

Study about European domestic mutual funds performance persistence

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8. APPENDIX

8.1 EQUALLY WEIGHTED PORTFOLIO - Regression

Those tables show the coefficient for both models considered as well as their associated p-values in (). The R-square and adjusted R-square of each model is also indicated.

Table 1: Model A - Carhart 4-Factor Model on Net Monthly Returns of equally weighted portfolios (1995-2020)

	Alpha	Rm-Rf	SMB	HML	MOM	R2	Adj. R2
All (1719)	-0.134 (0.06)	1.099 (0.0)	0.134 (0.0)	0.021 (0.43)	-0.008 (0.66)	0.957	0.957
France (695)	-0.115 (0.20)	1.068 (0.0)	0.219 (0.0)	-0.054 (0.12)	-0.001 (0.64)	0.926	0.925
Germany (377)	0.013 (0.92)	1.160 (0.0)	0.092 (0.09)	-0.157 (0.0)	-0.068 (0.03)	0.896	0.895
Italy (308)	-0.30 (0.09)	1.123 (0.0)	0.100 (0.20)	0.274 (0.0)	0.070 (0.12)	0.796	0.793
Netherlands (66)	-0.081 (0.45)	1.076 (0.0)	0.106 (0.03)	0.033 (0.42)	-0.038 (0.17)	0.904	0.903
Spain (273)	-0.231 (0.13)	1.09 (0.0)	0.035 (0.61)	0.252 (0.0)	0.010 (0.80)	0.833	0.831

Table 2: Model A' - Carhart 4-Factor Model on Gross Monthly Returns* of equally weighted portfolios (2003-2020)

*Continuous gross monthly returns data only available as of 04/2003

	Alpha	Rm-Rf	SMB	HML	MOM	R2	Adj. R2
All (1719)	0.026 (0.72)	1.081 (0.0)	0.079 (0.04)	0.155 (0.0)	-0.012 (0.59)	0.972	0.972
France (695)	0.04 (0.65)	1.071 (0.0)	0.074 (0.12)	0.076 (0.09)	-0.008 (0.76)	0.958	0.957
Germany (377)	0.169 (0.16)	1.151 (0.0)	0.099 (0.12)	-0.119 (0.05)	-0.052 (0.15)	0.933	0.932
Italy (308)	-0.079 (0.56)	1.070 (0.0)	0.066 (0.36)	0.421 (0.0)	0.029 (0.48)	0.918	0.917
Netherlands (66)	0.251 (0.07)	1.104 (0.0)	0.309 (0.0)	-0.072 (0.31)	-0.050 (0.24)	0.906	0.905
Spain (273)	-0.02 (0.89)	1.021 (0.0)	-0.145 (0.09)	0.527 (0.0)	-0.015 (0.75)	0.889	0.887

Table 3: Model B: Fama & French 5- factor Model on Net Monthly Returns (1995-2020)

	Alpha	Rm-Rf	SMB	HML	RMW	CMA	R2	Adj. R2
All (1719)	-0.079 (0.26)	1.071 (0.0)	0.132 (0.0)	0.037 (0.35)	-0.120 (0.02)	-0.101 (0.04)	0.959	0.959
France (695)	-0.083 (0.37)	1.058 (0.0)	0.216 (0.0)	-0.053 (0.31)	-0.088 (0.19)	-0.051 (0.43)	0.927	0.926
Germany (377)	0.043 (0.72)	1.135 (0.0)	0.077 (0.15)	-0.116 (0.09)	-0.206 (0.02)	-0.161 (0.06)	0.898	0.896
Italy (308)	-0.158 (0.37)	1.040 (0.0)	0.090 (0.26)	0.391 (0.0)	-0.077 (0.55)	-0.340 (0.0)	0.799	0.796
Netherlands (66)	-0.065 (0.55)	1.090 (0.0)	0.107 (0.03)	-0.037 (0.54)	-0.141 (0.07)	0.083 (0.28)	0.905	0.903
Spain (273)	-0.13 (0.14)	1.067 (0.0)	0.036 (0.60)	0.195 (0.02)	-0.183 (0.10)	-0.01 (0.94)	0.834	0.831

Table 4: Model B' - Fama & French 5- factor Model on Gross Monthly Returns* (2003-2020)

*Continuous gross monthly returns data only available as of 04/2003

	Alpha	Rm-Rf	SMB	HML	RMW	CMA	R2	Adj. R2
All (1719)	0.035 (0.64)	1.10 (0.0)	0.09 (0.02)	0.05 (0.38)	-0.125 (0.08)	0.135 (0.03)	0.973	0.973
France (695)	0.05 (0.53)	1.097 (0.0)	0.095 (0.04)	-0.079 (0.22)	-0.164 (0.06)	0.201 (0.01)	0.961	0.960
Germany (377)	0.192 (0.12)	1.17 (0.13)	0.10 (0.01)	-0.231 (0.01)	-0.245 (0.04)	0.05 (0.65)	0.934	0.932
Italy (308)	-0.03 (0.83)	1.065 (0.0)	0.05 (0.49)	0.36 (0.0)	-0.21 (0.12)	-0.085 (0.48)	0.919	0.917
Netherlands (66)	0.260 (0.07)	1.113 (0.0)	0.303 (0.00)	-0.128 (0.22)	-0.168 (0.23)	-0.002 (0.99)	0.906	0.904
Spain (273)	-0.08 (0.60)	1.05 (0.0)	-0.115 (0.18)	0.474 (0.00)	0.068 (0.66)	0.24 (0.08)	0.891	0.888

8.2 HETEROSKEDASTICITY – Plot of the residuals vs. fitted values of Y

Those figures represent the residual of each model in comparison with the fitted values. This representation allows to get an impression of the level of heteroskedasticity in the data as we observe an increased variance as the fitted values increase.

Figure 1 : Carhart 4-Factor model – Plot of the residuals vs. the fitted values of Y

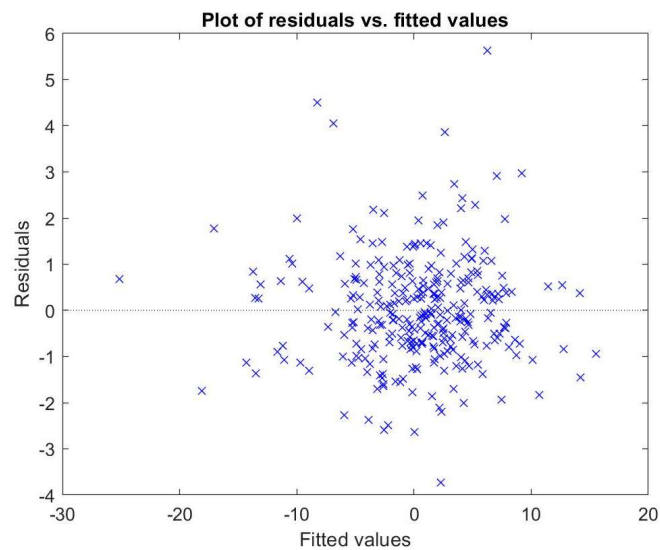
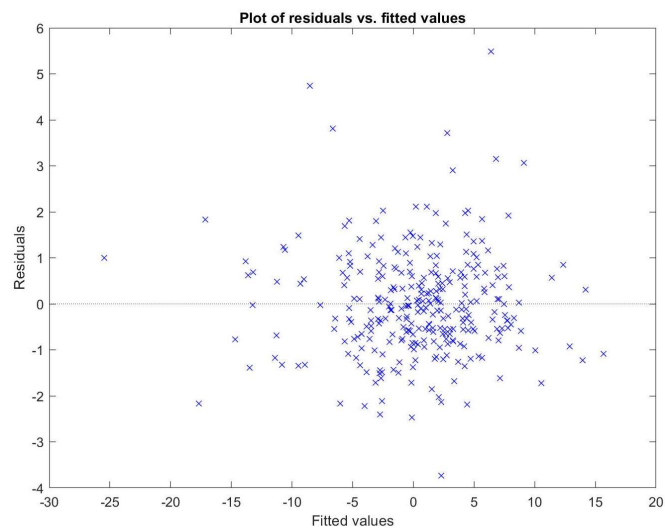


Figure 2: Fama & French 5-factor model - Plot of the residuals vs. the fitted values of Y



8.3 NEWKEY WEST CORRECTION – Equally weighted portfolios

Those table present the coefficient of both models and their Newey-west adjusted p-values in ().

Table 5: Newey-west adjusted - Carhart 4-Factor Model on Net Monthly Returns of equally weighted portfolios (1995-2020)

	Alpha	Rm-Rf	SMB	HML	MOM	R2	Adj. R2
All (2491)	-0.134 (0.07)	1.099 (0.0)	0.134 (0.0)	0.021 (0.71)	-0.008 (0.79)	0.957	0.957
France (695)	-0.115 (0.22)	1.068 (0.0)	0.219 (0.0)	-0.054 (0.33)	-0.001 (0.71)	0.926	0.925
Germany (377)	0.013 (0.91)	1.160 (0.0)	0.092 (0.16)	-0.157 (0.0)	-0.068 (0.06)	0.896	0.895
Italy (308)	-0.30 (0.03)	1.123 (0.0)	0.100 (0.15)	0.274 (0.04)	0.070 (0.29)	0.796	0.793
Netherlands (66)	-0.081 (0.46)	1.076 (0.0)	0.106 (0.04)	0.033 (0.47)	-0.038 (0.32)	0.904	0.903
Spain (273)	-0.231 (0.14)	1.090 (0.0)	0.035 (0.70)	0.252 (0.0)	0.010 (0.83)	0.833	0.831

Table 6 Newey-west adjusted - Fama & French 5-Factor Model on Net Monthly Returns of equally weighted portfolios (1995-2020)

	Alpha	Rm-Rf	SMB	HML	RMW	CMA	R2	Adj. R2
All (2491)	-0.079 (0.34)	1.071 (0.0)	0.132 (0.0)	0.037 (0.58)	-0.120 (0.06)	-0.101 (0.33)	0.959	0.959
France (695)	-0.083 (0.41)	1.058 (0.0)	0.216 (0.0)	-0.053 (0.43)	-0.088 (0.23)	-0.051 (0.61)	0.927	0.926
Germany (377)	0.043 (0.71)	1.135 (0.0)	0.077 (0.21)	-0.116 (0.21)	-0.206 (0.04)	-0.161 (0.21)	0.898	0.896
Italy (308)	-0.158 (0.31)	1.040 (0.0)	0.090 (0.22)	0.391 (0.0)	-0.077 (0.57)	-0.340 (0.05)	0.799	0.796
Netherlands (66)	-0.065 (0.56)	1.040 (0.0)	0.090 (0.04)	0.391 (0.61)	-0.141 (0.09)	0.083 (0.37)	0.905	0.903
Spain (273)	-0.13 (0.41)	1.067 (0.0)	0.036 (0.68)	0.195 (0.11)	-0.183 (0.13)	-0.01 (0.95)	0.834	0.831

8.4 NORMALITY ASSUMPTION – Alphas over each funds' life

Those graphs are used to test the normality assumption among the abnormal returns (alphas) we obtain by using different models. We first have an histogram of all the alphas obtained for each models and also a probability plot, which compare the distribution of the data in y to the normal distribution.

Figure 3 : Carhart 4-factor model - Probability plot of the Alphas over each fund's life

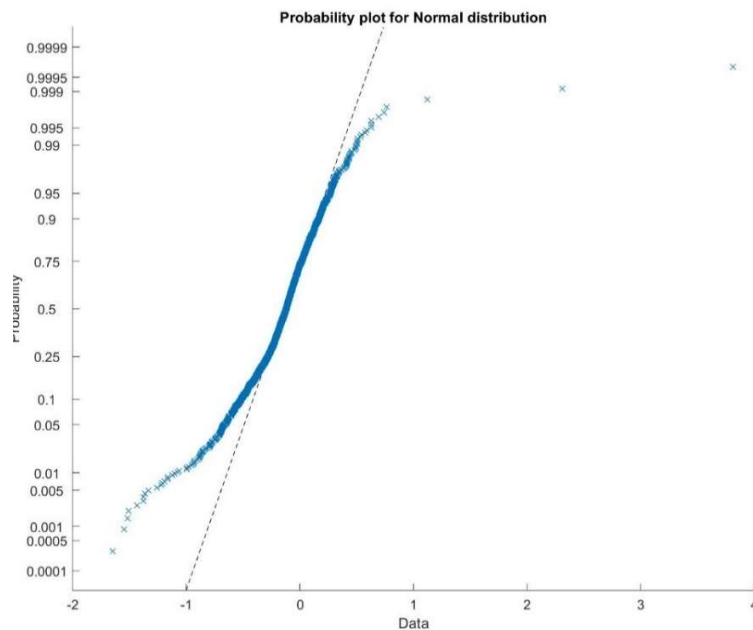


Figure 4 : Carhart - Histogram of the estimated alphas over each fund's life

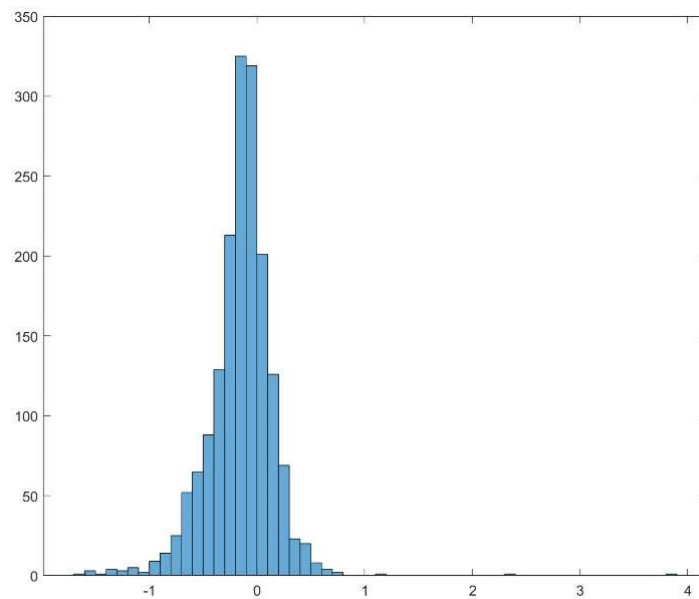


Figure 5 : Fama & French 5-factor model - Probability plot of the Alphas over each fund's life

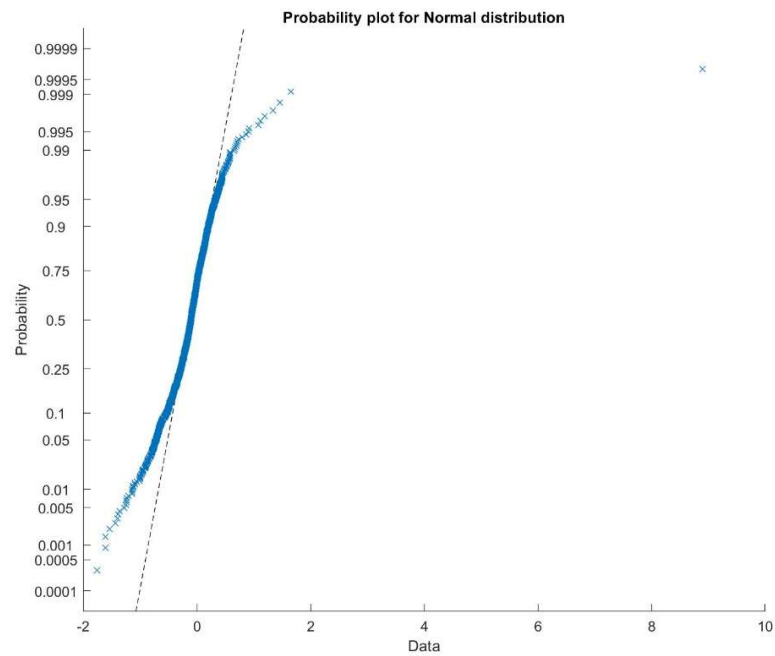
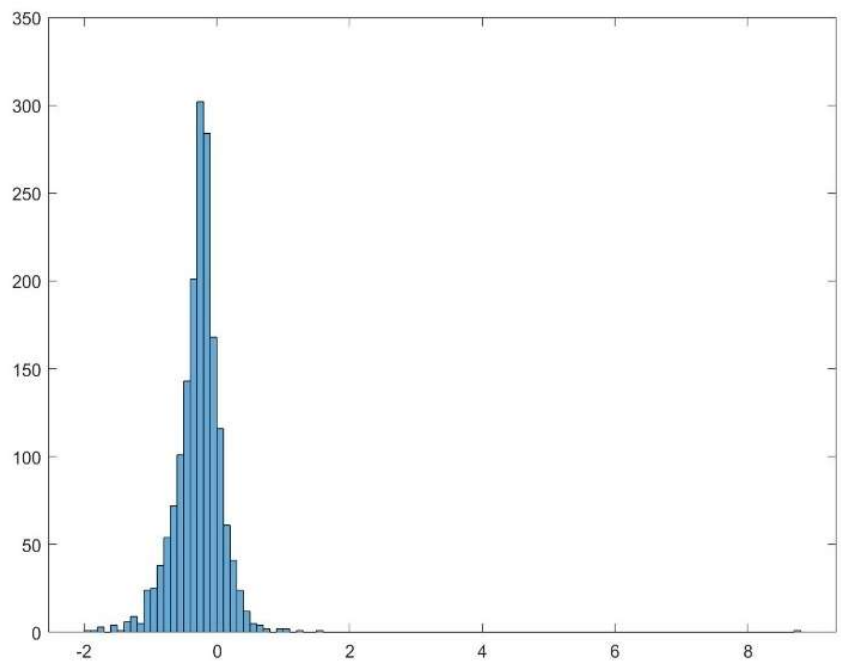


Figure 6: Fama & French 5-factor model - Histogram of the estimated alphas over each fund's life



8.5 REGRESSION OVER EACH FUND'S LIFE – Results

Those table shows the distribution of alphas over each fund's life for both models.

Table 7: Carhart 4-factor model - Histogram of the alpha's estimated p-values over each fund's life

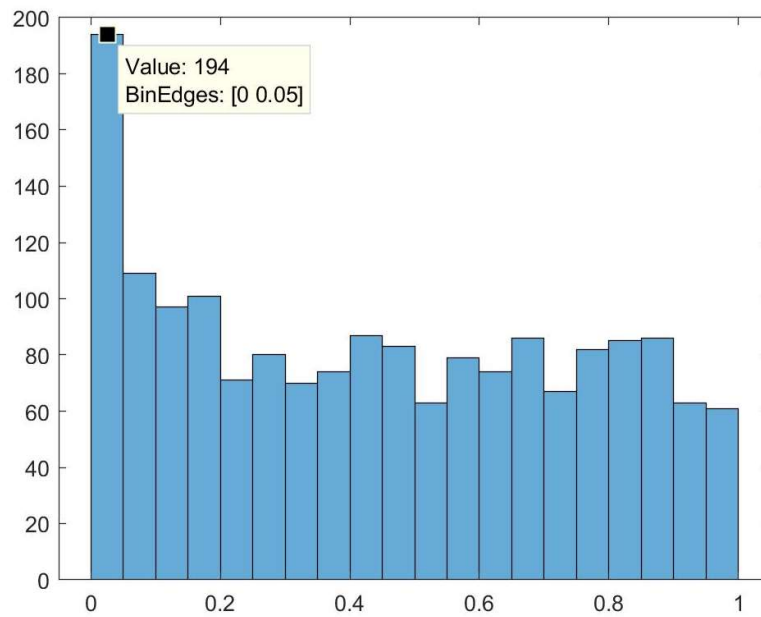
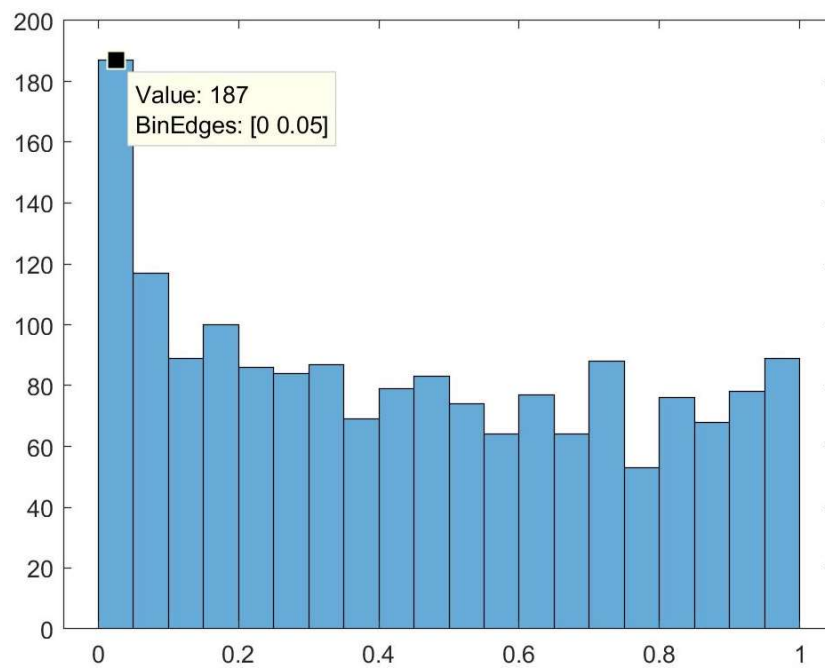


Table 8: Fama & French 5-factor model - Histogram of the alpha's estimated p-values over each fund's life



8.6 FALSE DISCOVERY RATE – Carhart 4-factor model: Analysis on all funds

This table shows the performance measures for the Carhart 4-factor model using the whole sample period (1995-2020) and computing each fund's alpha over his whole life. 1714 funds are taken into account, with each of them reporting at least 24 months of continuous performance reporting. The first panel (Panel A), shows the estimate of the proportion of each type of funds (Zero-Alphas, Unskilled and Skilled), before accounting for False discoveries. The second panel (Panel B), shows the proportion of lucky and skilled funds discovered in the right tail (positive alphas) after taking into account false discoveries, and this for 4 levels of significance which are 5, 10, 15 and 20% and the last panel (Panel C) shows the statistics for the left tail (Negative alphas).

Table 9: Carhart 4-factor model - Luck and long-term performance of All funds

Panel A. Proportion of unskilled and skilled funds (Before FDR adjustments and with 0.05 significance level)					
		No performance	Differential Performance	Negative Performance	Positive Performance
All funds	Proportion Number	88.68% 1520	11.32% 194	10.62% 182	0.70% 12
Panel B. Impact of luck in the right tail (Positive alphas)					
Significance level (ρ)		0.05	0.10	0.15	0.20
Sign. Alphas	S_{ρ}^{+} (%)	0.70%	0.99%	1.81%	2.63%
	FDR+	38.34	47.22	56.47	59.03
Lucky	F_{ρ}^{+} (%)	0.27%	0.47%	1.02%	1.55%
Skilled	T_{ρ}^{+} (%)	0.43%	0.52%	0.79%	1.08%
Panel C. Impact of luck in the left tail (Negative alphas)					
Significance level (ρ)		0.05	0.10	0.15	0.20
Sign. Alphas	S_{ρ}^{-} (%)	10.62%	16.68%	21.53%	26.60%
	FDR-	38.40	49.58	56.47	60.16
Unlucky	F_{ρ}^{-} (%)	4.08%	8.27%	12.16%	16.00%
Unskilled	T_{ρ}^{-} (%)	6.54%	8.41%	9.37%	10.60%

8.7 FALSE DISCOVERY RATE – Comparison between the two different models

The following table shows the sensitivity of the FDR when applying two different factor models to all the funds over their whole life in our sample. The results are showed at a significance level of 5%. For each model, we analyze the estimated FDR, the number of truly over/under-performing funds, the number of false discoveries.

Table 10: False discoveries: different factor models (5% significance level)

Panel A. Carhart 4-factor model ($\pi_0 = 0.88$)				
	False discovery rate FDR (%)	# of Significant funds (S)	# of False discoveries (F)	# of truly significant funds (T)
Best funds	38.34%	12	4.59	7.39
Worst funds	38.40%	182	69.89	112.11
Panel B. Fama & French 5-factor model ($\pi_0 = 0.86$)				
	False discovery rate FDR (%)	# of Significant funds (S)	# of False discoveries (F)	# of truly significant funds (T)
Best funds	36.05%	170	61.28	108.72
Worst funds	41.58%	17	7.07	9.93

8.8 FALSE DISCOVERY RATE RESULTS – Fama & French 5factor model: By country

Each of those table displays the alphas (computed using Fama & French 5-factor model) distribution, the left part shows the results for the worst funds, unlucky funds and funds with a truly negative performance (Denoted by $S_{\rho}^{-}, F_{\rho}^{-}, T_{\rho}^{-}$ respectively) and the right part shows the results for the best funds, lucky funds and funds with a truly positive performance (Denoted by $S_{\rho}^{+}, F_{\rho}^{+}, T_{\rho}^{+}$ respectively). The relative importance of those sets compared to the entire fund population of each country is also indicated.

Table 11: FDR results - Panel A: France

Impact of luck on the performance of the Best and Worst funds

Panel A : France									
Worst funds					Best funds				
ρ	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	ρ
FDR-	31.87%	41.31%	47.39%	53.44%	53.44%	45.42%	36.98%	24.89%	FDR+
S_{ρ}^{-}	81	126	163	195	11	9	6	4	S_{ρ}^{+}
F_{ρ}^{-}	26	52	77	104	6	4	2	1	F_{ρ}^{+}
T_{ρ}^{-}	55	74	86	91	5	5	4	3	T_{ρ}^{+}
$S_{\rho}^{-} (\%)$	11.72%	18.23%	23.59%	28.22%	1.59%	1.30%	0.86%	0.58%	$S_{\rho}^{+} (\%)$
$F_{\rho}^{-} (\%)$	3.76%	7.53%	11.14%	15.05%	0.86%	0.58%	0.29%	0.14%	$F_{\rho}^{+} (\%)$
$T_{\rho}^{-} (\%)$	7.96%	10.70%	12.45%	13.17%	0.73%	0.72%	0.57%	0.44%	$T_{\rho}^{+} (\%)$

Table 12: FDR results - Panel B: Germany**Impact of luck on the performance of the Best and Worst funds**

Panel B : Germany									
ρ	Worst funds				Best funds				ρ
	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	
FDR-	43.18%	51.29%	51.29%	51.29%	51.29%	51.29%	51.27%	41.90%	FDR+
S_{ρ}^{-}	15	30	44	63	36	23	15	11	S_{ρ}^{+}
F_{ρ}^{-}	6	15	23	32	18	12	8	5	F_{ρ}^{+}
T_{ρ}^{-}	9	15	21	31	18	11	7	6	T_{ρ}^{+}
S_{ρ}^{-} (%)	3.98%	7.96%	11.67%	16.71%	9.55%	6.10%	3.98%	2.92%	S_{ρ}^{+} (%)
F_{ρ}^{-} (%)	1.72%	4.08%	5.99%	8.57%	4.90%	3.13%	2.04%	1.22%	F_{ρ}^{+} (%)
T_{ρ}^{-} (%)	2.26%	3.88%	5.68%	8.14%	4.65%	2.97%	1.94%	1.70%	T_{ρ}^{+} (%)

Table 13: FDR results - Panel C: Italy**Impact of luck on the performance of the Best and Worst funds**

Panel C : Italy									
ρ	Worst funds				Best funds				ρ
	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	
FDR-	29.97%	40.73%	51.11%	57.59%	57.59%	49.46%	36.63%	26.19%	FDR+
S_{ρ}^{-}	42	60	71	81	11	6	4	1	S_{ρ}^{+}
F_{ρ}^{-}	13	24	36	47	6	3	1	0	F_{ρ}^{+}
T_{ρ}^{-}	29	36	35	34	5	3	3	1	T_{ρ}^{+}
S_{ρ}^{-} (%)	13.68%	19.54%	23.13%	26.38%	3.58%	1.95%	1.30%	0.33%	S_{ρ}^{+} (%)
F_{ρ}^{-} (%)	4.23%	7.82%	11.73%	15.31%	1.95%	0.97%	0.33%	0.00%	F_{ρ}^{+} (%)
T_{ρ}^{-} (%)	9.45%	11.72%	11.40%	11.07%	1.63%	0.98%	0.97%	0.33%	T_{ρ}^{+} (%)

Table 14: FDR results - Panel D: Netherlands

Impact of luck on the performance of the Best and Worst funds

Panel D : Netherlands

ρ	Worst funds				Best funds				ρ
	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	
FDR-	31.45%	38.86%	38.86%	45.38%	45.38%	38.86%	38.86%	/	FDR+
S_{ρ}^{-}	5	10	14	16	5	4	2	0	S_{ρ}^{+}
F_{ρ}^{-}	2	4	5	7	2	2	1	0	F_{ρ}^{+}
T_{ρ}^{-}	3	6	9	9	3	2	1	0	T_{ρ}^{+}
$S_{\rho}^{-} (\%)$	7.58%	15.15%	21.21%	24.24%	7.58%	6.06%	3.03%	0.00%	$S_{\rho}^{+} (\%)$
$F_{\rho}^{-} (\%)$	3.03%	6.06%	7.58%	10.61%	3.03%	3.03%	1.51%	0.00%	$F_{\rho}^{+} (\%)$
$T_{\rho}^{-} (\%)$	4.55%	9.09%	13.63%	13.63%	4.55%	3.03%	1.52%	0.00%	$T_{\rho}^{+} (\%)$

Table 15: FDR results - Panel E: Spain

Impact of luck on the performance of the Best and Worst funds

Panel E : Spain

ρ	Worst funds				Best funds				ρ
	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	
FDR-	39.08%	45.60%	59.84%	61.82%	61.82%	59.85%	45.60%	20.34%	FDR+
S_{ρ}^{-}	27	47	54	68	8	5	3	1	S_{ρ}^{+}
F_{ρ}^{-}	11	21	32	42	5	3	1	0	F_{ρ}^{+}
T_{ρ}^{-}	16	26	22	26	3	2	2	1	T_{ρ}^{+}
$S_{\rho}^{-} (\%)$	9.89%	17.21%	19.78%	24.91%	2.93%	1.83%	1.10%	0.37%	$S_{\rho}^{+} (\%)$
$F_{\rho}^{-} (\%)$	4.03%	7.69%	11.72%	15.38%	1.83%	1.10%	0.37%	0.00%	$F_{\rho}^{+} (\%)$
$T_{\rho}^{-} (\%)$	5.86%	9.52%	8.06%	9.53%	1.10%	0.73%	0.73%	0.37%	$T_{\rho}^{+} (\%)$

9. EXECUTIVE SUMMARY

Persistence in mutual funds' performance is a subject that has been highly debated among the literature. No consensus has been reached yet and most of the work related to the topic have been done on U.S. markets. However, due to the recent development in European market importance, it becomes easier and more relevant to study this market as well.

Persistence in performance has important consequences from an economic and practical perspective, if persistence is proven to be existing, then it represents a serious challenge to market efficiency, and it could also represent an important screening mechanism for investors.

This thesis will study the performance of active domestic equity funds in Europe, focusing on 5th countries that are France, Germany, Italy, Netherlands, and Spain.

First, a review of the literature regarding market efficiency, active management, and performance persistence in the U.S. and in Europe is performed, then a quick summary about the dataset is described and then we explain the methodology that will be used. Finally, empirical results are analyzed. To perform the analysis, we use several multi-factor models to calculate performance, as well as the use of the False Discovery Rate (FDR) to identify funds with a truly significant alpha and to eliminate the chance factor. In addition, we also use a non-parametric approach by using the Winner-Loser test and performing statistical tests on its results.

The first objective of this paper is to give an overview on the efficiency of European markets and the existence of "Skill" among mutual fund managers by also testing whether past performance can give information on future performance (if the existence of persistence is proven).

And the second objective would be to study the performance of domestic funds knowing that there is a cognitive bias for investors called "home bias" which pushes investors to overweight domestic investments compared to international investments, and to know if this bias is motivated by an "informational advantage" or if it is simply motivated by the familiarity that investors have with these companies and would therefore be an irrational choice.

Key words: mutual fund, performance, persistence, dynamic investment strategies, multifactor model, regression, manager skills, luck, false discoveries.

Key tools: Multiple Linear Regression, False Discovery Rate, Contingency table.