UNIVERSITÀ DI TRENTO
Dipartimento di Economia e Management

Master of Science in

FINANCE

STUDY OF DYNAMIC CORRELATION FOR RISK ASSESSMENT IN FINANCE: AN ANALYSIS OF THE NASDAQ 100 WITH AND WITHOUT THE EFFECT OF COVID-19

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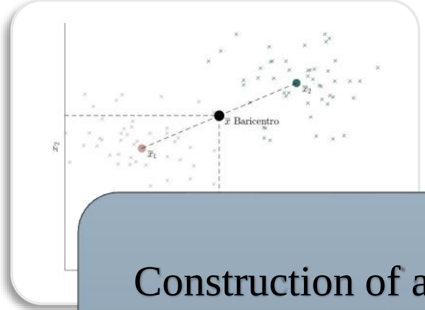
Purpose

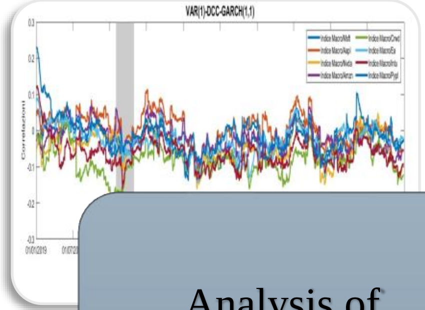
The objective is to analyse the dynamic pairwise correlations between an aggregated index and selected securities from the Nasdaq 100, with a view to applying them to portfolio risk calculations using Value at Risk (VaR) and Expected Shortfall (ES)



Construction of a Macroeconomic–Financial Index

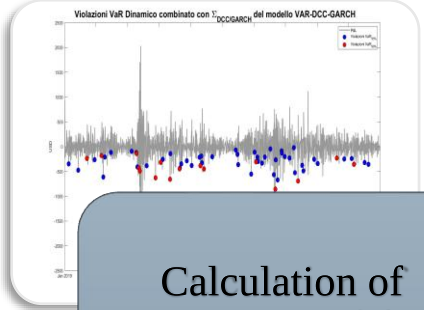
Cluster Analysis of the Nasdaq 100

multivariate



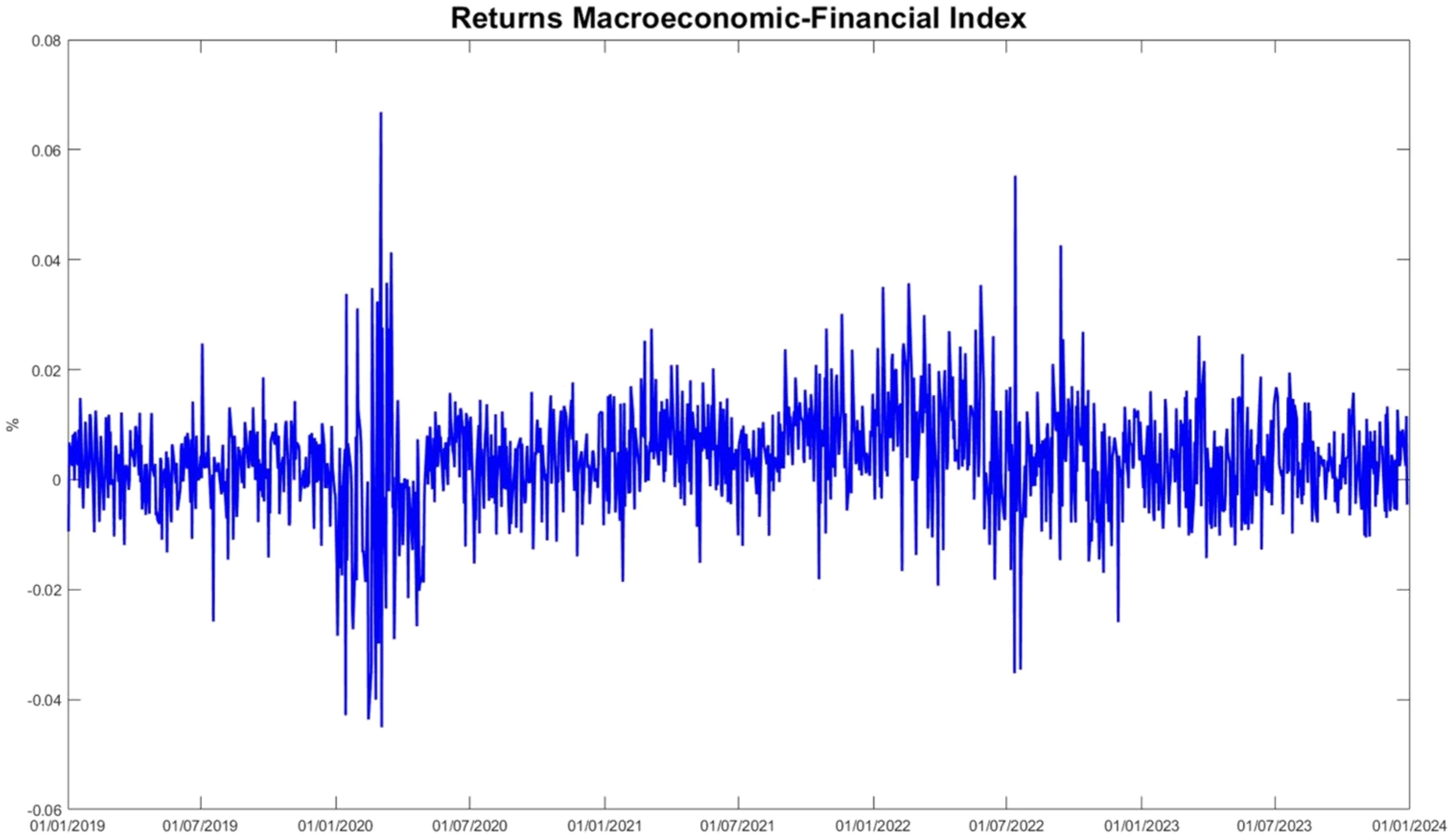
Analysis of Dynamic *Pairwise* Correlations between Index and Selected Securities

univariate



Calculation of *Dynamic* Risk Measures VaR and ES using Variance-Covariance Approach

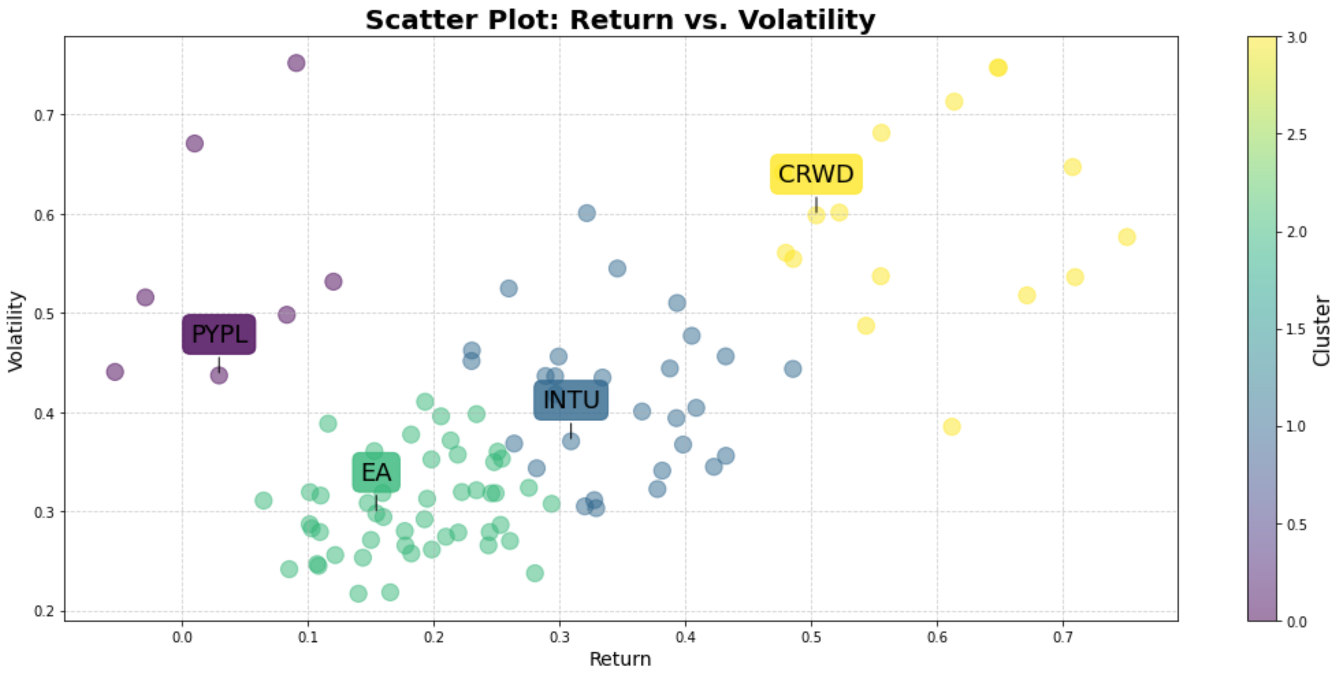
Macroeconomic-Financial Index



GOLD	Commodity	*Return*
WTI	US Oil	*Return*
VIX	Proxy Vol. Impl.	*Return*
FVX	Treasury 5Y	*Difference*
CPI	Consumer Price Index	*Δ%log(Cpi)*
LOIS	LIBOR–OIS Spread	*Difference*

All data are on a daily basis.

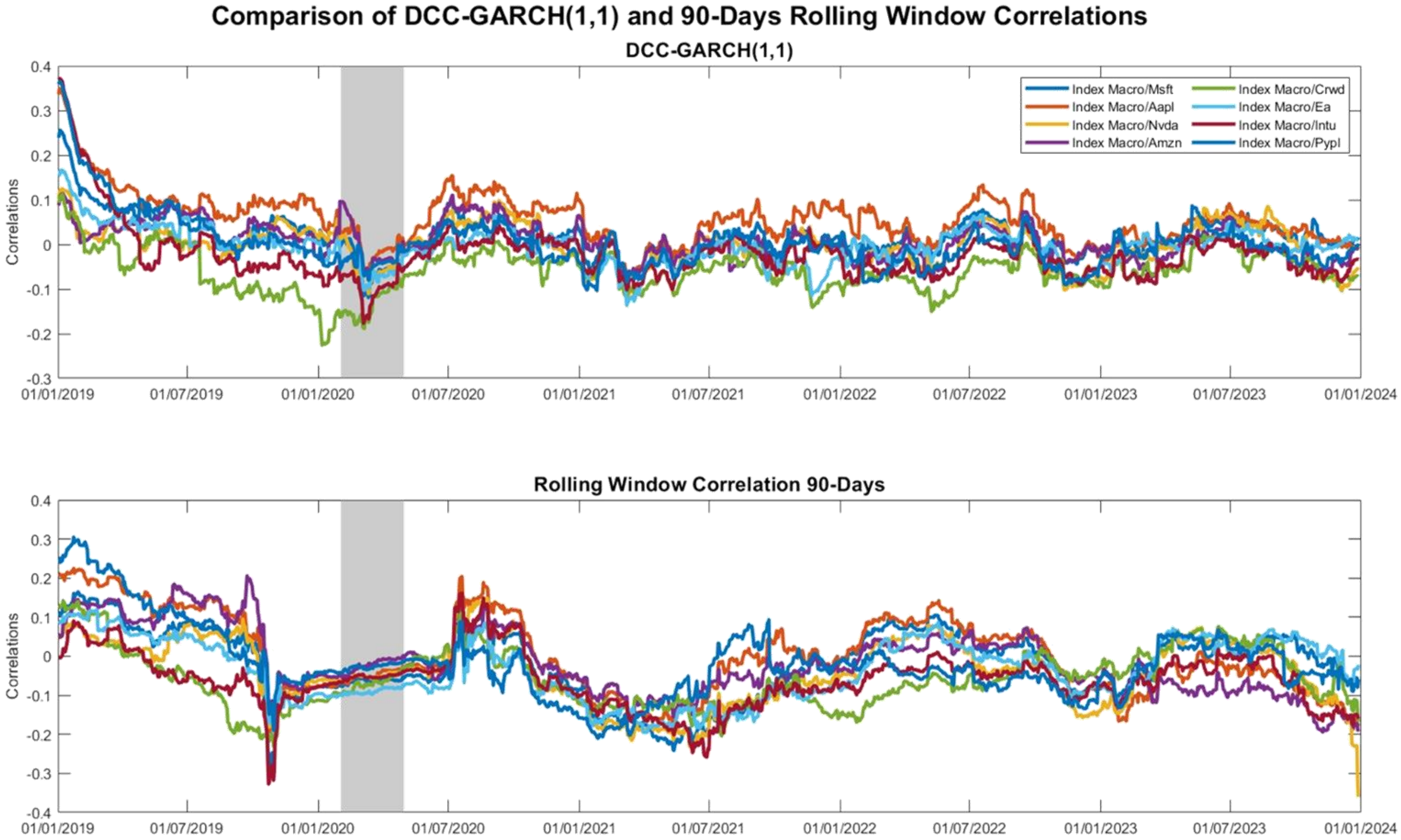
Cluster Analysis Results



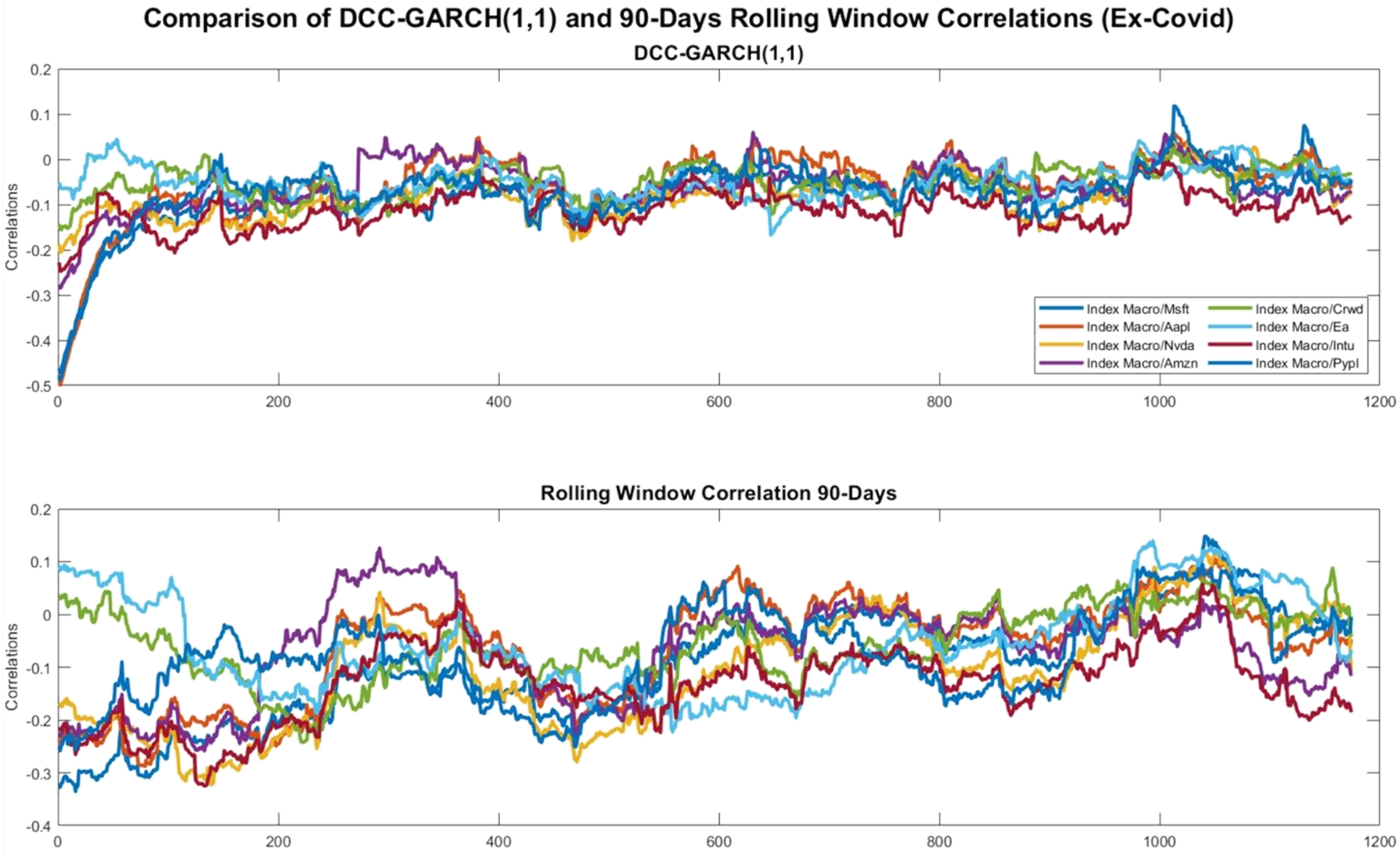
Cluster	*Closest Ticker*	*Average Returns*	*Volatility*	*Ret-Vol*
0	INTU	0.3093	0.3705	mid-mid
1	CRWD	0.5044	0.5984	high-high
2	PYPL	0.0296	0.4369	low-high
3	EA	0.1546	0.2978	low-low

To make the group as representative as possible of the Nasdaq 100, we have added the four largest capitalisation stocks of the index to the results: **Microsoft (MSFT), Apple (AAPL), Nvidia (NVDA), Amazon (AMZN)**.

Dynamic Correlations ($\hat{\Gamma}_t^{DCC}$)

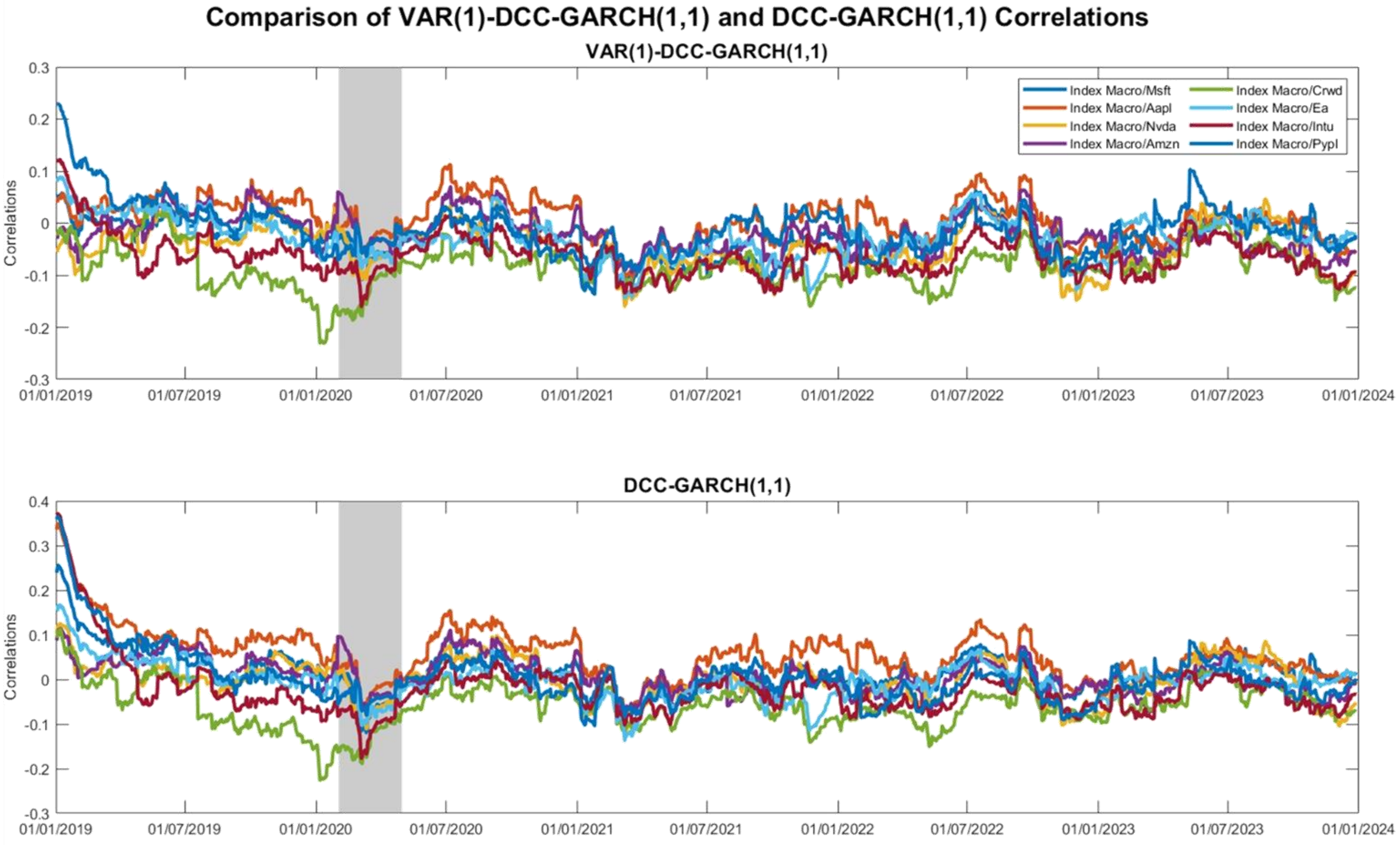


Dynamic Correlations ($\hat{\Gamma}_t^{DCC}$), Ex–Covid*

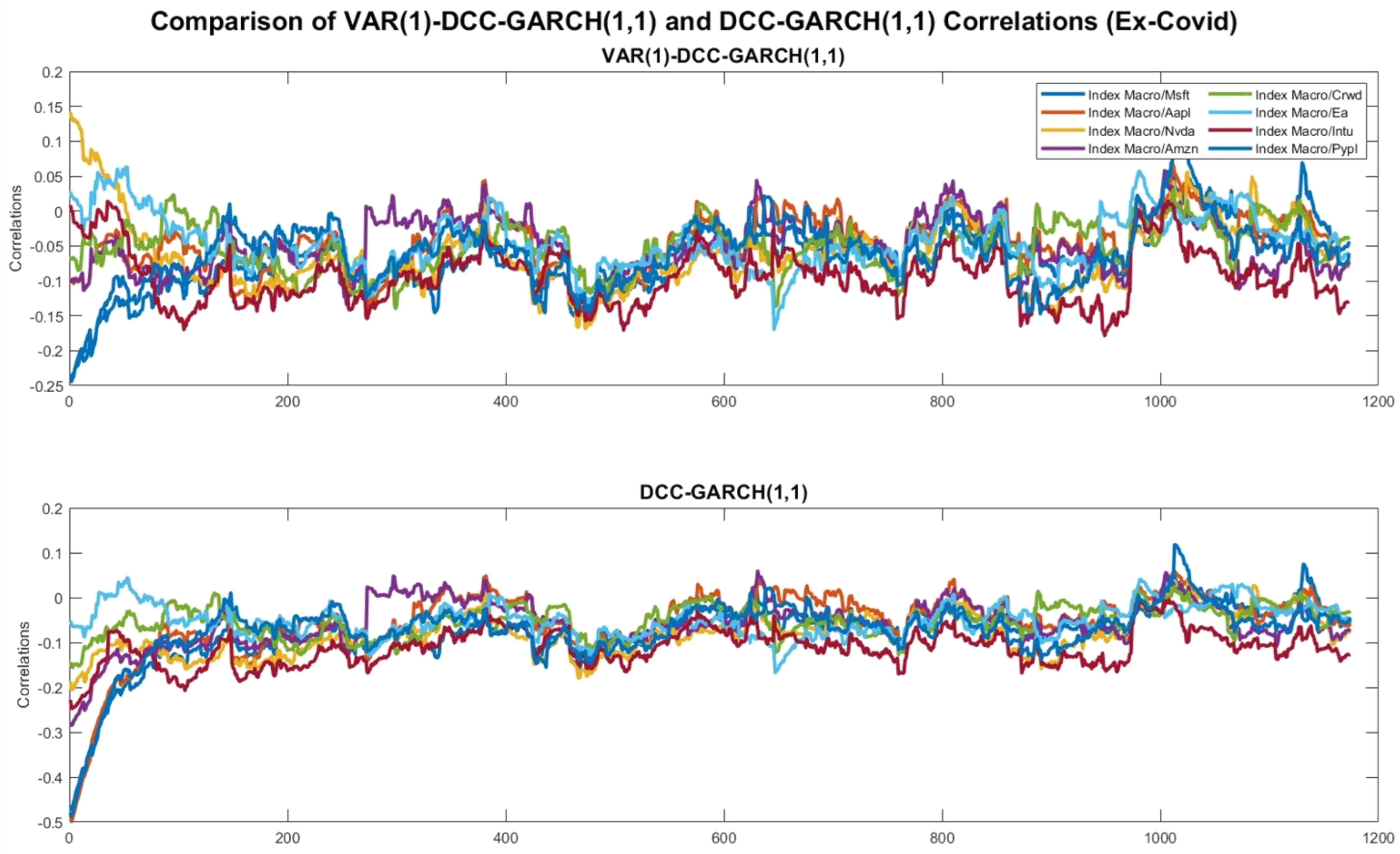


The term ‘Ex-Covid' denotes the exclusion of data relating to the months of February, March and April 2020 from the dataset.

Dynamic Correlations ($\hat{\Gamma}_t^{VAR-DCC}$)



Dynamic Correlations ($\hat{\Gamma}_t^{VAR-DCC}$), Ex–Covid



Model Selection

	α (Alpha)	β (Beta)
DCC–GARCH (1,1)	0.0091 *(0.0001)*	0.9701 *(0.0000)*
VAR(1)–DCC–GARCH (1,1)	0.0089 *(0.0024)*	0.9702 *(0.0000)*

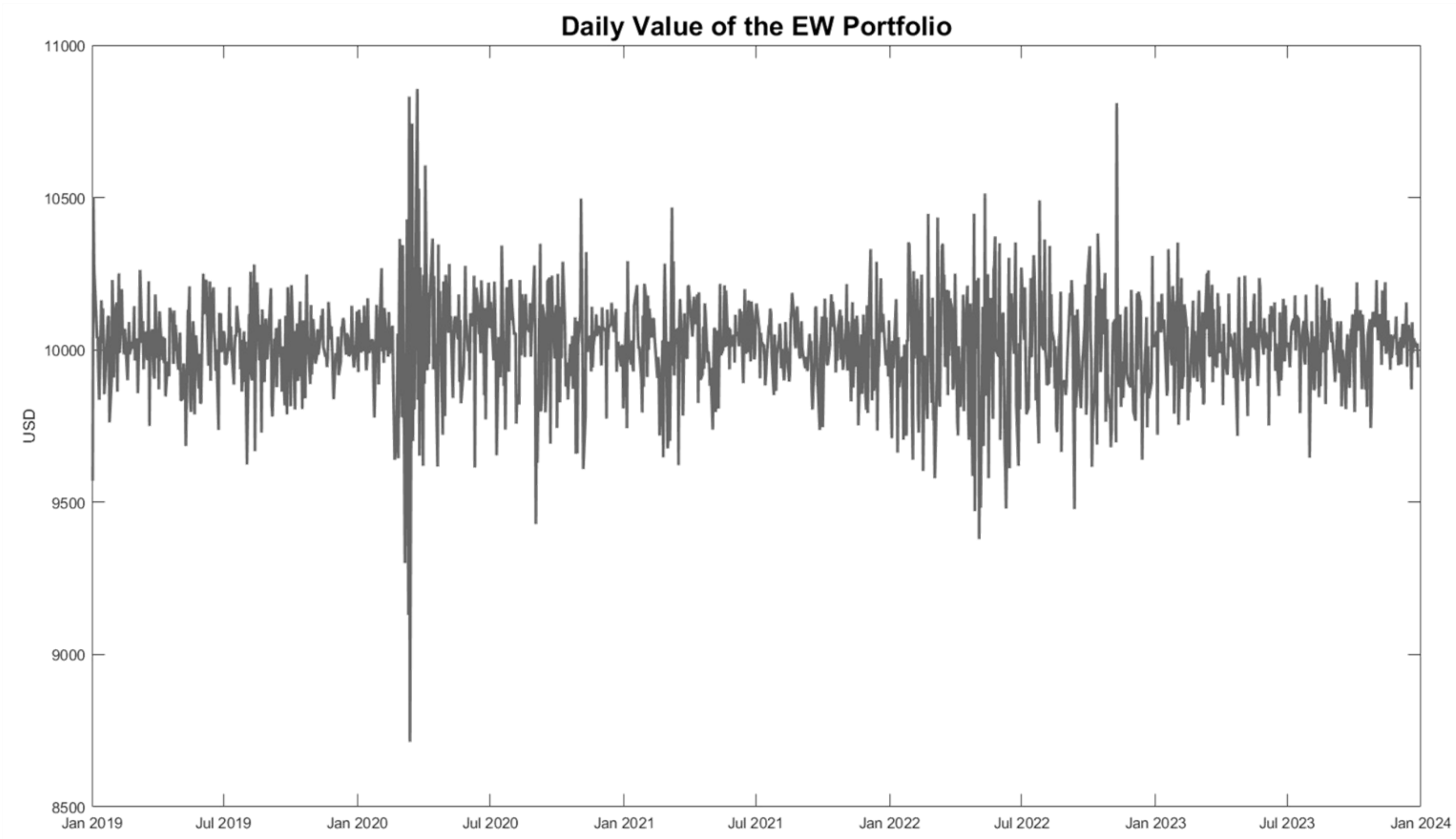
As seen for the trend in correlations, the parameter estimates also differ **marginally**: in particular, for both models, the impact of new information on correlations (α) is limited, while the persistence of correlations (β) tends to remain stable over time. The results are corroborated by the significant *p-values*.

Comparing the log-likelihood, however, the results confirm that the **VAR(1)–DCC–GARCH(1,1)** model offers a better fit to the data:

Likelihood Ratio Test

H_0	1
p-value	0

Empirical Results: Portfolio Construction

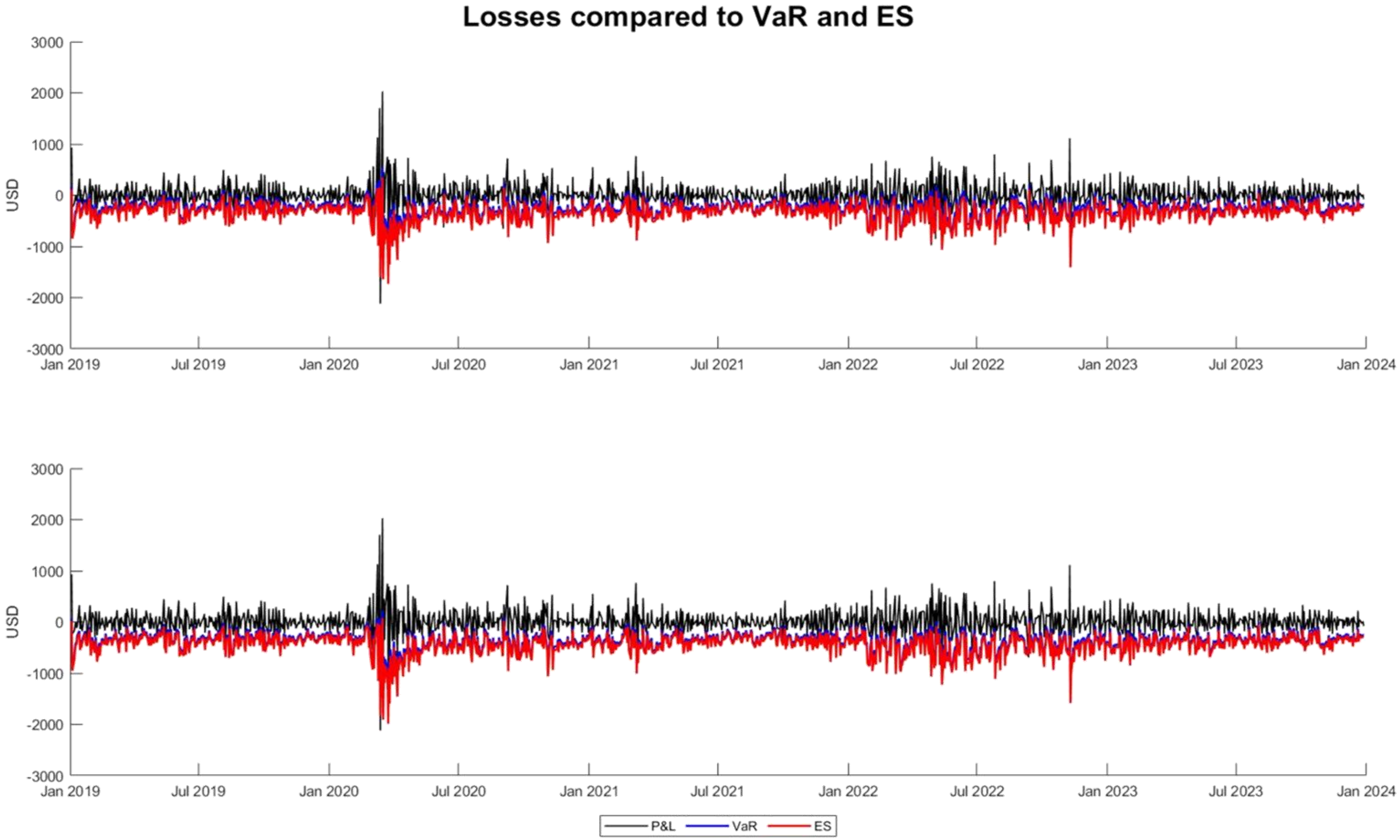


Assumptions

- US investor, no foreign exchange risk..
- Initial investment: $10.000.
- No transaction costs.
- Same weight for all assets.

$$E(r_P) = \sum_{i=1}^{n} w_i E(r_i) = w^T r$$

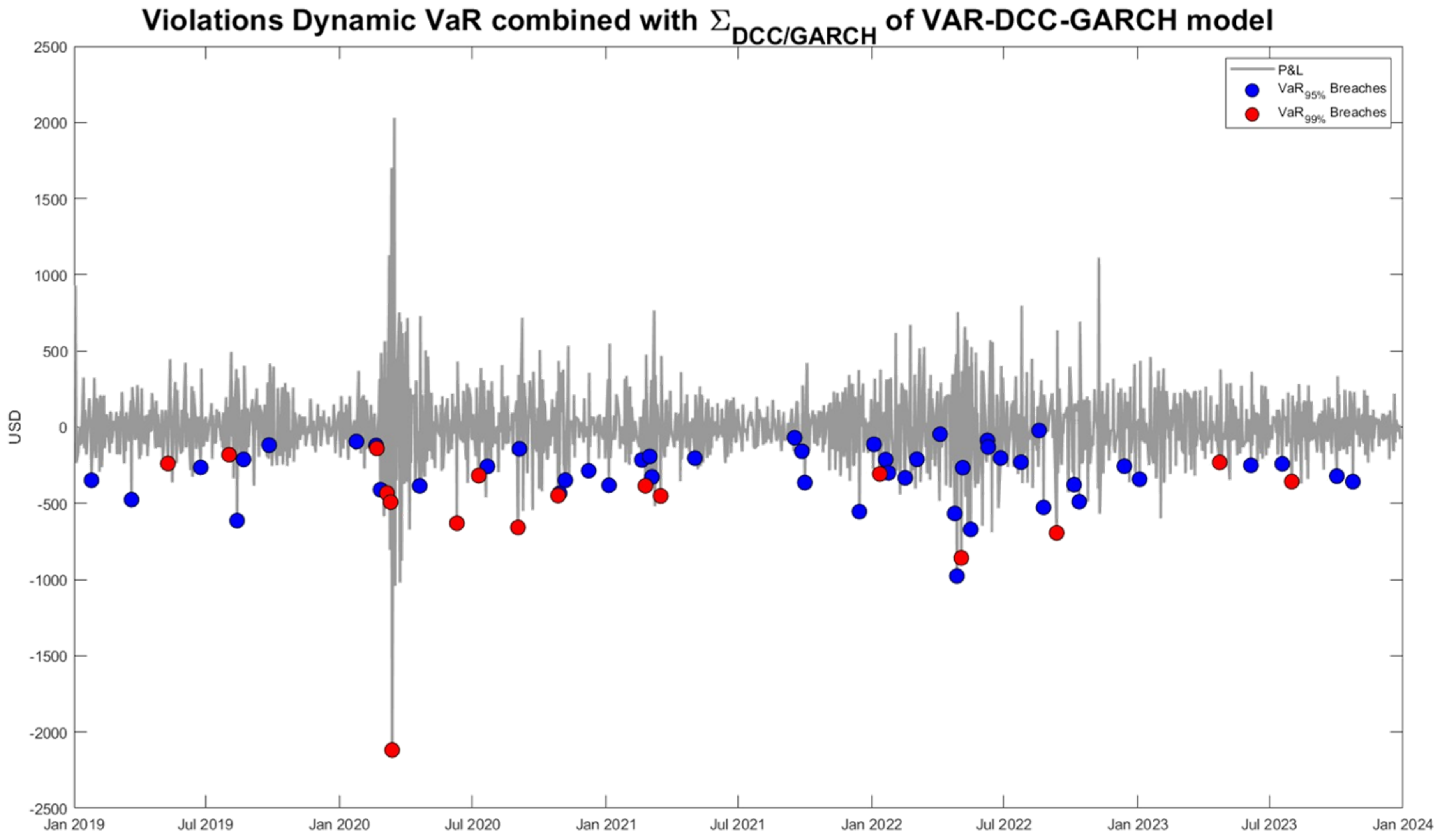
Empirical Results: Parametric Approach



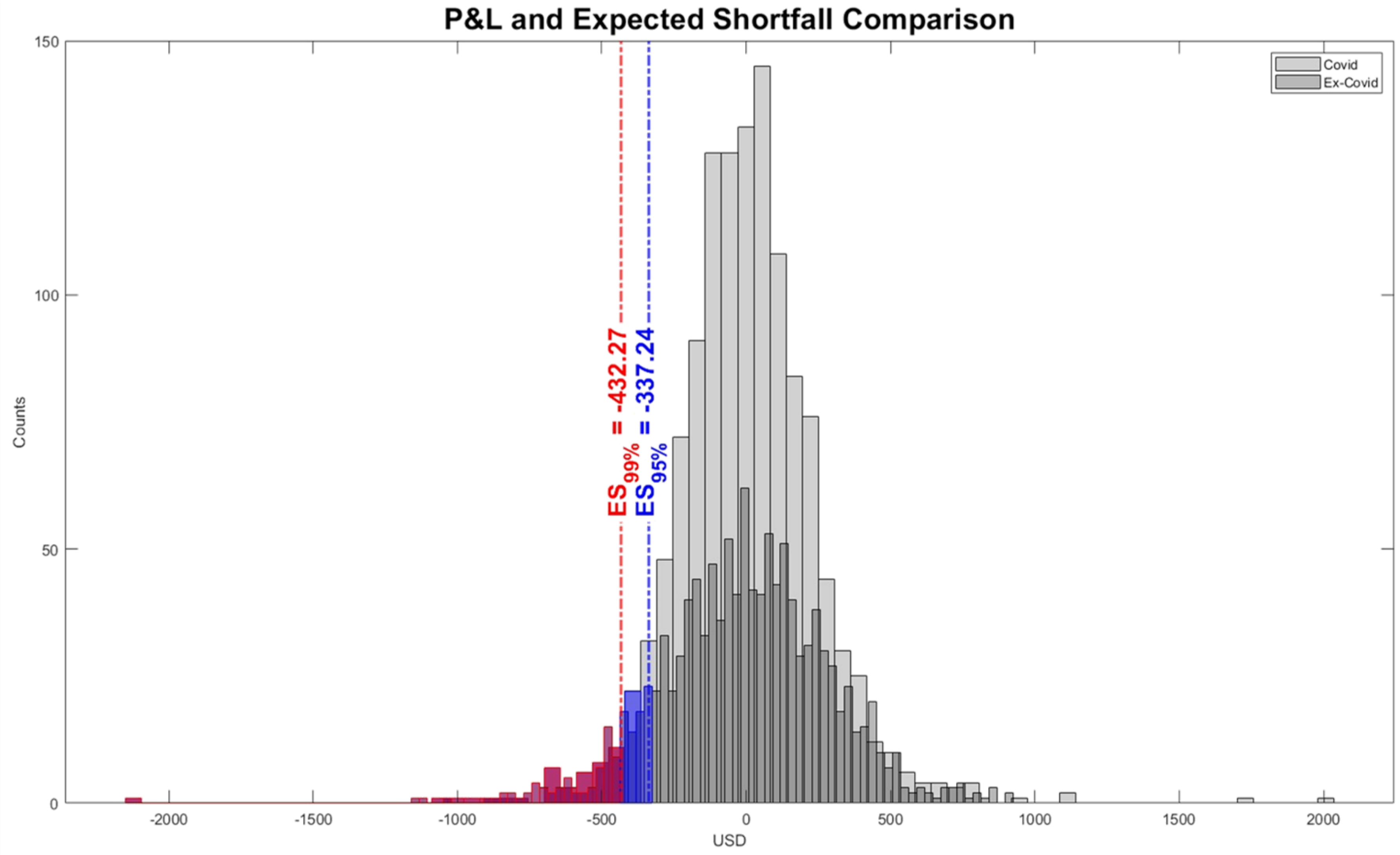
Empirical Results: Parametric Approach (cont'd)

Measures of Risk	Average	
	Covid	*Ex–Covid*
$VaR_{95\%}$	–271.34	–338.05
$VaR_{99\%}$	–378.82	–466.59
$ES_{95\%}$	–337.24	–416.86
$ES_{99\%}$	–423.27	–530.50

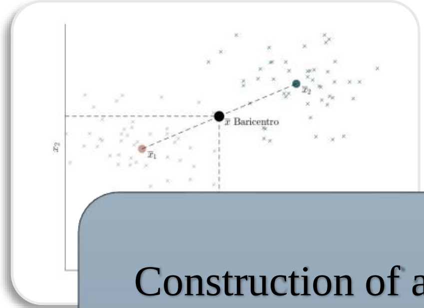
Empirical Results: VaR Breaches



Empirical Results: Expected Shortfall



Conclusions



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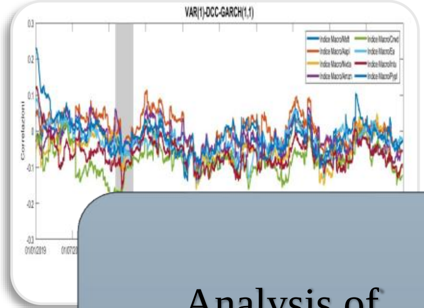

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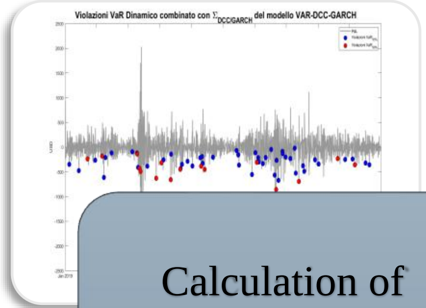

Calculation of *Dynamic* Risk Measures VaR and ES using Variance-Covariance Approach

- Importance of **data analysis** methodologies.
- More sophisticated econometric techniques are decisive for more **accurate** modelling of *second-order conditional moments*.
  - The exclusion of the most volatile months of the pandemic *reduced* the frequency of regime shifts between positive and negative correlations, stabilizing the correlation dynamics.
- The adoption of ES provides, compared to VaR, a more **precise** view of potential risk.
  - The exclusion of the most volatile months of the pandemic showed *higher* potential losses, suggesting the presence of other risk dynamics.