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The Impact of the Financial and the Health Crisis on Listed Hotel Stocks

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Abstract

Travel and tourism represent one of the largest industries in the world as far as percentages of GDP and occupation are concerned, consequently, asset managers could be interested to select listed hotel stocks in their portfolios. The hotel industry has shown some difficulties not only in periods of financial, but also during the health crisis (Covid-19), when global and local restrictions on travel and tourism had a negative effect on the hotel sector. This study aims to analyze how listed hotel stocks could improve their contribution to portfolio diversification in different stages of the market. First, we use a constraint mean-variance approach to analyze the effect of diversification, and then we study the difference in the performance of the hotel sector by using the Risk-Adjusted Performance (RAP) measure. We analyze three sample periods: a) the whole sample (01/2000-09/2021); b) the Financial Crisis sample (06/2007-06/2012) and c) the COVID sample (02/2021-09/2021). Our findings contribute to a good understanding of financial patterns in the hotel industry as an asset class at different stages and support our hypothesis of its possible positive contribution in terms of diversification and performance.

JEL classification numbers: G11, G12, G15
Keywords: Portfolio Management, Hotel Stocks, Financial Crisis, Health Crisis, Tourism.

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1. Introduction

The latest UNWTO World Tourism Barometer (2023) shows that international tourism recovered 63% of pre-pandemic levels. In 2022, Europe reached nearly 80% of pre-pandemic levels, while Asia and the Pacific reached only 23%, due to stronger pandemic-related restrictions. Even if, most experts (65%) believe international tourism will not return to 2019 levels until 2024 or later. We focus on hotel stocks asset class to analyze their contribution, in different stages of the market, in terms of the diversification of the portfolio. Our interest in this issue is based on the fact that when the economy falls, some discretionary expenses such as holidays are among the first to be cancelled and therefore, we believe that hotel stocks are cyclical and sensitive to economic trends.

Prior to the last crisis in the sector, caused by the restrictions linked to the Covid 2019 pandemic, the World Bank (2018) showed that there were 1,2 billion international travelers in 2017 and that this number will increase to 1,8 billion by 2030. These numbers would confirm that travel and tourism make up one of the largest industries in the world as far as percentage of GDP and occupation are concerned.

We remember that in the past, the global hospitality industry was subject to a large variety of crises. Around 2000 and 2015, significant disrupting incidents include the terrorist attacks of 11 September 2001, the global economic crisis that occurred in 2008 and the last pandemic in 2020. All these also contributed to a longer-term downturn in global tourism and hospitality growth, thereby decreasing foreign arrivals.

Nevertheless, tourism generates a transversal productive chain and includes, in addition, comparative advantages for women seeking employment. Technology has improved the interests and the opportunities for both travelers and producers. In the last few years, technology, and online travel agencies such as Expedia, TripAdvisor and Booking Holdings have played a big and unpredictable role in shaping the current state of travel and booking organizations.

The innovation has had a “ripple effect” throughout the tourism and hospitality industry, challenging traditional tourism supply and adding another layer of intricacy to an already complex sector.

In accordance with this rationale, we will examine if hotel stocks provide an opportunity for diversifying our financial portfolio. Particular attention is paid to understanding if there is any connection between when nations are faced with economic crises and the reduction in personal travel and business budgets.

This paper - with respect to previous literature - examines a significant sample in terms of the number of monthly stock prices over the period from January 2000 through September 2021 and local stock markets. Most of the previous scholars investigate unlisted companies (Kosová and Enz, 2012), hospitality indexes (and not single securities e.g., Chen, 2012), or small samples and single local markets (Kirill et al., 2018; Chen et al., 2005; Chen, 2007; Borghesi et al., 2015; Lee and Upneja, 2007).

Then we explicitly consider the changes which occur because of the Global Financial Crisis and the Pandemic (Covid 19) in terms of the diversification effect connected to hotel stock.
This paper is organized into the following parts: a) related literature, b) data, methodology and results, c) conclusion.

2. Related Literature

Asset managers have often chosen to exclude hotel properties from traditional real estate sectors, because they differ from typical real estate investment criteria in some ways. Hotel properties are often highly leveraged operationally due to their high maintenance and staffing needs. Moreover, the volatility of the accommodation industry reflects unsteady income streams even for high-profile city locations with established brand names. Pfeffer (2009) showed that these factors have disincentivized some real estate investors from hotel investments.
In the 2000s, the presence of two significant events explains the above- mentioned slackening: the terrorist attack against the Twin Towers in New York (on 11 September 2001) and the important global financial and economic crisis (2008).
Bloom (2009) examines the performance of hotel stocks relating to specific market indices. This investigation must assess whether future performance relating to market indices is in line with the perceived risk associated with those stocks as determined by beta. The results of this study indicate that both CAPM beta and Fama-French three-factor beta are very poor estimators of hotel stock performance in the downturn of 2008.
Some researchers have analyzed the impact of the global financial crisis on the Hospitality sector. Kosova et al. (2012), by using data on 34,695 hotels in the United States from 2000 to 2009 deploy a longitudinal modelling approach to assess the impact of two shocks, the 9/11 terrorist attack, and the financial crisis on hotel-performance metrics (hotel occupancy, average daily rate, and revenue per available room.) After checking for numerous factors including hotel heterogeneity (i.e., hotel fixed effects) and market characteristics such as seasonality, and macro-level changes, results show that both external shocks have a significant immediate impact on hotel performance. The effects of the financial crisis take longer to develop with respect to the 9/11 event but are less striking and apparently well handled by most hotel managers. According to the authors, it is also possible that, as they could depend on hotel firm-specific effects, the impact of such shocks is overstated, and hotels adjust relatively quickly. What’s more the related adjustments may vary across locations and segments. The hospitality industry, treated as an asset class, is not well understood because of its complexity and often this causes stock undervaluation (Lee and Upneja, 2007; Kim and Jang 2012).

3. Data and methodology

3.1 Data

The hotel stock data is collected from Thomson Reuters Datastream and consists of monthly stock prices over the period from January 2000 through September 2021. We clarify that the hotel stocks included in the sample are filtered by all listed stocks, (only active and ordinary share type), that are publicly traded worldwide for the sample period.

We start from the hotel and lodging companies included in the sample which are identified by looking for firms with the Standard Industrial Classification corresponding to the GICS Sector - Consumer Discretionary, Consumer Services, Hotels, Restaurants & Leisure, Hotels, Resorts & Cruise Lines; and the TRBC Sector - Hotels, Motels & Cruise Lines (NEC) and Hotels & Motels. Initially, 2760 companies were extracted. First, we drop all the companies not listed as ordinary shares and we obtain 1956 stocks. Secondly, we only consider the stocks with information which is available in terms of stock price during at least one year in the sample period (843 stocks). Those with missing or incomplete data with respect to balance sheet variables are removed from the sample which results in 366 stocks. Finally, we remove all double-listed stocks, that is, companies that are listed in more than one stock market. In this way we avoid duplicating information. The final count is 46 equity hotel companies.

We build an equally weighted portfolio (EW) to synthesize the financial performances of hotel stocks and then we consider this portfolio as a new asset class in a hypothetical asset allocation process.

According to Paea and Sabbaghi (2015) the difference between an equally and a value-weighted portfolio is positive when the economy is growing and negative when the economy is in contraction, because of the systematic risk. That is why we compare hotel asset class both as equally weighted portfolio and value- weighted portfolio (S&P 1500 Hotels Restaurants & Leisure Industry Index).

We specify that health emergencies hit the tourism and hotel industry in a special way. In this context, we remember that SARS which emerged in China in 2002-2003 strongly affected the tourism industry compared to other sectors (Dombey, 2003) and H1N1, a new influenza virus that emerged in Mexico in 2009, which impacted the behavioral intention of potential international tourists as argued by Lee et al. (2012).

COVID-19 is widespread around the globe and does not only affect economies at local levels, but also industries where the maintenance of social distancing is more problematic.

Nonetheless, the financial crisis hits the tourism and hotel industry at a worldwide level. For these reasons, we focus on and compare these two periods from the correlation perspective.

We investigate the changing dynamics during the financial crisis and COVID-19 periods considering the following risk-adjusted performance (RAP) measures: Sharpe, Treynor and Sortino.

When choosing to build our portfolios, we select three macro-categories: equity, bond, and commodity. The first two are the typical traditional assets, while commodities represent a good choice during the financial crisis. For this reason, we choose to use S&P 500 COMPOSIT, STOXX EUROPE 600, MSCI EM U$, FTSE GLOBAL 100, TOPIX as equity indexes; then US BENCHMARK 10 YEAR, JP BENCHMARK 10 YEAR, BENCHMARK 10 YEAR DS GOVT, EMU BENCHMARK 30 YEAR and ICE BofAML Emerging Markets as bond indexes; and finally Crude Oil-WTI and S&P GSCI Gold Total Return as commodity indexes.

3.2 Mean-Variance approach

To examine the contribution of EW in terms of diversification, first we simulate asset allocation processes over a twenty-year period and successively we study how the presence of EW can affect investor decisions. We apply a mean-variance model as a decision process, where the benefits of diversification are caught in the reduction of the overall risk (Statman, 2004). In the Markowitz mean-variance model, investors choose assets in their portfolio at the lowest possible risk for any given target rate of return (see Markowitz, 1952, 1959, 1987).
The optimization problem can be summarized by the following formulas.

$$\sum_{i=n}^{N} \sum_{j=1}^{N} w_i w_j \sigma_{i,i} \quad (1)$$

Subject to:

$$\sum_{i=1}^{N} w_i \mu_i = R^*$$

$$\sum_{i=1}^{N} w_i = 1$$

$$0 \leq w_i \leq 1 \quad (2)$$

Where N is the number of asset classes, μ_i is the expected return of i-th asset class, $\sigma_{i,i}$ is the covariance between asset class i-th and j-th, R^*it the desired expected return, $w_i$is the weight of the asset class in the portfolio.
We build the efficient frontier for each period using historical returns (μ_i) as inputs and covariance matrix ($\sigma_{i,i}$) calculated on the last year's data. Then, we select from the efficient frontier, the weight vector corresponding to the mean expected return (w*) instead of the investors' risk tolerance.
According to Benninga (2006), μ_i can be viewed as the historic average return of the asset classes over a given period.
We also consider a quantity constraint as an upper boundary allowed for the allocated proportions to each asset class in the building of an efficient frontier as

first suggested by Lee & Mitchell (1997). Among the many issues connected to the mean-variance approach, both practitioners and academics use quantitative constraints and cardinality to solve unrealistic assumptions. More advanced algorithms are used to constrain portfolio selection problems (Mansouri et al., 2011) We use the exact approach, considering the small number of investable assets, by introducing the following quantitative constraint.

$$w_i \leq c \tag{3}$$

We study the performances of constraint portfolios by applying three thresholds (c) to avoid excessive concentration in portfolios: 20%, 30% and 40%.
To test the portfolio performance of the mean-variance approach, we also follow a rolling-window approach like the one proposed by Gilli and Schumann (2011) on both a monthly and daily basis. This means the procedure is repeated by moving the time window one month ahead and considering the last year's data as input at each repetition of the process (according to Fotiadis et al., 2021).
By using this procedure, we rebalance the portfolio allocation each month and calculate the performance the for the following month, by multiplying w* - calculated at the time t – to the stock returns vector obtained at time t+1. We do not consider the transaction costs in our models.

4. Results

In table 1 – Panel A, the negative mean return obtained in 2002 and the other negative measures are caused by the SARS outbreak, which distressed the hotel industry, especially in Asia (-1.38% and -15.38% for Treynor and Sharpe ratios). Also, for the 2008-2011 and 2018 years, we find negative results, due to the financial crisis and economic slowdown. In 2018, the S&P 500 index finished the year down about 6 per cent, as did the major indices in Europe and most Asian markets. China's weakening growth, Brexit effects and oil prices are some of the factors that affect market financial performance and world economic growth.
In terms of RAP measures, the EW portfolio during 2020 reduces the Sharpe ratio (-0.99%), because the standard deviation rises more than the excess return and the free risk rate (we use JP BENCHMARK 10 YEAR DS GOVT monthly based), which also affects the Sortino Ratio, which becomes close to zero in the last years. These conditions amplify the rise of RAPs measures in 2021 (25.19%, 36.01% and 46.77% for Sortino, Treynor and Sharpe ratios, in the first 9 months of 2021).
The monthly mean returns of EW portfolios are positive for all three-period samples analyzed in table 1 - Panel B, also during the crisis and COVID periods (see Table 1 Panel B, 1.79%, 0.72% and 1.56% respectively for all periods, financial crisis and COVID samples). During the financial crisis sample, the mean return has shrunk by almost 60% compared to the long-run trend (1.79% vs 0.72%, Table 1). Although the pandemic was not yet over, the mean monthly return from February 2020 to September 2021 (COVID sample) was, therefore, more than twice as valuable as

the crisis period. From the risk side, as expected, we find high volatility during the crisis and COVID samples measured by monthly standard deviation. In fact, for the COVID sample, table 1 shows more pronounced volatility compared with the financial crisis sample (10.11% vs 8.25%). In addition, if we consider downside risk, the tracking error between the financial crisis and COVID is higher during the pandemic.

All these observations suggest that for the hotel industry, the COVID impact is not only stronger when compared with long-run trends, but also when compared to global benchmarks (the Downside side risk during the COVID sample is 4.55%, whereas during the financial crisis sample, it is 2.66%). We believe that the hotel industry is one of the sectors affected by the Pandemic restrictions.

Starting from Table 1 and by analyzing 2021 from February to September, we find a very low Beta close to zero (0.065) and this is confirmed by the reduction in correlation (Table 2).

In table 3, we report the significance of correlations for three sample periods, and we find a general reduction versus equity indexes during the financial crisis and the COVID periods.

Table 1: Equally Weighted Portfolio Statistics

Panel A –by years									
	Mean	**Standard deviation**	**Max**	**Min**	**Beta**	**Downside risk**	**Sortino**	**Treynor**	**Sharpe**
2000	-2.19%	6.13%	7.70%	-11.39%	0.8326	6.80%	-21.79%	-3.19%	-43.35%
2001	1.36%	7.93%	9.30%	-20.27%	0.7777	5.68%	52.59%	1.24%	12.21%
2002	-0.74%	6.79%	11.95%	-10.67%	0.7788	4.67%	25.47%	-1.38%	-15.83%
2003	4.67%	7.00%	22.75%	-3.88%	-0.3439	7.19%	44.35%	-12.57%	61.76%
2004	6.67%	8.39%	19.08%	-3.48%	2.4400	8.75%	63.19%	2.59%	75.40%
2005	5.58%	5.90%	17.28%	-2.16%	0.7287	6.58%	74.93%	7.19%	88.78%
2006	3.51%	4.14%	10.20%	-4.28%	1.0729	3.24%	70.77%	2.89%	74.80%
2007	1.87%	5.65%	12.45%	-9.11%	0.7287	6.31%	11.46%	2.05%	26.40%
2008	-5.49%	10.21%	7.58%	-31.05%	1.3744	3.35%	-55.78%	-4.23%	-56.93%
2009	6.43%	9.92%	25.02%	-9.95%	1.3092	6.20%	69.61%	4.70%	62.02%
2010	3.31%	6.04%	12.94%	-12.68%	0.8960	4.46%	59.25%	3.38%	50.15%
2011	-1.02%	4.32%	8.17%	-7.31%	0.6467	2.04%	-61.98%	-1.98%	-29.70%
2012	2.79%	4.76%	10.43%	-6.40%	0.8772	3.69%	42.32%	2.99%	55.04%
2013	3.56%	4.03%	10.77%	-3.04%	0.9872	2.76%	70.03%	3.44%	84.36%
2014	0.69%	2.06%	4.66%	-1.93%	0.2100	1.69%	18.96%	2.19%	22.33%
2015	1.45%	5.96%	12.55%	-8.64%	0.9285	4.37%	35.30%	1.38%	21.52%
2016	0.28%	4.79%	6.80%	-11.78%	1.2112	1.68%	4.89%	0.12%	2.96%
2017	3.06%	2.43%	6.43%	-0.93%	0.7825	2.32%	56.58%	3.69%	118.66%
2018	-0.53%	4.15%	6.21%	-7.84%	0.6869	2.68%	-5.40%	-1.06%	-17.47%
2019	1.36%	3.69%	6.46%	-6.97%	0.8706	1.31%	-14.04%	1.28%	30.08%
2020	0.02%	13.00%	23.01%	-28.71%	1.2701	4.63%	-47.95%	-0.10%	-0.99%
2021	2.47%	5.12%	16.40%	-2.27%	0.0665	4.83%	25.19%	36.01%	46.77%
Panel B – by periods									
a) All sample	1.79%	6.88%	25.02%	-31.05%	1.0066	2.84%	46.82%	1.51%	22.11%
b) Financial Crisis Sample	1.79%	6.88%	25.02%	-31.05%	1.0066	2.84%	46.82%	1.51%	22.11%
c) COVID sample	0.72%	8.25%	25.02%	-31.05%	1.1747	2.66%	29.96%	0.34%	4.84%
a)-b)	1.56%	10.11%	23.01%	-28.71%	1.1416	4.55%	-2.93%	1.27%	14.30%
a)-c)	-0.83%	-1.86%	2.01%	-2.34%	0.0330	-1.89%	32.89%	-0.93%	-9.46%
b)-c)	-0.83%	-1.86%	2.01%	-2.34%	0.0330	-1.89%	32.89%	-0.93%	-9.46%

The table contains descriptive statistics of the equally weighted portfolio of hotel stocks by years and periods. Each monthly weight is obtained by applying the ratio 1/n, where n is the number of the available stock prices. In Panel A, statistics are resumed by years, while in Panel B they are resumed by periods. In Panel B: No crisis sample covers January 2001-May 2007 and July 2012-January 2020 periods; Crisis sample covers June 2007-June 2012 period; COVID sample covers February 2020-September 2021 period. Beta, downside risk, Sortino and Treynor indexes consider FTSE Global as a benchmark. All values in the table are monthly based.

Table 2: Correlation Matrix

Panel A – All sample

	MSCI EM U$	S&P 500 COMPOSITE	STOXX EUROPE 600 E	FTSE GLOBAL 100 ($)	TOPIX	Crude Oil-WTI	S&P GSCI Gold	US 10 YEAR	JP 10 YEAR DS	BD 10 YEAR	EMU BENCHMARK 30 YR.	EQUALLY WEIGHTED
MSCI EM U$	1											
S&P 500 COMPOSITE	0.7541	1										
STOXX EUROPE 600 E	0.7204	0.8482	1									
FTSE GLOBAL 100 ($)	0.8097	0.9614	0.8609	1								
TOPIX	0.5646	0.5650	0.6210	0.5966	1							
Crude Oil-WTI	0.3320	0.2733	0.2562	0.3077	0.2910	1						
S&P GSCI Gold	0.2678	0.0298	-0.0500	0.1023	-0.0886	0.1047	1					
US 10 YEAR	-0.1003	-0.2343	-0.2344	-0.2156	-0.1798	-0.0931	0.1482	1				
JP 10 YEAR	-0.0445	-0.0236	-0.0255	-0.0245	-0.0426	0.0003	0.0026	0.0325	1			
BD 10 YEAR	-0.0016	0.0241	0.0151	0.0130	-0.0236	-0.0559	0.0078	0.0858	0.0646	1		
EMU BENCHMARK 30 YR.	-0.2089	-0.2241	-0.2004	-0.2392	-0.2180	-0.1593	0.0487	0.1694	0.0673	0.1628	1	
EQUALLY WEIGHTED	0.7419	0.6649	0.7060	0.6640	0.6109	0.3615	0.0754	-0.1567	-0.0184	-0.0008	-0.1783	1

Panel B –Financial Crisis Sample

	MSCI EM U$	S&P 500 COMPOSITE	STOXX EUROPE 600 E	FTSE GLOBAL 100 ($)	TOPIX	Crude Oil-WTI	S&P GSCI Gold	US 10 YEAR	JP 10 YEAR DS	BD 10 YEAR	EMU BENCHMARK 30 YR.	EQUALLY WEIGHTED
MSCI EM U$	1											
S&P 500 COMPOSITE	0.5023	1										
STOXX EUROPE 600 E	0.7375	0.6124	1									
FTSE GLOBAL 100 ($)	0.7359	0.8693	0.8597	1								
TOPIX	0.6330	0.1170	0.3848	0.3575	1							
Crude Oil-WTI	0.4014	0.2827	0.3783	0.4035	0.1813	1						
S&P GSCI Gold	0.1330	-0.0180	0.0392	0.1061	0.0369	0.2779	1					
US 10 YEAR	-0.0268	-0.0529	-0.0603	-0.0593	-0.0085	-0.0270	0.0108	1				
JP 10 YEAR DS	-0.0158	-0.0157	-0.0303	-0.0229	-0.0132	-0.0058	0.0058	0.1170	1			
BD 10 YEAR	-0.0521	-0.0553	-0.0718	-0.0752	-0.0091	-0.0383	-0.0184	0.0759	0.0771	1		
EMU BENCHMARK 30 YR.	-0.1250	-0.1260	-0.1790	-0.1734	-0.0436	-0.0817	-0.0208	0.1835	0.0467	0.3157	1	
EQUALLY WEIGHTED	0.7840	0.4962	0.6641	0.6574	0.5805	0.2966	0.0208	-0.0296	-0.0279	-0.0503	-0.1301	1

Panel C – Covid sample												
	MSCI EM U$	S&P 500 COMPOSITE	STOXX EUROPE 600 E	FTSE GLOBAL 100 ($)	TOPIX	Crude Oil-WTI	S&P GSCI Gold	US 10 YEAR	JP 10 YEAR DS	BD 10 YEAR	EMU BENCHMARK 30 YR.	EQUALLY WEIGHTED
MSCI EM U$	1											
S&P 500 COMPOSITE	0.5346	1										
STOXX EUROPE 600 E	0.6655	0.6845	1									
FTSE GLOBAL 100 ($)	0.5845	0.9707	0.7167	1								
TOPIX	0.4792	0.2797	0.4292	0.3136	1							
Crude Oil-WTI	0.0956	0.1649	0.1045	0.1567	0.0562	1						
S&P GSCI Gold	0.1513	0.1649	0.1203	0.2020	0.1011	0.0110	1					
US 10 YEAR	0.0293	0.0483	0.0489	0.0414	0.0451	0.0047	0.0006	1				
JP 10 YEAR DS	-0.0160	0.0300	-0.0986	0.0225	-0.0099	-0.0012	-0.1492	-0.0482	1			
BD 10 YEAR	0.0036	-0.0354	-0.0028	-0.0257	-0.0175	0.0026	0.0776	-0.0022	-0.0011	1		
EMU BENCHMARK 30 YR.	0.0036	-0.0354	-0.0028	-0.0257	-0.0175	0.0026	0.0776	-0.0022	-0.0011	1.0000	1	
EQUALLY WEIGHTED	0.6714	0.5638	0.6841	0.5325	0.4959	0.0949	0.0631	0.0166	-0.0691	0.0018	0.0018	1

The table contains the correlations between Equally Weighted portfolio and the major financial indexes. Panel-A All sample covers January 2000-september 2021, Panel B - Crisis sample covers June 2007-June 2012 period; Panel C-COVID sample covers February 2020-September 202 1period. Beta, downside risk, Sortino and Treynor indexes consider FTSE Global as a benchmark. All values in the table are monthly based.

Table 3: Significance of correlations and two mean tests

Panel A - Significance of the correlations											
	MSCI EM U$	S&P 500 COMP.	STOXX EUROPE 600 E	FTSE GLOBAL 100 ($)	TOPIX	Crude Oil-WTI	S&P GSCI Gold	US 10 YEAR	JP 10 YEAR DS	BD 10 YEAR	EMU 30 YR.
a) All sample	0.7419***	0.6648***	0.7059***	0.6640***	0.6108***	0.3615**	0.0754	-0.156	-0.018	-0.000	-0.178*
b) Financial Crisis sample	0.7839***	0.4961***	0.6640***	0.6573***	0.5804***	0.2965***	0.0208	-0.029	-0.027	-0.050	-0.130**
c) COVID sample	0.6714***	0.5638***	0.6841***	0.5325***	0.4959***	0.0948	0.0631	0.0165	-0.069	0.0018	0.0018
Panel B-Two mean differences test											
a) All sample	-0.0005***	-0.0005**	-0.0006***	-0.0005***	-0.0006***	-0.0008	-0.0004**	-0.0009***	-0.0009**	-0.0013***	-0.0012***
b) Financial Crisis sample	-0.000	-0.000	-0.000	-0.000	-0.000	0.0004	0.0007	0.0004	0.0002	0.0004	0.0003
c) COVID sample	-0.000	0.0001	-0.000	0.0002	-0.000	-0.006	-0.000	-0.000	-0.000	-0.000	-0.000

The table shows the significance of the correlation (Panel –A) and two mean differences tests (Panel - B) between Equally Weighted Portfolio and financial indexes. In Panel A, we test the Null Hypothesis: H0: $\rho=0$ by using the t-student test, where ρ is the coefficient of correlation. In Panel B, we test the Null Hypothesis: H0: $\mu_{ew}= \mu_i$ by using the t-student test, where μ_{ew} is the mean return of Equally Weighted portfolio and μ_i is the mean return of the i-financial index. The asterisks are used to represent the statistically significant coefficients at the 1% (***), 5% (**), and 10% (*) significance levels.

Tables 4 and 5 report the results of the mean-return approach, by using constraints and no-constraint allocations.

For no-constraint allocation, the introduction of an EW portfolio as a possible asset class improves, not only return and standard deviation, but also RAP measures, especially during the crisis period. When we consider the COVID sample, there is no improvement in the portfolio performances.

Also, in the long run (All samples), the introduction of EW does not significantly improve portfolio performances. In table 5, the comparison between Panel A and B does not provide a clear puzzle in terms of returns and risks (for All samples the difference in terms of mean is -0.02%, while if we consider the COVID sample, it is 0.00%). We find negative differences in the RAP measures for All samples (-1.66% Sortino, -9.37% Treynor and -1.24% Sharpe); while for the financial crisis period, the results are not unique (0.23% Sortino, -1.51% Treynor and 3.92% Sharpe).

When we consider constraints in the weight percentage of asset classes, also in the long run we find a positive contribution of EW to the portfolio performances. The improvements characterize the allocations with low constraints, which suggest more diversified allocations (Panel D and F of Table 5), through the Sortino and Treynor ratio, but not if we consider the Sharpe ratio. A pattern emerges for the financial crisis sample, where the improvements are clearer and where the Sharpe Ratio is considered. A constraint of 20% for each asset class improves the return during financial crises (0.03% in terms of mean return, while for the Sortino and Treynor ratios we find positive differences from D-C panels, respectively 0.29% and 1.35%). If we consider the COVID sample and the 20% constraint, we do not find any improvements, with the exception of standard deviation falls (-0.49%). The increase in boundary constraints increases the positive effects on the portfolio, mainly for 30% constraint. For this last constraint, as shown in Table 5 - Panel E and F, we find improvement for almost all indicators in All samples (with the exception of the Sharpe Ratio, -0.96%), financial crisis period (2.68%, 5.01% and 30.86% are the improvements for the Sortino, Treynor and Sharpe ratios), while for the Covid period we find improvements only for the Sharpe Ratio (+13.82%), even though the difference of the mean return is positive (+0.01%). If we consider 2021, we find a positive contribution of EW in constraints portfolios (Table 4, Panel E and F), as the hotel industry recovers faster than the other sectors.

Table 4: Mean Variance Optimization by year

Panel A - No Constraints - No Equally Weighted																					
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Mean	-0.0009	0.0073	-0.0011	0.0062	0.0092	-0.0026	0.0014	-0.0099	0.0133	0.0129	0.0002	0.0192	-0.0037	0.0121	0.0034	0.0120	0.0053	-0.0027	0.0058	-0.0022	0.0000
standard deviation	0.0103	0.0151	0.0647	0.0136	0.0211	0.0219	0.0186	0.0311	0.0152	0.0412	0.0323	0.0234	0.0409	0.0210	0.0463	0.0294	0.0104	0.0097	0.0123	0.0065	0.0000
Max	0.0134	0.0391	0.0589	0.0284	0.0423	0.0208	0.0259	0.0488	0.0385	0.0783	0.0516	0.0640	0.0538	0.0438	0.1134	0.0698	0.0236	0.0118	0.0318	0.0042	0.0000
Min	-0.0186	-0.0166	-0.1879	-0.0166	-0.0251	-0.0598	-0.0268	-0.0602	-0.0143	-0.0879	-0.0494	-0.0106	-0.1077	-0.0298	-0.0634	-0.0329	-0.0146	-0.0244	-0.0089	-0.0181	0.0000
Beta	-0.0140	-0.0013	-0.2058	0.3637	0.3336	0.5334	0.3424	0.1217	0.0584	0.0299	0.4522	0.2058	0.1046	0.8718	0.5307	0.2206	0.3111	0.1672	0.0901	0.0422	0.0000
downside risk	0.0524	0.0473	0.0512	0.0159	0.0190	0.0192	0.0213	0.0376	0.0422	0.0517	0.0251	0.0216	0.0393	0.0185	0.0282	0.0168	0.0134	0.0201	0.0353	0.0680	0.0300
sortino	0.0199	0.0684	-0.0069	-0.0006	0.0065	-0.0081	-0.0074	0.0491	-0.0032	0.0054	0.0016	0.0281	-0.0085	0.5157	0.0020	0.0109	-0.0071	0.0020	-0.0060	-0.0053	-0.0116
treynor	0.3471	-3.0075	0.0224	0.0077	0.0174	-0.0125	-0.0072	-0.1079	0.1808	0.3375	-0.0052	0.0853	-0.0512	0.0113	0.0032	0.0483	0.0114	-0.0280	0.0371	-0.0866	-
sharpe	-0.4722	0.2578	-0.0711	0.2045	0.2753	-0.3055	-0.1322	-0.4215	0.6936	0.2445	-0.0721	0.7514	-0.1308	0.4679	0.0371	0.3626	0.3431	-0.4824	0.2723	-0.5586	-
Panel B - No Constraints - Equally Weighted																					
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
mean	-0.0009	0.0076	-0.0004	0.0054	0.0093	-0.0026	0.0027	-0.0099	0.0132	0.0148	0.0002	0.0222	-0.0039	0.0106	0.0033	0.0121	0.0057	-0.0040	0.0057	-0.0022	0.0000
standard deviation	0.0103	0.0153	0.0653	0.0148	0.0210	0.0219	0.0208	0.0311	0.0155	0.0420	0.0323	0.0234	0.0409	0.0221	0.0462	0.0290	0.0105	0.0110	0.0124	0.0065	0.0000
Max	0.0134	0.0391	0.0589	0.0284	0.0423	0.0208	0.0408	0.0488	0.0386	0.0855	0.0516	0.0640	0.0538	0.0410	0.1130	0.0684	0.0236	0.0129	0.0318	0.0042	0.0000
Min	-0.0186	-0.0166	-0.1879	-0.0166	-0.0246	-0.0598	-0.0268	-0.0602	-0.0143	-0.0879	-0.0494	-0.0106	-0.1077	-0.0298	-0.0634	-0.0318	-0.0146	-0.0244	-0.0101	-0.0181	0.0000
Beta	-0.0140	-0.0010	-0.2001	0.4229	0.3318	0.5334	0.3244	0.1217	0.0592	0.0497	0.4522	0.2282	0.1102	0.8551	0.5303	0.2243	0.3291	0.1698	0.0851	0.0422	0.0000
downside risk	0.0524	0.0472	0.0515	0.0159	0.0190	0.0192	0.0215	0.0376	0.0423	0.0497	0.0251	0.0204	0.0392	0.0265	0.0282	0.0143	0.0143	0.0213	0.0355	0.0680	0.0300
sortino	0.0199	0.0694	-0.0067	-0.0021	0.0066	-0.0081	-0.0064	0.0491	-0.0032	0.0071	0.0016	0.0390	-0.0085	0.3028	0.0020	0.0099	-0.0077	0.0010	-0.0060	-0.0053	-0.0116
treynor	0.3471	-4.2138	0.0195	0.0045	0.0176	-0.0125	-0.0035	-0.1079	0.1776	0.2415	-0.0052	0.0903	-0.0499	0.0097	0.0031	0.0477	0.0122	-0.0350	0.0383	-0.0866	-
sharpe	-0.4722	0.2755	-0.0598	0.1292	0.2785	-0.3055	-0.0544	-0.4215	0.6789	0.2856	-0.0721	0.8824	-0.1343	0.3760	0.0353	0.3696	0.3827	-0.5402	0.2630	-0.5586	-
Panel C - 20% Constraints - No Equally Weighted																					
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
mean	0.0010	0.0073	0.0006	0.0050	0.0112	0.0005	0.0038	-0.0102	0.0144	0.0139	0.0051	0.0151	0.0002	0.0129	0.0015	0.0168	-0.0075	-0.0051	0.0136	0.0032	-0.0009
standard deviation	0.0115	0.0166	0.0553	0.0134	0.0227	0.0178	0.0157	0.0384	0.0121	0.0325	0.0268	0.0162	0.0285	0.0189	0.0399	0.0301	0.0549	0.0159	0.0183	0.0195	0.0092
Max	0.0133	0.0350	0.0589	0.0233	0.0536	0.0242	0.0346	0.0521	0.0401	0.0747	0.0497	0.0404	0.0553	0.0434	0.0966	0.0794	0.0282	0.0208	0.0481	0.0330	0.0175
Min	-0.0197	-0.0137	-0.1631	-0.0152	-0.0339	-0.0338	-0.0162	-0.0795	-0.0083	-0.0600	-0.0204	-0.0068	-0.0432	-0.0170	-0.0472	-0.0202	-0.1788	-0.0376	-0.0086	-0.0378	-0.0143
Beta	-0.0326	-0.0450	-0.0587	0.4144	0.3803	0.4459	0.3647	0.3293	0.1069	0.0872	0.3845	0.2303	0.3448	0.7794	0.5177	0.3812	-0.6348	0.2785	0.2696	0.1672	-0.0394
downside risk	0.0499	0.0485	0.0521	0.0128	0.0163	0.0186	0.0188	0.0330	0.0392	0.0383	0.0202	0.0167	0.0251	0.0214	0.0268	0.0083	0.0300	0.0171	0.0268	0.0645	0.0288
sortino	0.0233	0.0667	-0.0082	-0.0024	0.0109	-0.0083	-0.0064	0.0986	-0.0029	0.0058	0.0068	0.0093	-0.0069	0.4857	0.0007	0.0339	-0.0081	0.0002	-0.0043	-0.0055	-0.0095
treynor	0.0899	-0.0865	0.0487	0.0038	0.0204	-0.0082	-0.0001	-0.0407	0.1095	0.1270	0.0065	0.0584	-0.0041	0.0137	-0.0002	0.0405	0.0145	-0.0252	0.0412	0.0102	0.0418
sharpe	-0.2536	0.2351	-0.0517	0.1175	0.3424	-0.2042	-0.0021	-0.3488	0.9700	0.3405	0.0928	0.8292	-0.0499	0.5639	-0.0031	0.5119	-0.1682	-0.4423	0.6056	0.0879	-0.1790
Panel D - 20% Constraints - Equally Weighted																					
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
mean	-0.0009	0.0084	-0.0030	0.0050	0.0097	-0.0004	0.0032	-0.0076	0.0144	0.0124	0.0034	0.0180	-0.0021	0.0129	0.0034	0.0150	-0.0085	-0.0046	0.0144	0.0019	-0.0005
standard deviation	0.0101	0.0167	0.0639	0.0141	0.0227	0.0185	0.0165	0.0331	0.0123	0.0392	0.0307	0.0206	0.0329	0.0194	0.0452	0.0316	0.0536	0.0138	0.0198	0.0152	0.0037
Max	0.0090	0.0346	0.0582	0.0254	0.0423	0.0242	0.0287	0.0491	0.0379	0.0783	0.0519	0.0532	0.0545	0.0441	0.1138	0.0797	0.0262	0.0200	0.0487	0.0240	0.0038
Min	-0.0186	-0.0196	-0.1946	-0.0166	-0.0327	-0.0404	-0.0191	-0.0530	-0.0046	-0.0839	-0.0333	-0.0089	-0.0695	-0.0211	-0.0579	-0.0290	-0.1748	-0.0310	-0.0058	-0.0271	-0.0092
Beta	-0.0078	-0.0576	-0.1660	0.4350	0.3785	0.4564	0.3259	0.2197	0.1177	0.0447	0.4275	0.2133	0.2171	0.8144	0.5246	0.2417	-0.6898	0.2377	0.1995	0.1129	0.0103
downside risk	0.0513	0.0481	0.0578	0.0130	0.0152	0.0192	0.0203	0.0343	0.0394	0.0509	0.0218	0.0210	0.0319	0.0203	0.0280	0.0148	0.0313	0.0173	0.0286	0.0683	0.0309
sortino	0.0204	0.0699	-0.0086	-0.0025	0.0067	-0.0086	-0.0065	0.1031	-0.0029	0.0051	0.0047	0.0253	-0.0076	0.5116	0.0020	0.0224	-0.0081	0.0005	-0.0037	-0.0056	-0.0117
treynor	0.6197	-0.0871	0.0386	0.0035	0.0167	-0.0100	-0.0020	-0.0492	0.0996	0.2143	0.0019	0.0768	-0.0170	0.0131	0.0033	0.0563	0.0148	-0.0274	0.0596	0.0039	-0.1231
sharpe	-0.4747	0.3002	-0.1003	0.1096	0.2788	-0.2456	-0.0395	-0.3268	0.9500	0.2446	0.0261	0.7944	-0.1120	0.5489	0.0377	0.4301	-0.1904	-0.4738	0.6020	0.0287	-0.3406
Panel E - 30% Constraints - No Equally Weighted																					
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
mean	-0.0009	0.0083	-0.0040	0.0053	0.0092	-0.0004	0.0021	-0.0082	0.0128	0.0129	0.0014	0.0186	-0.0036	0.0124	0.0032	0.0122	-0.0047	-0.0041	0.0133	0.0008	-0.0002

standard deviation	0.0100	0.0159	0.0626	0.0138	0.0216	0.0197	0.0174	0.0309	0.0154	0.0412	0.0315	0.0222	0.0396	0.0203	0.0460	0.0292	0.0367	0.0120	0.0187	0.0094	0.0018
Max	0.0088	0.0363	0.0582	0.0259	0.0423	0.0219	0.0259	0.0477	0.0372	0.0783	0.0498	0.0567	0.0539	0.0436	0.1134	0.0698	0.0248	0.0174	0.0467	0.0156	0.0021
Min	-0.0186	-0.0183	-0.1879	-0.0166	-0.0288	-0.0475	-0.0196	-0.0639	-0.0131	-0.0879	-0.0428	-0.0106	-0.1021	-0.0259	-0.0634	-0.0323	-0.1152	-0.0244	-0.0061	-0.0186	-0.0042
Beta	0.7921	0.9606	1.1169	0.9114	0.8893	1.0453	0.9479	0.6430	0.9247	1.1628	1.1298	1.0407	1.1956	1.0254	1.1354	0.8167	0.6587	0.9400	0.9567	0.4203	0.0674
downside risk	0.0049	0.0044	0.0113	0.0044	0.0054	0.0051	0.0100	0.0102	0.0069	0.0080	0.0066	0.0053	0.0110	0.0067	0.0082	0.0092	0.0036	0.0038	0.0057	0.0094	0.0058
sortino	-0.0110	0.0144	-0.0082	0.0024	-0.0057	-0.0037	-0.0107	0.0040	-0.0029	-0.0065	-0.0058	0.0012	-0.0073	0.0170	0.0138	-0.0056	0.0072	0.0080	0.0043	-0.0010	0.0046
treynor	-0.0061	0.0051	-0.0066	0.0020	0.0065	-0.0044	-0.0018	-0.0178	0.0109	0.0087	-0.0011	0.0163	-0.0044	0.0099	0.0014	0.0133	-0.0097	-0.0064	0.0113	-0.0016	-0.0136
sharpe	-0.4844	0.3097	-0.1186	0.1320	0.2684	-0.2312	-0.0997	-0.3698	0.6529	0.2445	-0.0377	0.7648	-0.1316	0.4998	0.0334	0.3708	-0.1738	-0.5053	0.5797	-0.0708	-0.5066
Panel F - 30% Constraints - Equally Weighted																					
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
mean	-0.0009	0.0087	-0.0019	0.0045	0.0097	-0.0004	0.0047	-0.0076	0.0143	0.0143	0.0028	0.0205	-0.0024	0.0106	0.0036	0.0149	-0.0082	-0.0044	0.0138	0.0013	-0.0005
standard deviation	0.0101	0.0168	0.0646	0.0150	0.0227	0.0185	0.0181	0.0331	0.0126	0.0400	0.0304	0.0206	0.0331	0.0202	0.0453	0.0317	0.0537	0.0111	0.0202	0.0162	0.0041
Max	0.0090	0.0346	0.0583	0.0254	0.0423	0.0242	0.0385	0.0491	0.0386	0.0855	0.0519	0.0580	0.0548	0.0410	0.1130	0.0794	0.0265	0.0129	0.0487	0.0240	0.0046
Min	-0.0186	-0.0196	-0.1946	-0.0166	-0.0327	-0.0404	-0.0191	-0.0530	-0.0046	-0.0839	-0.0333	-0.0089	-0.0695	-0.0211	-0.0579	-0.0296	-0.1748	-0.0250	-0.0065	-0.0286	-0.0092
Beta	-0.0078	-0.0572	-0.1607	0.4696	0.3785	0.4564	0.3050	0.2197	0.1176	0.0644	0.4178	0.2235	0.2283	0.7837	0.5192	0.2369	-0.6785	0.1934	0.1931	0.1215	0.0182
downside risk	0.0513	0.0480	0.0579	0.0135	0.0152	0.0192	0.0204	0.0343	0.0397	0.0489	0.0229	0.0201	0.0317	0.0265	0.0280	0.0150	0.0344	0.0211	0.0293	0.0685	0.0309
sortino	0.0204	0.0709	-0.0082	-0.0032	0.0067	-0.0086	-0.0052	0.1031	-0.0030	0.0069	0.0040	0.0342	-0.0078	0.3015	0.0022	0.0219	-0.0090	0.0007	-0.0038	-0.0058	-0.0117
treynor	0.6197	-0.0936	0.0333	0.0022	0.0167	-0.0100	0.0029	-0.0492	0.0984	0.1785	0.0005	0.0845	-0.0176	0.0106	0.0038	0.0570	0.0146	-0.0329	0.0588	-0.0018	-0.0654
sharpe	-0.4747	0.3180	-0.0829	0.0680	0.2788	-0.2456	0.0481	-0.3268	0.9185	0.2873	0.0066	0.9177	-0.1214	0.4091	0.0431	0.4259	-0.1846	-0.5725	0.5627	-0.0131	-0.2879
Panel G - 40% Constraints - No Equally Weighted																					
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
mean	-0.0009	0.0083	-0.0040	0.0053	0.0092	-0.0004	0.0021	-0.0082	0.0128	0.0129	0.0014	0.0186	-0.0036	0.0124	0.0032	0.0122	-0.0047	-0.0041	0.0133	0.0008	-0.0002
standard deviation	0.0100	0.0159	0.0626	0.0138	0.0216	0.0197	0.0174	0.0309	0.0154	0.0412	0.0315	0.0222	0.0396	0.0203	0.0460	0.0292	0.0367	0.0120	0.0187	0.0094	0.0018
Max	0.0088	0.0363	0.0582	0.0259	0.0423	0.0219	0.0259	0.0477	0.0372	0.0783	0.0498	0.0567	0.0539	0.0436	0.1134	0.0698	0.0248	0.0174	0.0467	0.0156	0.0021
Min	-0.0186	-0.0183	-0.1879	-0.0166	-0.0288	-0.0475	-0.0196	-0.0639	-0.0131	-0.0879	-0.0428	-0.0106	-0.1021	-0.0259	-0.0634	-0.0323	-0.1152	-0.0244	-0.0061	-0.0186	-0.0042
Beta	-0.0101	-0.0405	-0.1635	0.3987	0.3672	0.5140	0.3381	0.1340	0.0794	0.0299	0.4476	0.1851	0.1203	0.8465	0.5074	0.2235	-0.3876	0.2118	0.1741	0.0618	0.0172
downside risk	0.0517	0.0475	0.0512	0.0158	0.0181	0.0169	0.0200	0.0316	0.0419	0.0517	0.0236	0.0216	0.0388	0.0191	0.0291	0.0163	0.0242	0.0198	0.0297	0.0636	0.0300
sortino	0.0202	0.0706	-0.0078	-0.0023	0.0069	-0.0079	-0.0074	0.0617	-0.0034	0.0054	0.0027	0.0263	-0.0085	0.5164	0.0018	0.0115	-0.0073	0.0010	-0.0040	-0.0049	-0.0118
treynor	0.5502	-0.1082	0.0450	0.0046	0.0156	-0.0075	-0.0060	-0.0900	0.1208	0.3414	-0.0032	0.0865	-0.0436	0.0128	0.0018	0.0472	0.0155	-0.0275	0.0652	-0.0274	-0.0957
sharpe	-0.5564	0.2748	-0.1175	0.1322	0.2659	-0.1949	-0.1166	-0.3900	0.6221	0.2474	-0.0460	0.7225	-0.1324	0.5325	0.0199	0.3613	-0.1642	-0.4868	0.6090	-0.1793	-0.9128
Panel H - 40% Constraints - Equally Weighted																					
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
mean	-0.0009	0.0087	-0.0031	0.0046	0.0092	-0.0004	0.0036	-0.0082	0.0128	0.0148	0.0011	0.0216	-0.0037	0.0109	0.0031	0.0122	-0.0043	-0.0043	0.0131	0.0007	-0.0001
standard deviation	0.0100	0.0161	0.0632	0.0147	0.0216	0.0197	0.0196	0.0309	0.0157	0.0420	0.0314	0.0222	0.0396	0.0215	0.0459	0.0289	0.0368	0.0110	0.0188	0.0096	0.0018
Max	0.0088	0.0363	0.0583	0.0259	0.0423	0.0219	0.0408	0.0477	0.0386	0.0855	0.0498	0.0580	0.0540	0.0410	0.1130	0.0684	0.0248	0.0129	0.0467	0.0156	0.0021
Min	-0.0186	-0.0183	-0.1879	-0.0166	-0.0288	-0.0475	-0.0196	-0.0639	-0.0131	-0.0879	-0.0428	-0.0106	-0.1021	-0.0259	-0.0634	-0.0318	-0.1152	-0.0244	-0.0061	-0.0186	-0.0042
Beta	-0.0101	-0.0399	-0.1591	0.4370	0.3672	0.5140	0.3172	0.1340	0.0803	0.0497	0.4430	0.2075	0.1292	0.8287	0.5070	0.2267	-0.3753	0.1835	0.1724	0.0640	0.0164
downside risk	0.0517	0.0473	0.0514	0.0139	0.0181	0.0169	0.0203	0.0316	0.0420	0.0497	0.0241	0.0204	0.0386	0.0265	0.0291	0.0139	0.0263	0.0212	0.0300	0.0636	0.0300
sortino	0.0202	0.0716	-0.0075	-0.0028	0.0069	-0.0079	-0.0061	0.0617	-0.0034	0.0071	0.0024	0.0372	-0.0086	0.3142	0.0018	0.0103	-0.0080	0.0008	-0.0041	-0.0049	-0.0117
treynor	0.5502	-0.1178	0.0410	0.0027	0.0156	-0.0075	-0.0016	-0.0900	0.1191	0.2438	-0.0039	0.0919	-0.0414	0.0112	0.0016	0.0467	0.0152	-0.0327	0.0647	-0.0285	-0.0959
sharpe	-0.5564	0.2930	-0.1032	0.0805	0.2659	-0.1949	-0.0260	-0.3900	0.6090	0.2884	-0.0556	0.8571	-0.1347	0.4321	0.0180	0.3663	-0.1548	-0.5475	0.5944	-0.1895	-0.8634

The table shows the portfolio's results of the mean-variance optimization for different hypotheses year by year. by using a recursive approach to build the portfolios. The optimization input parameters are estimates from the previous year on monthly observations. In Panel A. we apply a mean-variance approach with no restriction to the weight of each asset class (No Constraints) and without considering Equally Weighted portfolio as an asset class (No Equally Weighted). In Panel B. we apply a mean-variance approach without restriction (No Constraints) and consider an Equally Weighted portfolio as an asset class. In Panel C. we apply a mean-variance approach with a weight limit of 20% of each asset class (Constraints) and without considering Equally Weighted portfolio as an asset class (No Equally Weighted). In Panel D. we apply a mean-variance approach with a weight limit of 20% of each asset class (Constraints) and considering Equally Weighted portfolio as an asset class. In Panel E. we apply a mean-variance approach with a weight limit of 30% of each asset class (Constraints) and without considering Equally Weighted portfolio as an asset class (No Equally Weighted). In Panel F. we apply a mean-variance approach with a weight limit of 30% of each asset class (Constraints) and considering Equally Weighted portfolio as an asset class. In Panel G. we apply a mean-variance approach with a restriction of 40% to the weight of each asset class (Constraints) and without considering Equally Weighted portfolio as an asset class (No Equally Weighted). In Panel H. we apply a mean-variance with a weight limit of 40% of each asset class (Constraints) and consider an Equally Weighted portfolio as an asset class.

Table 5: Mean Variance Optimization results by period – Equally Weighted Portfolio

	Financial Crisis Sample			All Sample			COVID Sample		
	Panel A	**Panel B**	**B-A**	**Panel A**	**Panel B**	**B-A**	**Panel A**	**Panel B**	**B-A**
Mean	0.62%	0.72%	0.10%	0.39%	0.37%	-0.02%	-0.11%	-0.11%	0.00%
Standard deviation	2.70%	2.75%	0.05%	2.44%	2.47%	0.03%	0.33%	0.33%	0.00%
Max	7.83%	8.55%	0.72%	11.34%	11.30%	-0.05%	0.42%	0.21%	-0.21%
Min	-8.79%	-8.79%	0.00%	-18.79%	-18.79%	0.00%	-1.81%	-0.91%	0.91%
Beta	20.17%	20.59%	0.42%	25.43%	25.98%	0.55%	2.11%	2.11%	0.00%
Downside risk	3.32%	3.28%	-0.05%	2.90%	2.96%	0.06%	4.90%	4.90%	0.00%
Sortino	1.23%	1.46%	0.23%	4.53%	2.86%	-1.66%	-0.84%	-0.84%	0.00%
Treynor	8.06%	6.55%	-1.51%	-19.95%	-29.32%	-9.37%	-	-	-
Sharpe	17.73%	21.65%	3.92%	5.83%	4.60%	-1.24%	-	-	-
	Panel C	**Panel D**	**D-C**	**Panel C**	**Panel D**	**D-C**	**Panel C**	**Panel D**	**D-C**
Mean	0.70%	0.73%	0.03%	0.45%	0.38%	-0.07%	0.11%	0.07%	-0.05%
Standard deviation	2.36%	2.54%	0.18%	2.64%	2.79%	0.14%	1.43%	0.95%	-0.49%
Max	7.47%	7.83%	0.35%	9.66%	11.38%	1.72%	3.30%	1.39%	-1.91%
Min	-7.95%	-8.39%	-0.44%	-17.88%	-19.46%	-1.58%	-3.78%	-1.81%	1.96%
Beta	25.05%	22.48%	-2.57%	23.39%	19.87%	-3.52%	6.39%	6.16%	-0.23%
Downside risk	2.77%	3.13%	0.36%	2.72%	2.90%	0.18%	4.66%	4.96%	0.30%
Sortino	1.85%	2.15%	0.29%	4.49%	4.57%	0.09%	-0.75%	-0.87%	-0.11%
Treynor	4.34%	5.69%	1.35%	1.14%	5.26%	4.12%	2.60%	-5.96%	-8.56%
Sharpe	31.36%	27.48%	-3.88%	9.26%	5.46%	-3.79%	-4.55%	-15.60%	-11.05%
	Panel E	**Panel F**	**F-E**	**Panel E**	**Panel F**	**F-E**	**Panel E**	**Panel F**	**F-E**
Mean	0.66%	0.82%	0.16%	0.36%	0.37%	0.01%	0.03%	0.04%	0.01%
Standard deviation	2.64%	2.58%	-0.06%	2.66%	2.79%	0.13%	0.56%	1.02%	0.45%
Max	7.83%	8.55%	0.72%	11.34%	11.30%	-0.05%	1.56%	1.43%	-0.13%
Min	-8.79%	-8.39%	0.40%	-18.79%	-19.46%	-0.67%	-1.86%	-1.89%	-0.03%
Beta	97.48%	22.47%	-75.01%	95.72%	19.65%	-76.07%	24.38%	6.98%	-17.40%
Downside risk	0.79%	3.11%	2.32%	0.64%	3.01%	2.37%	0.76%	4.97%	4.21%
Sortino	-0.35%	2.33%	2.68%	0.20%	2.95%	2.75%	0.18%	-0.87%	-1.06%
Treynor	0.25%	5.26%	5.01%	0.09%	5.10%	5.01%	-0.76%	-3.36%	-2.60%
Sharpe	19.25%	30.86%	11.61%	4.22%	3.26%	-0.96%	-28.87%	-15.05%	13.82%
	Panel G	**Panel H**	**H-G**	**Panel G**	**Panel H**	**H-G**	**Panel G**	**Panel H**	**H-G**
Mean	0.66%	0.76%	0.10%	0.36%	0.35%	-0.01%	0.03%	0.03%	0.00%
Standard deviation	2.64%	2.70%	0.05%	2.66%	2.67%	0.01%	0.56%	0.57%	0.01%
Max	7.83%	8.55%	0.72%	11.34%	11.30%	-0.05%	1.56%	0.88%	-0.68%
Min	-8.79%	-8.79%	0.00%	-18.79%	-18.79%	0.00%	-1.86%	-1.14%	0.72%
Beta	20.24%	20.53%	0.29%	21.24%	21.39%	0.15%	3.95%	4.02%	0.07%
Downside risk	3.17%	3.14%	-0.04%	2.91%	2.96%	0.05%	4.68%	4.68%	0.00%
Sortino	1.42%	1.65%	0.23%	4.54%	2.98%	-1.57%	-0.83%	-0.83%	0.00%
Treynor	7.49%	5.99%	-1.50%	4.39%	4.23%	-0.17%	-6.16%	-6.22%	-0.07%
Sharpe	17.32%	21.38%	4.06%	4.18%	2.76%	-1.42%	-54.61%	-52.65%	1.96%

The table shows the portfolio's results of the mean-variance optimization for different hypotheses for different periods, by using a recursive approach to build the portfolios. The optimization input parameters are estimates from the previous year on monthly observations. In Panel A, we apply a mean-variance approach with no restriction to the weight of each asset class (No Constraints) and without considering Equally Weighted portfolio as an asset class (No Equally Weighted). In Panel B, we apply a mean-variance approach without restriction (No Constraints) and consider an Equally Weighted portfolio as an asset class. In Panel C, we apply a mean-variance approach with a weight limit of 20% of each asset class (Constraints) and without considering Equally Weighted portfolio as an asset class (No Equally Weighted). In Panel D, we apply a mean-variance approach with a weight limit of 20% of each asset class (Constraints) and considering Equally Weighted portfolio as an asset class. In Panel E, we apply a mean-variance approach with a weight limit of 30% of each asset class (Constraints) and without considering Equally Weighted portfolio as an asset class (No Equally Weighted). In Panel F, we apply a mean-variance approach with a weight limit of 30% of each asset class (Constraints) and considering Equally Weighted portfolio as an asset class. In Panel G, we apply a mean-variance approach with a restriction of 40% to the weight of each asset class (Constraints) and without considering Equally Weighted portfolio as an asset class (No Equally Weighted). In Panel H, we apply a mean-variance with a weight limit of 40% of each asset class (Constraints) and consider an Equally Weighted portfolio as an asset class.

The results contained in Table 6 confirm what we have already argued in the comparison between constraint and no-constraint portfolios by using the EW portfolio as an asset class. The EW portfolio chosen as an asset class instead of the S&P index shows better performance especially during the great financial crisis and the COVID-19 periods. These results are in line with the findings of Paea & Sabbaghi (2015) given that the S&P index is value-based.

Table 6: Mean-Variance Optimization results by period - S&P 1500 Hotels Restaurants & Leisure Industry Index

	Financial Crisis Sample			All Sample			COVID Sample		
	Panel A	**Panel B**	**B-A**	**Panel A**	**Panel B**	**B-A**	**Panel A**	**Panel B**	**B-A**
Mean	0.62%	0.59%	-0.02%	0.39%	0.41%	0.02%	-0.11%	-0.12%	-0.01%
Standard deviation	2.70%	2.56%	-0.14%	2.44%	2.44%	0.01%	0.33%	0.35%	0.02%
Max	7.83%	7.83%	0.00%	11.34%	11.34%	0.00%	0.42%	0.21%	-0.21%
Min	-8.79%	-8.79%	0.00%	-18.79%	-18.79%	0.00%	-1.81%	-1.01%	0.80%
Beta	20.17%	17.69%	-2.48%	25.43%	26.79%	1.36%	2.11%	2.23%	0.12%
Downside risk	3.32%	3.52%	0.20%	2.90%	2.84%	-0.05%	4.90%	4.90%	0.00%
Sortino	1.23%	1.31%	0.09%	4.53%	4.42%	-0.10%	-0.84%	-0.84%	0.00%
Treynor	8.06%	9.64%	1.58%	-19.95%	-6.56%	13.39%			
Sharpe	17.73%	18.91%	1.18%	5.83%	6.78%	0.94%			
	Panel C	**Panel D**	**D-C**	**Panel C**	**Panel D**	**D-C**	**Panel C**	**Panel D**	**D-C**
Mean	0.70%	0.70%	0.00%	0.45%	0.50%	0.05%	0.11%	0.10%	-0.01%
Standard deviation	2.36%	2.41%	0.05%	2.64%	2.66%	0.02%	1.43%	1.45%	0.02%
Max	7.47%	7.47%	0.00%	9.66%	9.71%	0.05%	3.30%	2.51%	-0.79%
Min	-7.95%	-7.88%	0.07%	-17.88%	-18.10%	-0.22%	-3.78%	-2.74%	1.04%
Beta	25.05%	26.03%	0.98%	23.39%	24.77%	1.37%	6.39%	6.13%	-0.26%
Downside risk	2.77%	2.76%	-0.01%	2.72%	2.79%	0.07%	4.66%	4.68%	0.01%
Sortino	1.85%	1.87%	0.02%	4.49%	4.37%	-0.11%	-0.75%	-0.76%	0.00%
Treynor	4.34%	4.10%	-0.24%	1.14%	-4.45%	-5.60%	2.60%	3.02%	0.42%
Sharpe	31.36%	28.76%	-2.60%	9.26%	9.57%	0.31%	-4.55%	-12.16%	-7.61%
	Panel E	**Panel F**	**F-E**	**Panel E**	**Panel F**	**F-E**	**Panel E**	**Panel F**	**F-E**
Mean	0.66%	0.70%	0.04%	0.36%	0.42%	0.07%	0.03%	0.04%	0.01%
Standard deviation	2.64%	2.50%	-0.15%	2.66%	2.75%	0.08%	0.56%	0.98%	0.42%
Max	7.83%	7.83%	0.00%	11.34%	11.38%	0.04%	1.56%	1.38%	-0.18%
Min	-8.79%	-8.39%	0.40%	-18.79%	-19.07%	-0.29%	-1.86%	-1.94%	-0.08%
Beta	97.48%	22.34%	-75.14%	95.72%	22.60%	-73.12%	24.38%	6.12%	-18.26%
Downside risk	0.79%	3.11%	2.33%	0.64%	2.92%	2.28%	0.76%	4.98%	4.22%
Sortino	-0.35%	1.95%	2.30%	0.20%	4.26%	4.06%	0.18%	-0.88%	-1.06%
Treynor	0.21%	5.69%	5.48%	0.09%	-1.07%	-1.17%	-1.42%	-17.86%	-16.43%
Sharpe	17.32%	25.87%	8.54%	4.18%	5.94%	1.77%	-54.61%	-30.75%	23.85%
	Crisis Sample			**No Crisis**			**COVID**		
	Panel G	**Panel H**	**F-E**			**diff**			
Mean	0.66%	0.64%	-0.02%	0.36%	0.39%	0.03%	0.03%	0.02%	-0.01%
Standard deviation	2.64%	2.53%	-0.11%	2.66%	2.65%	-0.01%	0.56%	0.58%	0.02%
Max	7.83%	7.83%	0.00%	11.34%	11.34%	0.00%	1.56%	0.89%	-0.67%
Min	-8.79%	-8.79%	0.00%	-18.79%	-18.79%	0.00%	-1.86%	-1.23%	0.63%
Beta	20.24%	18.31%	-1.92%	21.24%	23.42%	2.18%	3.95%	3.85%	-0.10%
Downside risk	3.17%	3.33%	0.16%	2.91%	2.87%	-0.04%	4.68%	4.69%	0.01%
Sortino	1.42%	1.66%	0.24%	4.54%	4.36%	-0.18%	-0.83%	-0.84%	0.00%
Treynor	7.49%	9.27%	1.78%	4.39%	-1.58%	-5.98%	-6.16%	-8.23%	-2.08%
Sharpe	17.32%	20.08%	2.75%	4.18%	4.62%	0.44%	-54.61%	-58.90%	-4.29%

The table shows the portfolio's results of the mean-variance optimization for different hypotheses for different periods, by using a recursive approach to build the portfolios. The optimization input parameters are estimates from the previous year on monthly observations. In Panel A, we apply a mean-variance approach with no restriction to the weight of each asset class (No Constraints) and without considering S&P 1500 Hotels Restaurants & Leisure Industry Index as an asset class. In Panel B, we apply a mean-variance approach without restriction (No Constraints) and consider &P 1500 Hotels Restaurants & Leisure Industry Index as an asset class. In Panel C, we apply a mean-variance approach with a weight limit of 20% of each asset class (Constraints) and without considering S&P 1500 Hotels Restaurants & Leisure Industry Index as an asset class

(No Equally Weighted). In Panel D, we apply a mean-variance approach with a weight limit of 20% of each asset class (Constraints) and consider S&P 1500 Hotels Restaurants & Leisure Industry Index as an asset class. In Panel E, we apply a mean-variance approach with a weight limit of 30% of each asset class (Constraints) and without considering S&P 1500 Hotels Restaurants & Leisure Industry Index as an asset class (No Equally Weighted). In Panel F, we apply a mean-variance approach with a weight limit of 30% of each asset class (Constraints) and consider S&P 1500 Hotels Restaurants & Leisure Industry Index as an asset class. In Panel G, we apply a mean-variance approach with a restriction of 40% to the weight of each asset class (Constraints) and without considering &P 1500 Hotels Restaurants & Leisure Industry Index as an asset class (No Equally Weighted). In Panel H, we apply a mean-variance with a weight limit of 40% of each asset class (Constraints) and consider S&P 1500 Hotels Restaurants & Leisure Industry Index as an asset class.

5. Conclusion

In our study, we analyze the role of hotel stocks in the financial market during the 2000-2021 period. We focus on two periods that most affect these stocks: the great financial crisis and COVID. We are aware of the fact that the pandemic was not over in September 2021, but we try to provide some clues about how the financial performance of this sector may improve diversification across the world. To do this, we start with the analysis of an equally weighted portfolio composed of available hotel stocks and then we capture the role in terms of diversification by simulating an asset allocation process in a mean-variance framework. Findings suggest a positive contribution of the hotel industry to the asset allocation process, even in terms of RAPs measures. When analyzing the great financial crisis and COVID periods, we find different patterns and contributions to the portfolio's performance. During the great financial crisis, hotel activities were affected by the global economic crisis, more precisely by the shrinking capital market and decreasing consumer expenditure. For this period, the improvements in terms of performance are clear and can be caught in terms of both RAPs measures and tracking errors. Unlike other epidemic outbreaks, COVID-19 determines an increase in systematic risk (Skare et al., 2021), but our results are less clear compared to the crisis period. There are several explanations for this evidence. First, there are still elements of uncertainty surrounding the pandemic and the free movement of people around the world. Furthermore, the difference between what happened during the financial crisis and the ways in which people were able to work at a distance (e.g., smart working, remote work software platforms, etc.) have improved and this changes the mobility of people for work purposes. Alongside these structural elements, if we consider more diversified investments, the hotel sector still has an improvement in investment performance under the diversification perspective compared to other asset classes. Our results, in a period of scarcity of financial resources such as COVID-19, are relevant regarding hotel managers.

COVID-19 changes the rules of international travel and hotel activities, so that policymakers and investors must develop new readiness criteria to consider hotel industries as an asset class and its recovery from COVID-19's disaster.

To these results, other two main factors must be added that could amplify the uncertainty and complexity. First, the hotel industry recovery is accelerating in the first half of 2021, as shown by the performance of the S&P 1500 Hotels Restaurants & Leisure Industry Index. Second, the hotel groups are transforming themselves because of indirect competition caused by online retailers, media, and lodging

companies. Digital technology is permitting new business models such as apps for self-check-in and other 24/7/365 services support.
Additional analyses should improve the mean-variance approach used in our paper, their accuracy, and their robustness. In addition, the EW portfolio approach needs further exploration, as the hotel stock picking in the building portfolio should be done considering fundamentals and propensity to the financial distress of the companies.

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