BENEFITS OF CMU

The stock market investors' view

ESM conference – EU Savings and Investments Union

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MOTIVATION

- Home bias persists:
  - Intra-EU equity HB has dropped in 2010s from 90% to 82% for EZ countries
  - EU investors remain heavily concentrated in domestic markets
- Low levels of corporate investments in some EU countries
- Several benefits of fostering CB investments:
  - Diversification strengthens resilience to economic shocks: capital markets channel of risk-sharing
  - Improve the allocation of savings (& the capacity to finance innovation)
  - More diversification should help improve the performance of investors' portfolios

THIS PAPER

Focus on the gains of further financial integration from the investor point of view

1. Realistic portfolio optimization:
    - Uses constrained portfolio optimization models
    - Compare optimal portfolio to a realistic reference portfolio
    - Out-of-sample analysis: Simulate real-time decision-making by investors
2. EU-centric approach: Assesses diversification within the EU, not globally
3. Robustness checks: Includes additional constraints on institutional quality and political risk
4. Performance under uncertainty: Examines effect of market volatility on diversification gains

DATA

- Scope: 21 EU countries, listed shares, daily data (2009–2023, 3,783 observations)
- Total return indexes (price + dividends/capital repayments): stationary, but not normally distributed
- Sources:
  - Market cap: World Federation of Exchanges, World Bank
  - GDP: World Bank, OECD
  - Volatility: VSTOXX (market volatility quintiles)
  - Institutional quality: World Bank WGI (Voice & accountability, political stability, rule of law)
    → *Robustness check: Alternative indicators (Coppedge et al., 2023)*

MAIN ASSUMPTIONS

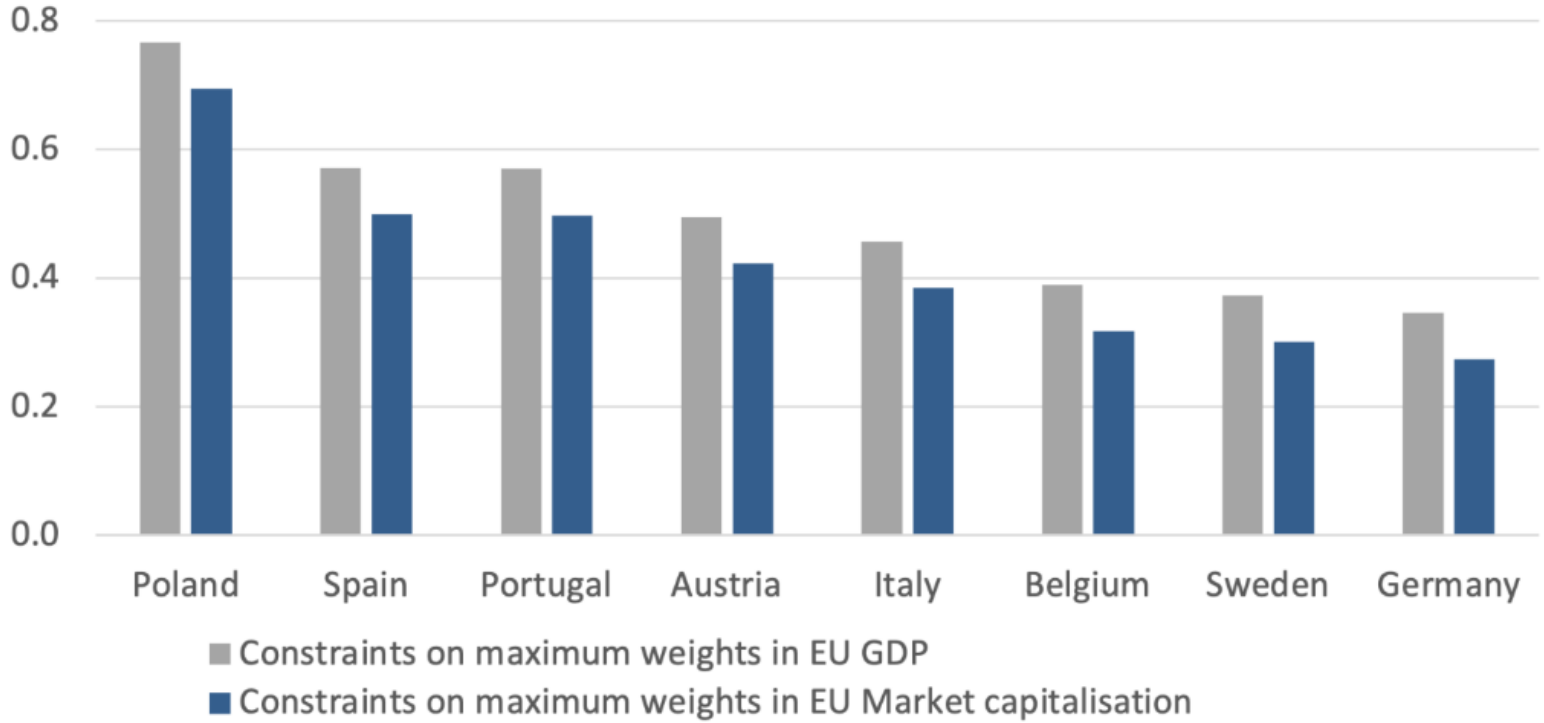
- Portfolios follow national indexes: no optimization within national indexes
- Intra-EU reallocation only: external exposures unchanged
- Risk free rate: 1-month Euribor
- Reference portfolio:
  - Based on IMF (CPIS) and ECB data (mutual fund investments)
  - Use 3-step method (Monti & Felettigh, 2008) to adjust for mutual funds' role
  - Benchmark: representative national investor (stable over sample period)

  → *Robustness: 100% domestic portfolio as alternative*

METHODS

- Optimal distribution and diversification gains using the mean-variance optimization framework
- Performance metric: **Delta Sharpe ratio** = optimal SR – benchmark SR
- Rolling-window approach (DeMiguel et al., 2009):
    1. Estimate optimal weights using past 3 years
    2. Apply weights for the next 6 months
    3. Roll forward and repeat
- Test significance: bootstraps accounting for non-normal returns (Ledoit&Wolf 2008, 2011)
- Portfolio strategies:
    - Heuristic portfolios: 1/N, market capitalization or GDP weighted
    - Max Sharpe ratio: without and with constraints (no short selling, limits based on GDP/market cap)
    - Min variance: same constraints
    - ICA-based: a combination of minimum variance and risk parity portfolios

SIGNIFICANT GAINS FOR 8 COUNTRIES – DELTA SHARPE RATIOS



Note: **The Sharpe ratio compares the return of a portfolio with its risk. The delta Sharpe is the difference between the annualised Sharpe ratios of the optimal portfolio and of the national realistic reference portfolio (see Gossé and Jehle 2024).**

- Gains are statistically significant (10% level) for 8 countries
- Larger gains with constraints based on GDP
- These countries represent over 50% of listed equity investment in the EU

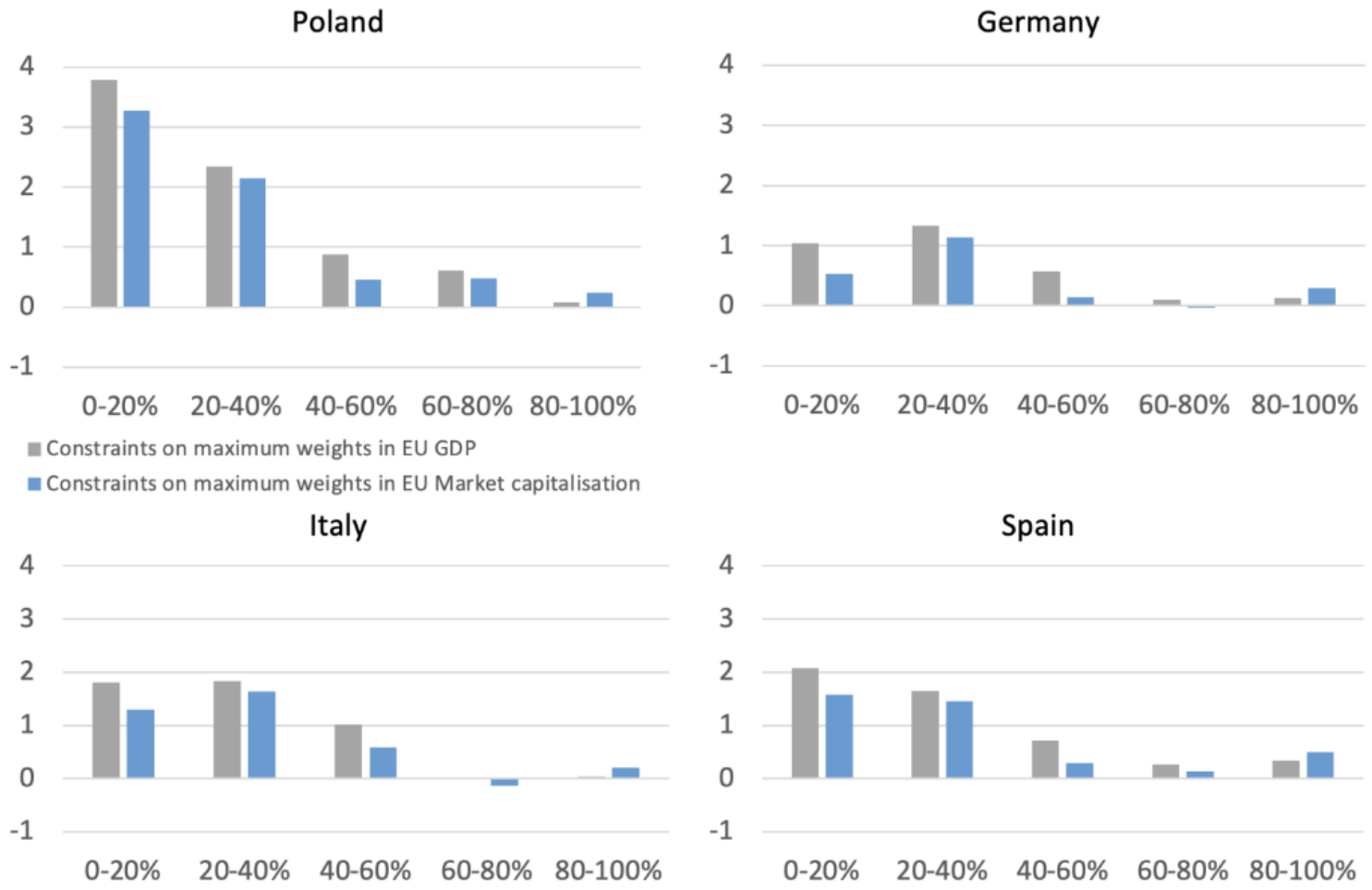
CEEC'S SHARE IN EU MARKET CAP, GDP, AND OPTIMAL PORTFOLIOS (%)

	Share in the EU		Share in optimal portfolio	
	Market capitalisation	GDP	Constraints on maximum weights in EU Market capitalisation	Constraints on maximum weights in EU GDP
Mean CEECs share over the period	3.4	9.4	5.4	20.9

***Note*: Shares are expressed as a % of the total market capitalisation, total GDP, and the total investments made in EU stock markets by European investors (for optimal portfolios).**

- Gains achieved by reallocating investments toward other EU countries, especially CEECs
- This requires deeper equity markets in some countries, particularly in CEECs
- Cross-border investment should be supported (e.g., Capital Markets Union)
- Convergence in capital market size (as % of GDP) would:
  - Increase diversification gains
  - Raise CEECs' share in portfolios to over 20%

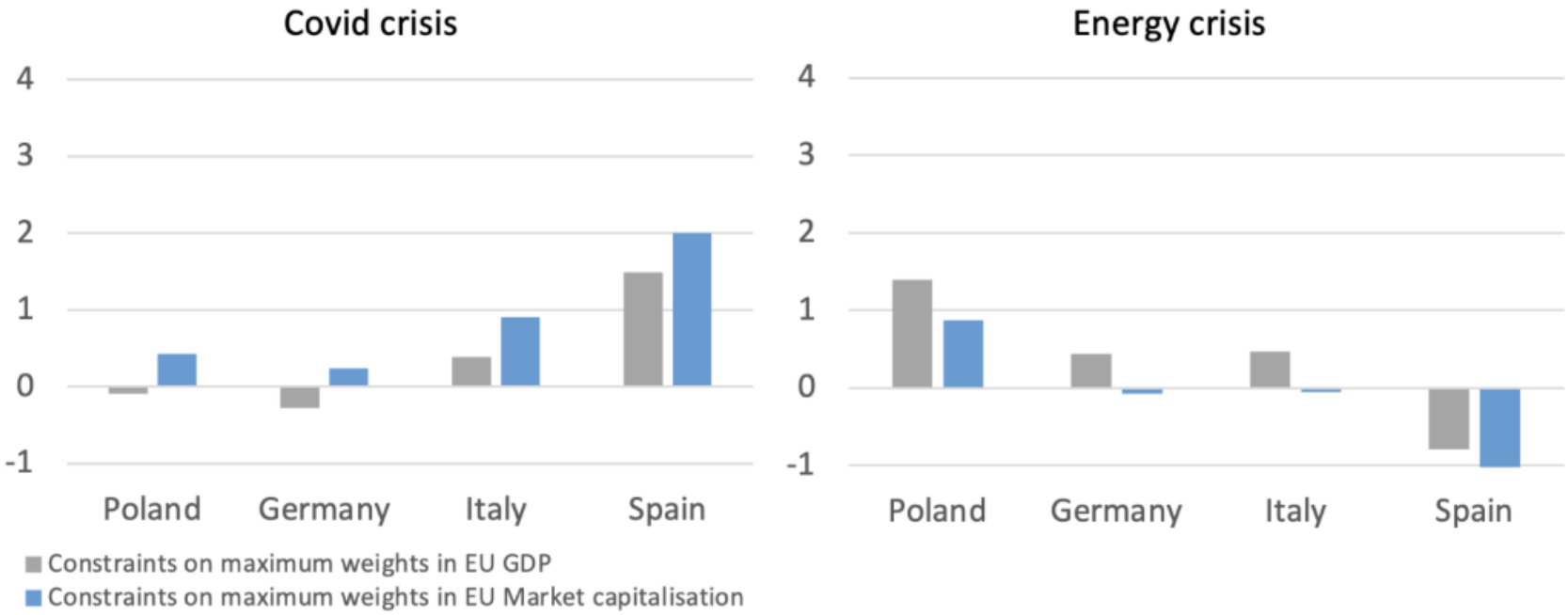
LEVEL OF VOLATILITY – DELTA SHARPE RATIOS



***Note*: The figures show the delta Sharpe ratio for the different quantiles of market volatility (measured with the VSTOXX).**

- Market volatility levelsclassified into quintiles (VSTOXX)
- Optimal portfolio models perform better in low-volatility periods
- Notably in Poland, Germany, Italy, and Spain
- Gains are limited or negligible during high-volatility periods

COVID AND ENERGY CRISES – DELTA SHARPE RATIO



***Note*: The figures show the delta Sharpe ratio for the quantiles of market volatility (measured with the VSTOXX) for the periods of high volatility (using the same 80% threshold as in Figure 1) following the Covid (March to July 2021) and energy crises (March to June 2022).**

Delta Sharpe ratio during crises mirrors high-volatility trends, with exceptions:

- Spain: Higher SR during COVID, lower during energy crisis
- Poland: Higher SR during energy crisis

DIVERSIFICATION GAINS ARE NOT ASSOCIATED WITH LOWER INSTITUTIONAL QUALITY OR HIGHER POLITICAL RISK

Table. CEEC's mean share with constraints on institutional indicators for the four largest countries exhibiting significant gains

	Share in optimal portfolio: limit on the share in EU market capitalisation			Share in optimal portfolio: limit on the share in EU GDP		
	Rule of law	Voice and accountability	Political stability	Rule of law	Voice and accountability	Political stability
Germany	5	4.2	5.4	14.7	9.5	20.9
Italy	5.4	5.4	5.4	20.9	20.9	20.9
Poland	5.4	5.4	5.1	20.9	20.9	20
Spain	5.4	5.4	5.4	20.9	20.9	20.9

***Note*: Results are expressed as a percentage of the optimal portfolio.**

- Political risk may deter investors from reallocating portfolios toward higher-risk countries, especially amid democratic decline and geopolitical tensions
- Additional constraints: ensure optimal portfolios maintain or improve average institutional quality
- CEECs' portfolio share remains elevated, even with institutional and GDP constraints

CONCLUSIONS

- **Significant diversification gains** are possible for EU investors by reducing home bias and diversifying more across EU countries
- **Out-of-sample estimates show improved performance** for up to 8 EU countries covering more than 50% of total EU investment in listed shares
- Diversification benefits are **particularly robust in four large EU countries** and are more pronounced during periods of low market volatility
- **Institutional quality and political risk constraints do not reduce gains –** portfolios remain compatible with investor preferences
- **Developing CEEC capital markets** is key to meeting increased demand from diversified portfolios
- Results support further progress on the CMU to boost CB investments and market integration

APPENDIX

SUMMARY STATISTICS OF THE ANNUALISED RETURNS OF LISTED SHARES FOR FULLY DOMESTIC PORTFOLIOS AND THE REALISTIC REFERENCE PORTFOLIOS

Country	Cap_i (%)	Domestic MSCI indices			Realistic reference portfolios			
		Mean (%)	Standard Deviation (%)	Sharpe ratio	Mean (%)	Standard Deviation (%)	Sharpe ratio	Amount of EU listed shares held (M€)
AT	1.2	8.2	31.4	0.26	10	26.1	0.38	74,386
BE	4.5	11.5	23.6	0.49	10.6	21.7	0.49	168,15
BG	0.2	1.5	25.2	0.06	4.2	23	0.18	4618
CZ	0.3	10.5	24.4	0.43	10.3	20.5	0.5	13,611
DK	3.3	22.4	22.7	0.99	20.9	20.5	1.02	172,755
EE	0	13.2	25.5	0.52	10.4	19.5	0.54	1665
FI	2.4	9.7	25.8	0.38	13.2	22	0.6	109,923
FR	24.9	13.4	24.1	0.56	14.7	22	0.67	1,288,499
DE	20.7	11.2	24.4	0.46	11.9	22.3	0.53	828,909
HU	0.2	10.2	36.1	0.28	10.9	25.2	0.43	9988
IE	1.7	11.5	29.5	0.39	12.9	23.1	0.56	166,117
IT	7	7.9	29.4	0.27	11.3	26.9	0.42	262,231
LT	0	15.7	18.2	0.86	10.9	14.7	0.74	2853
NL	9.4	17.1	23.4	0.73	15.6	21.3	0.73	205,822
PL	2	4.5	31.5	0.14	3.1	27.7	0.11	77,564
PT	0.7	5.1	24.6	0.21	6.9	22.5	0.31	14,758
RO	0.3	17.3	29.3	0.59	20.9	21.9	0.96	8758
SI	0.1	11	19.9	0.55	14.2	18.5	0.77	4363
ES	11.8	6.4	27.7	0.23	7.7	25	0.31	392,628
SE	8.4	16.4	28.4	0.58	12.2	24.2	0.51	423,217

Note. Cap_i is the share of each country's capitalisation among all European countries in 2014 as a %. Values for the mean, the standard deviation and the Sharpe ratio are also annualised. The amount of EU listed shares includes both foreign and domestic shares.

METHODS – OPTIMIZATION STRATEGIES

Sharpe ratio & Delta sharpe ratio: $$\mathrm{SR} = \frac{w^T(\mu - r_f)}{(w^T V w)^{1/2}} \qquad \Delta\,\mathrm{SR} = \mathrm{SR}_{\mathrm{optimal}} - \mathrm{SR}_{\mathrm{RRP}}$$

Maximum sharpe ratio approach: $$w^{MSR} = \underset{w \in A}{\operatorname{argmax}} \quad SR(w) = \underset{w \in A}{\operatorname{argmax}} \quad \frac{w^T(\mu - r_f)}{(w^T V w)^{1/2}}$$

Minimum variance approach: $$w^{MVP} = \underset{w \in A}{\operatorname{argmin}} \quad V(w) = \underset{w \in A}{\operatorname{argmin}} \quad w^T V w$$

Independent component analysis approach: $$w^{ICMV} = (1 - \delta) w^{MVP} + \delta w^{IC} \qquad (5)$$

Where δ is the shrinkage intensity which is computed via a 10-fold cross-validation.

BASELINE: RRPS AND OPTIMAL PORTFOLIOS: DELTA SHARPE RATIOS

	RRP	Heuristic models			Maximum Sharpe Ratio approach						Minimum Variance approach						
		Eq-w	MC-w	GDP-w	MSR-short	MSR-noshort	MSR-MC-max	MSR-MC-min&max	MSR-GDP-max	MSR-GDP-min&max	MV-short	MV-noshort	MV-MC-max	MV-MC-min&max	MV-GDP-max	MV-GDP-min&max	ICMV
AT	0.384	0.184	0.21	0.325**	−0.082	0.462	0.416*	0.4*	0.429**	0.389*	0.585	0.484	0.399*	0.371*	0.44**	0.411**	0.512
BE	0.489	0.079	0.105	0.22	−0.187	0.356	0.311*	0.294*	0.324**	0.284*	0.48	0.379	0.293*	0.266*	0.334**	0.306*	0.407
BG	0.183	0.385	0.41	0.526	0.118	0.662	0.617	0.6	0.629	0.59	0.785**	0.685*	0.599	0.572	0.64	0.612	0.713**
CZ	0.501	0.067	0.092	0.208	−0.199	0.344	0.299	0.282	0.311	0.272	0.468	0.367	0.281	0.254	0.322	0.294	0.395
DK	1.021	−0.453*	−0.428	−0.313	−0.72*	−0.176	−0.221	−0.238	−0.209	−0.248	−0.053	−0.154	−0.239	−0.266	−0.198	−0.226	−0.125
EE	0.535	0.033	0.058	0.174	−0.233	0.31	0.265	0.248	0.278	0.238	0.434	0.333	0.247	0.22	0.288	0.26	0.361
FI	0.603	−0.034	−0.009	0.106	−0.301	0.243	0.198	0.181	0.21	0.171	0.366	0.265	0.18	0.152	0.221	0.193	0.294
FR	0.667	−0.099	−0.074	0.042	−0.365	0.178	0.133	0.116	0.146	0.106	0.302	0.201	0.115	0.088	0.156	0.128	0.229
DE	0.533	0.035	0.061	0.176	−0.231	0.313	0.267*	0.251*	0.28**	0.24*	0.436	0.335	0.25*	0.222*	0.291*	0.262*	0.364
HU	0.435	0.133	0.159	0.274	−0.133	0.411	0.365	0.348	0.378	0.338	0.534	0.433	0.348	0.32	0.388	0.36	0.461
IE	0.559	0.009	0.035	0.15	−0.257	0.287	0.241	0.224	0.254	0.214	0.41	0.309	0.223	0.196	0.264	0.236	0.337
IT	0.422	0.147	0.172	0.287*	−0.12	0.424	0.379*	0.362*	0.391*	0.352*	0.547	0.446	0.361*	0.333*	0.402**	0.374**	0.475
LT	0.742	−0.174	−0.148	−0.033	−0.44	0.104	0.058	0.042	0.071	0.031	0.227	0.126	0.041	0.013	0.081	0.053	0.154
NL	0.734	−0.166	−0.141	−0.025	−0.432	0.111	0.066	0.049	0.079	0.039	0.235	0.134	0.048	0.021	0.089	0.061	0.162
PL	0.113	0.455*	0.481*	0.596**	0.189	0.733**	0.687**	0.671**	0.7**	0.66**	0.856**	0.755**	0.67**	0.642**	0.711***	0.682***	0.783**
PT	0.309	0.259	0.285	0.4*	−0.007	0.536	0.491*	0.474*	0.504**	0.464*	0.66*	0.559	0.473*	0.446*	0.514**	0.486**	0.587*
RO	0.957	−0.389	−0.363	−0.248	−0.655	−0.111	−0.157	−0.174	−0.144	−0.184	0.012	−0.089	−0.174	−0.202	−0.134	−0.162	−0.061
SI	0.766	−0.197	−0.172	−0.057	−0.464	0.08	0.035	0.018	0.047	0.007	0.203	0.102	0.017	−0.011	0.058	0.03	0.131
ES	0.307	0.261*	0.286*	0.401**	−0.006	0.538	0.493**	0.476**	0.505**	0.466**	0.661*	0.561	0.475**	0.448**	0.516**	0.488**	0.589
SE	0.506	0.062	0.088	0.203	−0.204	0.34	0.294*	0.278*	0.307**	0.267*	0.463	0.362	0.277*	0.249	0.318*	0.289	0.391

Note: The first column shows the Sharpe ratio of the realistic reference portfolio and the other columns the delta Sharpe ratio for each portfolio (compared to the Sharpe ratio of the RRP). Sharpe ratio values are annualised. For t-statistics from the Ledoit and Wolf (2008) test, * (**/***) indicates significance at the 10% level (5%level/1%level). Appendix E presents the mean out-of-sample perfomances of the different maximised portfolios. Abbreviations of models are summarised in Table 2.

BASELINE: RRP AND OPTIMAL PORTFOLIOS: REDUCTION IN THE LOG-VARIANCE

	RRP	Heuristic models			Maximum Sharpe Ratio approach						Minimum Variance approach						
		Eq-w	MC-w	GDP-w	MSR-short	MSR-noshort	MSR-MC-max	MSR-MC-min&max	MSR-GDP-max	MSR-GDP-min&max	MV-short	MV-noshort	MV-MC-max	MV-GDP-max	MV-MC-min&max	MV-GDP-min&max	ICMV
AT	−2.69	−0.43***	−0.42***	−0.97***	0.88***	−1.19***	−0.56***	−0.57***	−0.75***	−0.73***	−1.77***	−1.79***	−0.68***	−0.67***	−0.89***	−0.87***	−1.71***
BE	−3.06	−0.06**	−0.05	−0.6***	1.25***	−0.82***	−0.19***	−0.2***	−0.38***	−0.36***	−1.4***	−1.42***	−0.31***	−0.3***	−0.52***	−0.5***	−1.34***
BG	−2.94	−0.18**	−0.17**	−0.72***	1.13***	−0.94***	−0.31***	−0.32***	−0.5***	−0.48***	−1.52***	−1.54***	−0.43***	−0.42***	−0.64***	−0.62***	−1.46***
CZ	−3.17	0.06	0.07	−0.48***	1.37***	−0.7***	−0.07	−0.08	−0.26***	−0.25***	−1.28***	−1.3***	−0.2***	−0.18***	−0.4***	−0.38***	−1.22***
DK	−3.17	0.05	0.07	−0.49***	1.37***	−0.71***	−0.08*	−0.09**	−0.26***	−0.25***	−1.28***	−1.3***	−0.2***	−0.19***	−0.41***	−0.38***	−1.22***
EE	−3.27	0.15*	0.16*	−0.39***	1.47***	−0.61***	0.02	0.01	−0.17**	−0.15*	−1.19***	−1.21***	−0.1	−0.09	−0.31***	−0.29***	−1.12***
FI	−3.03	−0.09*	−0.07*	−0.62***	1.23***	−0.84***	−0.22***	−0.23***	−0.4***	−0.39***	−1.42***	−1.44***	−0.34***	−0.33***	−0.55***	−0.52***	−1.36***
FR	−3.03	−0.09***	−0.08***	−0.63***	1.23***	−0.85***	−0.22***	−0.23***	−0.41***	−0.39***	−1.43***	−1.45***	−0.34***	−0.33***	−0.55***	−0.53***	−1.37***
DE	−3	−0.11***	−0.1***	−0.65***	1.2***	−0.87***	−0.24***	−0.25***	−0.43***	−0.42***	−1.45***	−1.47***	−0.37***	−0.35***	−0.57***	−0.55***	−1.39***
HU	−2.76	−0.36***	−0.35***	−0.9***	0.96***	−1.12***	−0.49***	−0.5***	−0.68***	−0.66***	−1.7***	−1.72***	−0.61***	−0.6***	−0.82***	−0.8***	−1.63***
IE	−2.93	−0.18***	−0.17***	−0.72***	1.13***	−0.94***	−0.31***	−0.32***	−0.5***	−0.49***	−1.52***	−1.54***	−0.44***	−0.42***	−0.64***	−0.62***	−1.46***
IT	−2.63	−0.49***	−0.47***	−1.03***	0.83***	−1.25***	−0.62***	−0.63***	−0.81***	−0.79***	−1.83***	−1.85***	−0.74***	−0.73***	−0.95***	−0.92***	−1.76***
LT	−3.84	0.72***	0.74***	0.18**	2.04***	−0.04	0.59***	0.58***	0.4***	0.42***	−0.62***	−0.64***	0.47***	0.48***	0.26	0.29***	−0.55***
NL	−3.1	−0.02	−0.01	−0.56***	1.3***	−0.78***	−0.15***	−0.16***	−0.34***	−0.32***	−1.36***	−1.38***	−0.27***	−0.26***	−0.48***	−0.46***	−1.3***
PL	−2.57	−0.55***	−0.54***	−1.09***	0.76***	−1.31***	−0.68***	−0.69***	−0.87***	−0.85***	−1.89***	−1.91***	−0.8***	−0.79***	−1.01***	−0.99***	−1.83***
PT	−2.99	−0.13***	−0.12***	−0.67***	1.18***	−0.89***	−0.26***	−0.27***	−0.45***	−0.44***	−1.47***	−1.49***	−0.38***	−0.37***	−0.59***	−0.57***	−1.41***
RO	−3.04	−0.08	−0.07	−0.62***	1.24***	−0.84***	−0.21*	−0.22*	−0.4***	−0.38***	−1.42***	−1.44***	−0.33**	−0.32***	−0.54***	−0.51***	−1.35***
SI	−3.37	0.25***	0.27***	−0.28***	1.57***	−0.5***	0.13*	0.12*	−0.06	−0.05	−1.08***	−1.1***	0	0.02	−0.2***	−0.18***	−1.02***
ES	−2.78	−0.34***	−0.33***	−0.88***	0.97***	−1.1***	−0.47***	−0.48***	−0.66***	−0.65***	−1.68***	−1.7***	−0.59***	−0.58***	−0.8***	−0.78***	−1.62***
SE	−2.84	−0.28***	−0.27***	−0.82***	1.04***	−1.04***	−0.41***	−0.42***	−0.6***	−0.58***	−1.62***	−1.64***	−0.53***	−0.52***	−0.74***	−0.71***	−1.55***

Note: The first column shows the annualised log-variance of the realistic reference portfolio and the other columns the reduction in the log-variance for each portfolio (compared to the log-variance of the RRP). For t-statistics from the Ledoit and Wolf (2011) test, * (**/***) indicates significance at the 10% level (5%level/1%level). Abbreviations of models are summarised in Table 2.

DELTA SHARPE RATIOS – CONSTRAINTS ON INSTITUTIONAL INDICATORS

	MSR-MC-max			MSR-GDP-max			MV-MC-max			MV-GDP-max		
	RL	VA	PS	RL	VA	PS	RL	VA	PS	RL	VA	PS
AT	0.417*	0.417*	0.361	0.349*	0.362*	0.393*	0.483**	0.425*	0.481**	0.389**	0.408*	0.475**
BE	0.311*	0.311*	0.307*	0.347**	0.306*	0.313*	0.293*	0.311**	0.293*	0.35**	0.317**	0.332**
BG	0.617	0.617	0.617	0.629	0.629	0.629	0.599	0.599	0.599	0.64	0.64	0.64
CZ	0.299	0.299	0.297	0.309	0.311	0.328	0.281	0.281	0.35	0.323	0.322	0.355
DK	–	–	−0.205	–	–	−0.195	–	–	−0.158	–	–	−0.129
EE	0.265	0.267	0.265	0.283	0.294	0.278	0.244	0.247	0.248	0.303	0.29	0.288
FI	–	–	0.198	–	–	0.21	–	–	0.18	–	–	0.221
FR	0.133	0.133	0.023	0.173	0.161	0.072	0.115	0.115	0.142	0.163	0.153	0.127
DE	0.27*	0.268*	0.267*	0.264**	0.206*	0.281**	0.273*	0.28**	0.255*	0.324**	0.255**	0.295*
HU	0.365	0.365	0.365	0.378	0.378	0.378	0.348	0.348	0.36	0.388	0.388	0.393
IE	0.241	0.241	0.249	0.262	0.251	0.274*	0.223	0.215	0.3*	0.296*	0.25	0.335**
IT	0.379*	0.379*	0.379*	0.391*	0.391*	0.391*	0.361*	0.361*	0.361*	0.402**	0.402**	0.402**
LT	0.058	0.058	0.058	0.071	0.071	0.073	0.041	0.041	0.065	0.081	0.081	0.108
NL	0.076	0.061	0.052	0.019	0.003	0.052	0.112	0.076	0.107	0.112	0.06	0.135
PL	0.687**	0.687**	0.675**	0.7**	0.7**	0.664**	0.67**	0.67**	0.668**	0.711***	0.711***	0.695***
PT	0.491*	0.491*	–	0.5**	0.526**	–	0.473**	0.473*	–	0.514**	0.521**	–
RO	−0.157	−0.157	−0.157	−0.144	−0.144	−0.144	−0.174	−0.174	−0.174	−0.134	−0.134	−0.134
SI	0.035	0.035	0.051	0.047	0.047	0.073	0.017	0.017	0.097	0.058	0.058	0.123
ES	0.493**	0.493**	0.493**	0.505**	0.505**	0.505**	0.475**	0.475**	0.475**	0.516**	0.516**	0.516**
SE	–	–	–	–	–	–	–	–	–	–	–	–

Note: RL stands for *Rule of law* (VA and PS for *Voice and accountability* and *Political stability* respectively) and indicates that constraint (6) is used as an additional constraint. When optimal portfolios cannot improve the mean institutional indicator in the training periods, no values are reported. This is the case for Denmark, Finland, Portugal and Sweden. Values for the Sharpe ratio are annualised. Abbreviations of models are summarised in Table 2.

CEEC MEAN SHARE WITH CONSTRAINTS ON INSTITUTIONAL INDICATORS

	MSR-MC-max			MSR-GDP-max			MV-MC-max			MV-GDP-max		
	RL	VA	PS	RL	VA	PS	RL	VA	PS	RL	VA	PS
AT	2.2	4.3	3.7	3.3	8.4	13.4	5.3	9.1	9.5	8.4	11.6	21.9
BE	5.4	4.6	5.4	19.5	13.7	20.7	13	12.4	13	25.0	17.5	34
BG	5.4	5.4	5.4	20.9	20.9	20.9	13	13	13	34.0	34.0	34
CZ	5.4	5.4	4.1	20.9	20.9	16	13	13	10.1	33.7	34.0	24.5
DK	–	–	4.8	–	–	17.4	–	–	10.9	–	–	28.6
EE	5.4	5.3	5.4	20.1	18.6	20.9	13	13	13	29.9	29.5	34
FI	–	–	5.4	–	–	20.9	–	–	13	–	–	34
FR	5.4	5.4	2.7	19.5	20	9.1	13	13	6.7	26	28.9	17.2
DE	5	4.2	5.4	14.7	9.5	20.9	12.4	9.3	13	18.8	12.9	34
HU	5.4	5.4	5.4	20.9	20.9	20.9	13	13	13	34.0	34	33.9
IE	5.4	5.1	5.2	18.6	16.1	19.4	13	12.7	11.4	24.3	19.9	30.9
IT	5.4	5.4	5.4	20.9	20.9	20.9	13	13	13	34.0	34.0	34
LT	5.4	5.4	5.4	20.9	20.9	20.9	13	13	12.7	34.0	34.0	33.7
NL	4.2	4.2	4.7	8.8	7.5	18.1	9.2	7.8	12	14.4	10.8	28.4
PL	5.4	5.4	5.1	20.9	20.9	20	13	13	13	34.0	34.0	32.2
PT	5.4	5.4	–	20.9	19.8	–	13	13	–	33.9	32.5	–
RO	5.4	5.4	5.4	20.9	20.9	20.9	13	13	13	34.0	34.0	34
SI	5.4	5.4	5.1	20.9	20.9	18.6	13	13	12.1	34.0	34.0	30.1
ES	5.4	5.4	5.4	20.9	20.9	20.9	13	13	13	34.0	34.0	34
SE	–	–	–	–	–	–	–	–	–	–	–	–

Note: RL stands for *Rule of law* (VA and PS for *Voice and accountability* and *Political stability* respectively) and indicates that constraint (6) is used as an additonal constraint. When optimal portfolios cannot improve the mean institutional indicator in the training periods, no values are reported. Results are expressed as a percentage of the optimal portfolio. Abbreviations of models are summarised in Table 2.

SHARPE RATIOS – ROBUSTNESS ANALYSIS

	Investing in the euro area				Alternative restrictions on the portfolios' weights				Returns expressed in domestic currency				Domestic portfolio			
	MSR-MC-max	MSR-GDP-max	MV-MC-max	MV-GDP-max	MSR-MC-max	MSR-GDP-max	MV-MC-max	MV-GDP-max	MSR-MC-max	MSR-GDP-max	MV-MC-max	MV-GDP-max	MSR-MC-max	MSR-GDP-max	MV-MC-max	MV-GDP-max
AT	0.389*	0.384*	0.347*	0.326	0.372*	0.395**	0.332*	0.327*	0.426*	0.449**	0.386*	0.424**	0.485*	0.498**	0.468*	0.509**
BE	0.283*	0.278	0.242*	0.221*	0.267*	0.289**	0.226*	0.222	0.32*	0.343**	0.28*	0.318*	0.389*	0.401**	0.371*	0.412**
BG	–	–	–	–	0.573	0.595	0.532	0.527	0.627	0.65	0.587	0.625	0.645	0.657	0.627	0.668
CZ	–	–	–	–	0.255	0.277	0.214	0.209	0.317	0.34	0.277	0.315	0.354	0.367	0.337	0.378
DK	–	–	–	–	−0.265	−0.243	−0.306	−0.311	−0.221	−0.198	−0.261	−0.223	−0.239	−0.226	−0.257	−0.216
EE	0.249	0.244	0.207	0.186	0.221	0.243	0.18	0.176	0.27	0.293	0.23	0.268	0.328	0.34	0.31	0.351
FI	0.176	0.172	0.135	0.114	0.153	0.176	0.113	0.108	0.197	0.219	0.156	0.195	0.22	0.232	0.202	0.243
FR	0.103	0.098	0.061	0.041	0.089	0.111	0.048	0.043	0.142	0.165	0.102	0.14	0.121	0.133	0.103	0.144
DE	0.239*	0.234**	0.197	0.176	0.223**	0.246**	0.183*	0.178	0.277*	0.299**	0.236	0.275*	0.284*	0.296**	0.266*	0.307*
HU	–	–	–	–	0.321	0.344	0.281	0.276	0.279	0.302	0.239	0.277	0.443	0.456	0.426	0.466
IE	0.217	0.212	0.176	0.155	0.197	0.22	0.157	0.152	0.247	0.269	0.207	0.245	0.294	0.307	0.277	0.318
IT	0.349	0.344*	0.307*	0.287*	0.335*	0.357*	0.294*	0.289	0.389*	0.411**	0.348*	0.387*	0.404*	0.416*	0.386*	0.427**
LT	0.029	0.024	−0.013	−0.033	0.014	0.037	−0.026	−0.031	0.068	0.091	0.028	0.066	0.068	0.08	0.05	0.091
NL	0.039	0.034	−0.003	−0.024	0.022	0.044	−0.019	−0.024	0.069	0.091	0.028	0.067	0.007	0.02	−0.01	0.03
PL	–	–	–	–	0.643**	0.666**	0.603**	0.598**	0.691**	0.713**	0.651***	0.689***	0.695**	0.707**	0.677**	0.718***
PT	0.463*	0.458*	0.421*	0.401*	0.447*	0.469*	0.406*	0.402*	0.501*	0.523**	0.461*	0.499**	0.566*	0.579**	0.548*	0.589**
RO	–	–	–	–	−0.201	−0.178	−0.241	−0.246	−0.239	−0.216	−0.279	−0.241	−0.157	−0.144	−0.174	−0.134
SI	0.008	0.003	−0.034	−0.054	−0.01	0.013	−0.05	−0.055	0.044	0.067	0.004	0.042	0.077	0.09	0.059	0.1
ES	0.463**	0.458**	0.422**	0.401**	0.449**	0.471**	0.408**	0.403**	0.503**	0.525**	0.463**	0.501**	0.525**	0.538**	0.507**	0.548**
SE	–	–	–	–	0.25*	0.273*	0.21	0.205	0.134	0.157	0.094	0.132	0.318*	0.33*	0.3*	0.341*

Note: The different columns show the delta Sharpe ratio for each portfolio compared to the Sharpe ratio of the RRP. Sharpe ratio values are annualised. For t-statistics from the Ledoit and Wolf (2008) test, * (**/***) indicates significance at the 10% level (5%level/1%level). Abbreviations of models are summarised in Table 2.

CONSTRAINTS AND MAXIMUM SHARPE RATIO