0041*****	
	(7.76)		**(2.51)**	
IDV		**-.0064*****		-.0034
		(-5.22)		(-1.42)
Growth cases × UAI	**.0079*****		**.0087*****	
	(3.06)		**(3.20)**	
Growth cases × IDV		-.0091		-.0130
		(-1.45)		(-1.72)
Loss Prov.	**12.99*****	**12.29*****	**18.80*****	**17.10*****
	(4.46)	**(4.11)**	**(3.72)**	**(3.35)**
Manag. Eff	.1269	.2258	.4083	.5060
	(0.81)	(1.45)	(1.50)	(1.87)
ROE	**-1.704*****	**-2.175*****	-1.464	**-1.852****
	(-3.83)	**(-4.83)**	(-1.88)	**(-2.37)**
Liquidity	-.1762	**-.4731*****	-.1429	-.4627
	(-1.05)	**(-2.71**)	(-0.42)	(-1.33)
Capital Adeq	-.9367	-.8849	-.4726	-.4265
	(-1.47)	(-1.30)	(-0.36)	(-0.31)
Sector ZSCORE	-.0026	**.0056*****	.0018	**.0079****
	(-1.12)	**(2.74)**	(0.39)	**(2.01)**
Largest 3/ total	**-0046*****	**-0084*****	-0011	-0037
	(-4.77)	**(-8.09)**	(-0.57)	(-1.82)
Stringency	1247	. .1369	.0366	.0568
	(1.18)	(1.30)	(0.32)	(0.50)

Time fixed effects	Yes	Yes	Yes	Yes
Observations	8350	8350	2321	2321
Banks	48	48	48	48
R-squared	0.33	0.33	0.40	0.39

The interaction terms between uncertainty avoidance and individualism, which represent the moderating impact of culture on bank volatility, yield varied results. The interaction coefficient for uncertainty avoidance is positive and significant at the 1% level, indicating that the increase in bank volatility due to the daily rise in confirmed COVID-19 cases is mitigated or amplified by a decrease or increase in UAI. However, the impact of the growth in confirmed cases on volatility does not appear to be sensitive to individualism, as the interaction coefficient estimate for IDV is not significant in both periods. Our findings underscore the importance of culture, more specifically, uncertainty avoidance in mitigating the contagion risk during extreme shocks in the European banking environment. This is despite the strong correlations observed in shock transfers between European countries' banking systems (Daly et al., 2019).

We also conducted a "placebo test" by using the number of COVID-19 cases without a one-day lag. The coefficients of the interaction variables became statistically non-significant, suggesting that the reporting of COVID-19 cases is responsible for the observed changes in volatility. Due to brevity, the results are not presented.

Furthermore, the regression results indicate significant associations between certain financial ratios, such as asset quality and profitability ratios, and bank concentration ratios at the sector level, with the risks related to bank stock performance, in line with previous research. For instance, Bekaert et al. (2012) argue that corporate variables are among the most crucial determinants of aggregate idiosyncratic volatility, alongside index composition and business cycle variables. The "concentration-stability" hypothesis posits that banking systems with fewer banks are more efficient and possess greater resources, serving as a buffer during financial crises (Beck, Demirgüç-Kunt, & Levine, 2003). Additionally, higher bank concentration contributes to improved access to loans and deposits, enhancing financial stability (Owen & Pereira, 2018).

Table 4. The effect of UAI on the relationship between the sample banks' volatility and the Covid-19 crisis (incl. vaccination period, Jan2020-Sep 2021)

The table reports the results of the impact of UAI on the volatility of European banks before and after vaccinations using the random-effects panel regression model controlling for time fixed effects. Three volatility parameters are used as dependent variable namely; Log[R], Log[Rmarket] and Log[Rmeanadj] (see appendix1 for the definitions). Growth cases × Vaccination denotes the daily percentage change of Covid-19 confirmed cases during the period of vaccinations, whereas Vaccination is a dummy variable that takes the value of 1 in the days with vaccinations or otherwise zero. The interaction term, Growth cases × UAI shows the moderating impact of culture for the whole analysis period. The interaction term, Growth cases × Vaccination × UAI indicates the same for the period of vaccinations, The control variables are sample banks' primary year-end 2019 financial ratios (CAMEL). We use the per capita GDP and inflation as macro control variables and for banking sector control variables; we employ sector banking concentration and ZSCORE ratios, which respectively indicate efficiency and bank risk taking culture (available as of 2017). In addition, we check the effect of changes in stringency index, which represents government social distancing measures in each country. The coefficient estimates for each variable have corresponding heteroscedasticity-robust t-values in parentheses, **,*** indicate significance at the 5 and 1 percent significance levels, respectively.

	Log[R]		**Log[Rmarket]**		**Log[Rmeanadj]**	
	(1)	(2)	(3)	(4)	(5)	(6)
UAI	**.0049*** **	**.0047*** **	**.0030*** **	**.0027*** **	**.0052*** **	**.0052*** **
	(8.22)	**(7.71)**	**(4.13)**	**(3.68)**	**(7.79)**	**(7.41)**
Growth cases	**-.**3941	**-.**4539	-.4348	**-.**5464	-.7688	**-.8168****
	(-1.08)	(-1.24)	(-0.97)	(-1.22)	(1.87)	**(-1.98)**
Growth cases × UAI	**.0094****	**.0099****	**.0118****	**.0127****	**.0161*** **	**.0164*** **
	(2.10)	**(2.19)**	**(2.16)**	**(2.31)**	**(3.19)**	**(3.22)**
Growth cases × Vaccination		2.733		.2636		3.553
		(0.59)		(0.48)		(0.71)
Growth cases × UAI × Vaccination		.0516		.1628		.0351
		(0.70)		(1.35)		(0.42)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Control variables: CAMEL, Sector and Country ratios						
Observations	18102	18102	18861	18861	18871	18871
Banks	48	48	48	48	48	48
R-squared	0.30	0.30	0.17	0.17	0.27	0.27

We expanded our analysis to include the vaccination period and examined how the relationship between volatility and the growth in confirmed cases is influenced by national-level culture in light of positive news regarding the pandemic.

The UAI and IDV results are presented in Tables 4 and 5, respectively. To ensure the robustness of our findings, we used three volatility parameters (Log|R|, Log|Rmarket|, and Log|Rmeanadj|) as dependent variables. We introduced a dummy variable called "Vaccination," which takes a value of 1 on days with vaccinations and 0 otherwise, to explore the moderating effect of national culture on volatility during both the vaccination and non-vaccination periods. The interaction term Growth cases × UAI (or Growth cases × IDV) represents the overall moderating impact of culture, while Growth cases × UAI × Vaccination (or Growth cases × IDV × Vaccination) indicates the change in this effect during the vaccination period.

The UAI coefficients in Table 4 validate our initial findings from Table 3, as they remain statistically significant at the 1% level in all regressions. Additionally, the positive and significant interaction coefficients for the entire period confirm that lower UAI helps mitigate the increase in banks' volatility resulting from the growth in confirmed cases. However, the interaction terms during the vaccination period are not statistically significant, suggesting that the moderating role of UAI on the crisis's effect persists even during days of vaccination.

Table 5 demonstrates that IDV coefficients are consistently negatively associated with the volatility of bank returns, consistent with the findings in Table 3. However, the impact of the growth in confirmed cases on volatility does not appear to be sensitive to individualism, as the Growth cases × IDV coefficients are not statistically significant in four out of six regressions. The non-significant interaction terms of individualism for the overall period align with the results in Table 3, indicating that individualism may have played a minor role in controlling the influence of the pandemic on volatility during the peak of the crisis. However, we observe a significantly moderating impact of higher individualism on the relationship between the growth in cases and volatility during the period of positive news and vaccinations. The Growth cases × Vaccination × IDV interaction term is consistently negative and significant at the 1% level for all volatility parameters. These findings support social studies by Shupp and Williams (2008) and Chui et al. (2010), suggesting that high individualism leads to

overconfidence and a greater incentive for risk-taking activities, particularly during periods of positive expectations.

Table 5. The effect of IDV on the relationship between the sample banks' volatility and the Covid-19 crisis (incl. vaccination period, Jan2020-Sep 2021)

The table reports the results of the impact of IDV on the volatility of European banks before and after vaccinations using the random-effects panel regression model controlling for time fixed effects. Three volatility parameters are used as dependent variable namely; Log[R], Log[Rmarket] and Log[Rmeanadj] (see appendix1 for the definitions). Growth cases × Vaccination denotes the daily percentage change of Covid-19 confirmed cases during the period of vaccinations, whereas Vaccination is a dummy variable that takes the value of 1 in the days with vaccinations or otherwise zero. The interaction term, Growth cases × IDV shows the moderating impact of culture for the whole analysis period. The interaction term, Growth cases × Vaccination × IDV indicates the same for the period of vaccinations, The control variables are sample banks' primary year-end 2019 financial ratios (CAMEL). We use the per capita GDP and inflation as macro control variables and for banking sector control variables; we employ sector banking concentration and ZSCORE ratios, which respectively indicate efficiency and bank risk taking culture (available as of 2017). In addition, we check the effect of changes in stringency index, which represents government social distancing measures in each country. The coefficient estimates for each variable have corresponding heteroscedasticity-robust t-values in parentheses, **,*** indicate significance at the 5 and 1 percent significance levels, respectively..

	Log[R]		**Log[Rmarket]**		**Log[Rmeanadj]**	
	(1)	(2)	(3)	(4)	(5)	(6)
IDV	**-.0075*** **	**-.0067*** **	**-.0098*** **	**-.0089*** **	**-.0029*** **	**-.0020** **
	(-9.08)	**(-7.43)**	**(-9.29)**	**(-8.07)**	**(-2.94)**	**(-1.97)**
Growth cases	**-.**1109	**.**0436	**1.403*** **	**1.496*** **	.7104	**.**8129
	(-0.27)	(0.11)	**(2.73)**	**(2.90)**	(1.43)	(1.63)
Growth cases × IDV	.0063	.0032	**-.0177** **	**-.0202*** **	-.0065	-.0087
	(1.00)	(0.50)	**(-2.22)**	**(-2.51)**	(-0.86)	(-1.14)
Growth cases × Vaccination		**39.11*** **		**37.71*** **		**29.66*** **
		(4.42)		**(3.37)**		**(2.81)**
Growth cases × IDV × Vaccination		**-.5273*** **		**-.4455*** **		**-.3796*** **
		(-4.02)		**(-2.71)**		**(-2.46)**
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Control variables: CAMEL, Sector and Country ratios						
Observations	18102	18102	18861	18861	18871	18871
Banks	48	48	48	48	48	48
R-squared	0.30	0.30	0.17	0.17	0.27	0.27

Our results indicate that the influence of national-level culture, as captured by uncertainty avoidance (UAI) and individualism (IDV), on the relationship between

COVID-19 cases and volatility is not uniform across the entire pandemic period. Specifically, we find that UAI has a stronger impact during the height of the crisis, whereas IDV becomes more influential during the vaccination period, when positive events are taking place. These findings suggest that the role of cultural factors in shaping the dynamics between cases and volatility varies depending on the stage of the pandemic.

5. Conclusion

This study examines the impact of national culture on the volatility of European banks during the Covid-19 crisis. It is the first study to investigate the influence of national culture on the riskiness of publicly traded banks during a global crisis. The results reveal a statistically significant difference in volatility among European banks based on varying levels of uncertainty avoidance and individualism, indicating the importance of culture from a regional perspective. These findings remain robust even after controlling for firm-specific, sector-related, and macroeconomic factors. The results are consistent with behavioral literature, which emphasizes the role of attitudes and beliefs in explaining large market movements beyond rational investor behavior.

Additionally, the study finds that low uncertainty avoidance moderates the impact of adverse shocks on the volatility of European banks during the crisis peak, while ongoing vaccinations mitigate the pandemic's effects in later stages. In this sense, the observed interconnectedness between banking entities operating in different countries and the systemic risk spill over mechanism are influenced by culture. In contrast, high individualism contributes to stability in volatility following the vaccination drive, but it is not significantly effective in moderating the impact of Covid-19 on bank volatilities during the financial turmoil.

This research provides valuable insights into the behavior of equity investors in the banking sector during economic and financial crises and highlights behavioral differences based on two key cultural dimensions. Portfolio managers and financial advisers can leverage these findings to enhance their understanding of trading decisions in European banking equities and develop improved policies for including banking stocks

or related indices in investment portfolios. Overall, this study offers comprehensive insights into the impact of national culture on banks' volatility, enabling policymakers to make more informed decisions.

Appendix-Definition and source of variables.

Variable	Definition	Source
Log[R]	The logarithm of absolute daily returns of 48 European banks	investing.com
Log[Rmarket]	The logarithm of residual daily returns of 48 European banks from the market model using STOXX® Europe 600 banks index	investing.com and STOXX
Log[Rmeanadj]	The logarithm of mean adjusted residual daily returns, computed by subtracting daily stock market returns by the mean of returns during the entire year of 2019.	investing.com
Growth cases	Percentage growth in cumulative cases in t-1 between 1st of January 2020 and 21st of September 2021	OxCGRT
Vaccination period	Vaccination days of each country between 1st of January 2020 and 21st of September 2021	IVADO, Canada
UAI	Hofstede's cultural index on uncertainty avoidance.	Hofstede(2010)
ROE	Return on equity, which is defined as net profit as a percentage of equity of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
Capital Adeq	The capital adequacy, which is measured by stockholders' equity to total assets ratio of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
Loss Prov.	The asset quality, which is represented by the share of nonperforming loans to total average loans. of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
Manag. Eff	Management quality, which is defined by cost to income ratio of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
Liquidity	Liquidity, represented by the ratio of cash and cash equivalents to total assets. of a bank as of 2019, before the start of the covid crisis	investing.com and financial statements
GDP per Capita	Gross Domestic Product (GDP) of a country divided by its total population as of 2019, before the start of the covid crisis	OxCGRT
Inflation	Annual growth rate of the consumer price index of a country as of 2019	Statista
Stringency	The percentage change in daily stringency index, which shows the level of government social distancing measures in each country, such as closure of schools, work places, public places and travel restrictions.	OxCGRT
Z- score	Banking sector risk taking culture of each country (as of 2017)	World Bank
Largest 3/ total	The percentage share of the largest 3 banks in the total banking sector assets of each country (available as of 2017)	World Bank

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