February 24, 2022 - cascad#222

Execution Report

Title: Do carbon emissions impact stocks' returns: An evidence from EU Emissions Trading Scheme

Authors: **Inessa Benchora & Sébastien Galanti**

Full reference: Benchora, Inessa, and Galanti, Sébastien "Do carbon emissions impact stocks' returns: An evidence from EU Emissions Trading Scheme" Working paper, February 23, 2022.

The structure and contents of this execution report provided by **cascad** for the certification are similar to those recommended by the AEA Data Editor.

1. DATA DESCRIPTION

This study relies on data on environmental, social, and governance (ESG) disclosures of firms to build a global carbon risk score based on 1,637 firms from 43 countries (2010-2016). There are two main sources of data: (1) the European Union Emissions Trading System (EU-ETS), from which the authors extracted carbon emission data for more than 1,000 firms from 31 European countries and 16 sectors and (2) Datastream-Refinitiv Eikon, from which the authors obtained equity prices that they used to compute monthly stock returns.

For a thorough description of the data, please refer to Section 3 of the paper.

2. CODE DESCRIPTION

For the purpose of this certification, we aimed to check the results displayed in Tables 1-6, 9, and in Figures 1-8. Note that Tables 7 and 8 do not contain any result.

The replication package contains 11 data files called *allX.dta* (where X ∈ {0;5}) and *sallX.dta* (where X ∈ {1;5}), and one Stata 17 script, *code.do*, which creates all the Tables and Figures of the paper. It uses three Excel files, "data.xlsx", "market_cap.xslx" and "price_trade.xlsx" to create the aforementioned dta files, which are then used to compute the Tables and Figures.

3. REPLICATION STEPS

The replication material was downloaded from the cascad website, and run using Stata 17 on a computer with 64GB RAM, intel® Core™ i9-9900K CPU @3.60-5.00GHz, Nvidia Geforce RTX 2060, and Windows 10 OS. We encountered one issue during the replication. Please note however, that the authors did not provide the raw Excel data files. We only ran the parts of the code that generate the results using the dta files.

4. FINDINGS

We reproduced all the Tables and Figures with perfect accuracy.

4.1. TABLE 1: DESCRIPTIVE STATISTICS OF VERIFIED EMISSIONS

Original:

Year	N	Mean	Std.Dev.	p25	p75
2005	166	6729848	1.73e+07	117462	4356134
2006	166	6757043	1.72e+07	127106	4648817
2007	166	6928775	1.73e+07	117538	4389100
2008	166	6783255	1.65e+07	125844	5117255
2009	166	5856253	1.44e+07	108705	4084708
2010	166	5923742	1.45e+07	119072	3967388
2011	166	5828297	1.44e+07	109993	4044198
2012	166	5834122	1.53e+07	100140	3681461
2013	166	5659437	1.42e+07	117226	4744431
2014	166	5479751	1.39e+07	117314	4217064
2015	166	5553444	1.42e+07	104734	4173898
2016	166	5304566	1.38e+07	108326	4487749
2017	166	5324252	1.33e+07	106894	4248754
2018	166	5029537	1.24e+07	104111	4091576
2019	166	4454682	1.01e+07	102503	3941068
Total	2490	5829800	1.47e+07	111655	4356134

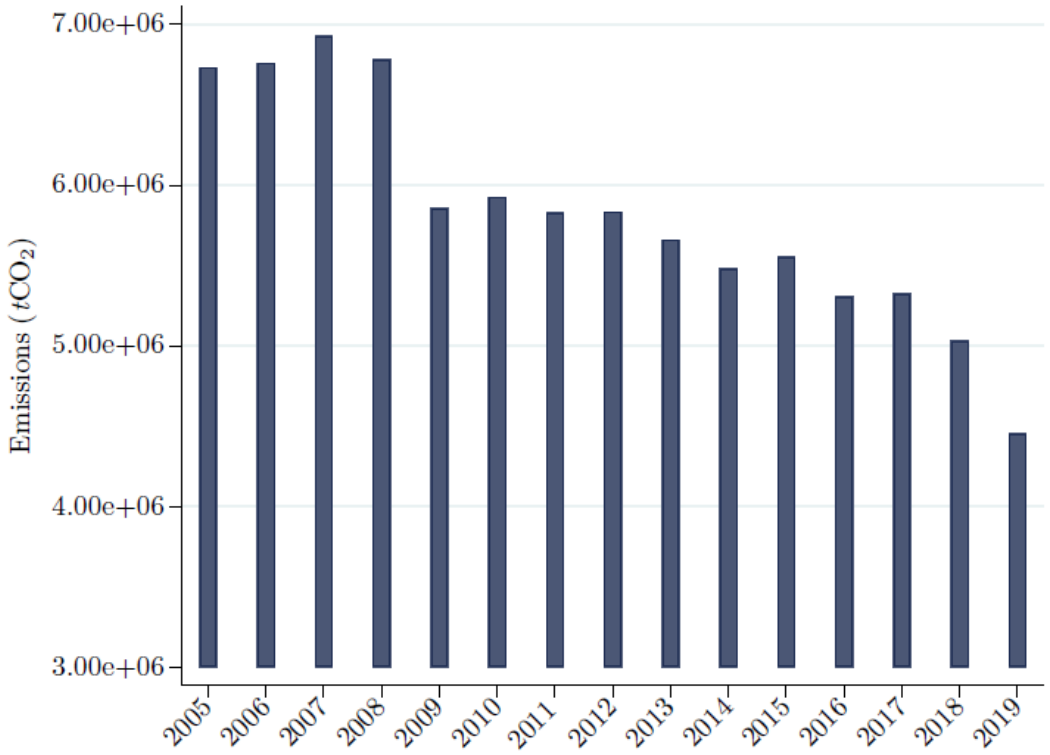
Source: Carbon Market Data. Authors' calculations.

Reproduced:

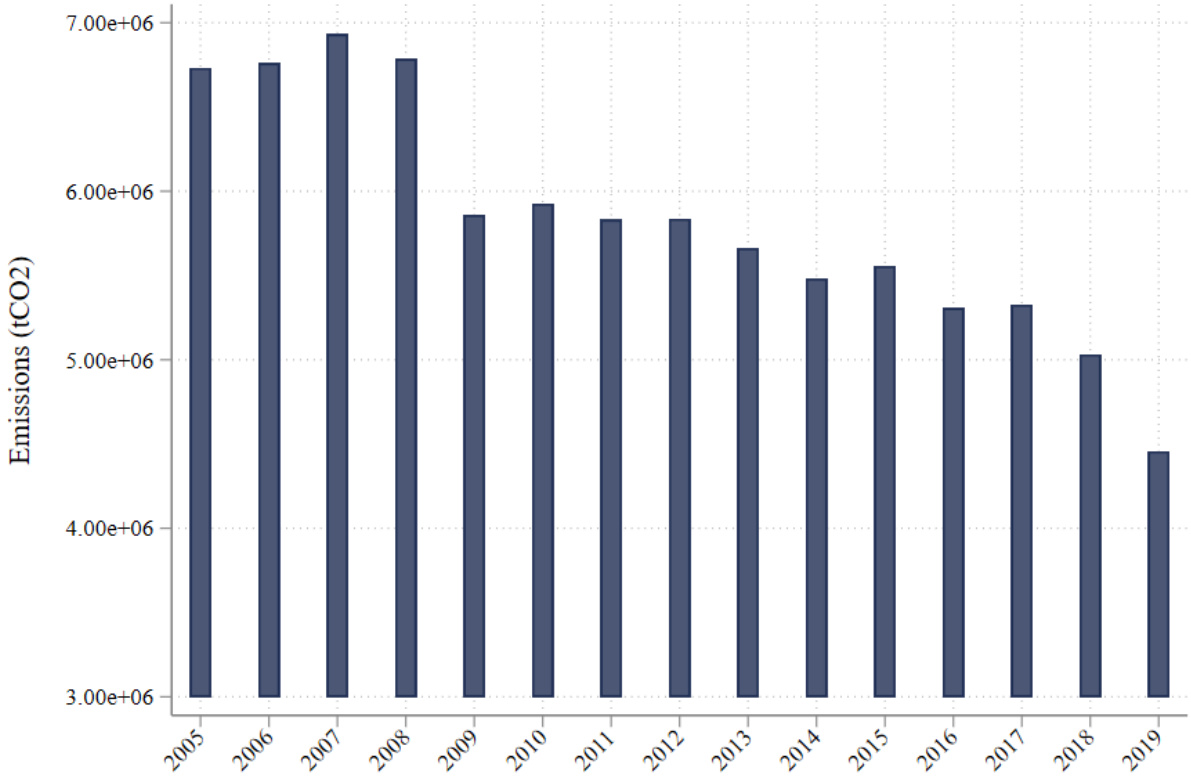
year	N	Mean	SD	p25	p75	Max	Min
2005	166	6729848	1.73e+07	117462	4356134	1.48e+08	0
2006	166	6757043	1.72e+07	127106	4648817	1.49e+08	0
2007	166	6928775	1.73e+07	117538	4389100	1.49e+08	0
2008	166	6783255	1.65e+07	125844	5117255	1.44e+08	0
2009	166	5856253	1.44e+07	108705	4084708	1.32e+08	0
2010	166	5923742	1.45e+07	119072	3967388	1.33e+08	0
2011	166	5828297	1.44e+07	109993	4044198	1.31e+08	0
2012	166	5834122	1.53e+07	100140	3681461	1.47e+08	0
2013	166	5659437	1.42e+07	117226	4744431	1.37e+08	0
2014	166	5479751	1.39e+07	117314	4217064	1.34e+08	0
2015	166	5553444	1.42e+07	104734	4173898	1.38e+08	0
2016	166	5304566	1.38e+07	108326	4487749	1.39e+08	0
2017	166	5324252	1.33e+07	106894	4248754	1.28e+08	0
2018	166	5029537	1.24e+07	104111	4091576	1.19e+08	0
2019	166	4454682	1.01e+07	102503	3941068	9.02e+07	0
Total	2490	5829800	1.47e+07	111655	4356134	1.49e+08	0

4.2. FIGURE 1: ANNUAL AVERAGE OF VERIFIED EMISSIONS (2005-2019)

Original:



Reproduced:



4.3. TABLE 2: DETAILS OF THE DISTRIBUTION OF THE VARIABLE EMISSIONS

Original:

	Percentiles	Smallest		
			Obs.	2.490
1%	0	0	Mean	5829800
5%	4766	0	Sd. Dev.	1.47e+07
10%	18385	0	Variance	2.16e+14
25%	111655	0	Skewness	5.545885
			Kurtosis	43.43437
50%	564409.5			
	Percentiles	Largest		
75%	4356134	1.47e+08		
90%	1.77e+07	1.48e+08		
95%	2.73e+07	1.49e+08		
99%	6.96e+07	1.49e+08		

Source: Authors' calculations. The unit is tons of CO_2.

Reproduced:

emissions

	Percentiles	Smallest		
1%	0	0		
5%	4766	0		
10%	18385	0	Obs	2,490
25%	111655	0	Sum of wgt.	2,490
50%	564409.5		Mean	5829800
		Largest	Std. dev.	1.47e+07
75%	4356134	1.47e+08		
90%	1.77e+07	1.48e+08	Variance	2.16e+14
95%	2.73e+07	1.49e+08	Skewness	5.545885
99%	6.96e+07	1.49e+08	Kurtosis	43.43437

4.4. TABLE 3: DESCRIPTIVE STATISTICS OF THE THREE CARBON PORTFOLIOS

Original:

Portfolios	N	Mean	Min.	Max.	Sd.	p25	p75
All observation period: *January 2005 - December 2019*							
Green	179	0.007	-0.205	0.130	0.054	-0.013	0.040
Medium	179	0.006	-0.154	0.121	0.047	-0.016	0.036
Brown	179	0.003	-0.143	0.100	0.050	-0.029	0.039
Total	537	0.005	-0.205	0.130	0.050	-0.018	0.038
Phase 1: *January 2005 - December 2007*							
Green	35	0.019	-0.075	0.077	0.039	-0.010	0.056
Medium	35	0.016	-0.086	0.095	0.036	-0.009	0.038
Brown	35	0.022	-0.085	0.100	0.047	-0.009	0.057
Total	105	0.019	-0.086	0.100	0.041	-0.009	0.046
Phase 2: *January 2008 - December 2012*							
Green	60	0.001	-0.205	0.130	0.074	-0.020	0.052
Medium	60	-0.000	-0.154	0.121	0.060	-0.021	0.042
Brown	60	-0.008	-0.143	0.099	0.060	-0.048	0.038
Total	180	-0.002	-0.205	0.130	0.065	-0.031	0.043
Phase 3: *January 2013 - December 2019*							
Green	84	0.006	-0.112	0.103	0.040	-0.014	0.033
Medium	84	0.006	-0.108	0.095	0.040	-0.016	0.034
Brown	84	0.002	-0.111	0.092	0.041	-0.025	0.027
Total	252	0.005	-0.112	0.103	0.040	-0.017	0.032

Source: Authors' calculations. The phases refer to the three phases of the EU-ETS.

Reproduced:

group	N	Mean	Min	Max	SD	p75
0	179	.0070298	-.2046391	.1298488	.0536359	.0395947
1	179	.005857	-.1544265	.1212421	.0468777	.0360201
2	179	.0025877	-.1425302	.1003767	.0501713	.0388724
Total	537	.0051581	-.2046391	.1298488	.0502453	.0380142

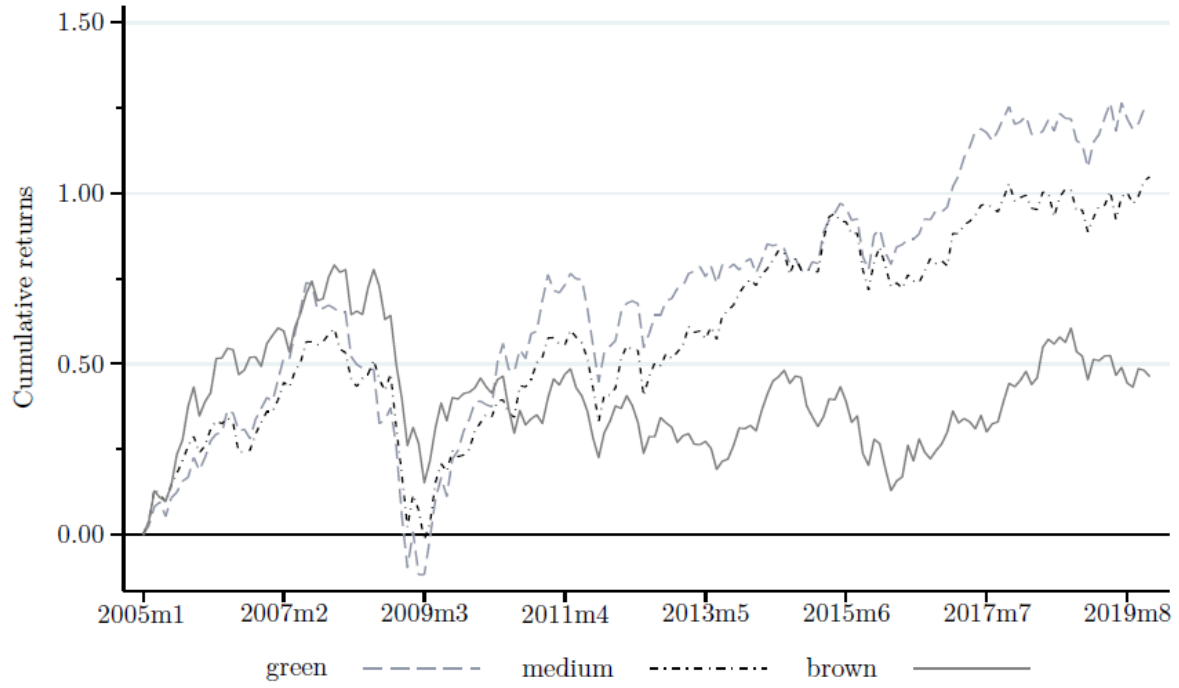
group	N	Mean	Min	Max	SD	p25	p75
0	35.000	0.019	-0.075	0.077	0.039	-0.010	0.056
1	35.000	0.016	-0.086	0.095	0.036	-0.009	0.038
2	35.000	0.022	-0.085	0.100	0.047	-0.009	0.057
Total	105.000	0.019	-0.086	0.100	0.041	-0.009	0.046

group	N	Mean	Min	Max	SD	p25	p75
0	60.000	0.001	-0.205	0.130	0.074	-0.020	0.052
1	60.000	-0.000	-0.154	0.121	0.060	-0.021	0.042
2	60.000	-0.008	-0.143	0.099	0.060	-0.048	0.038
Total	180.000	-0.002	-0.205	0.130	0.065	-0.031	0.043

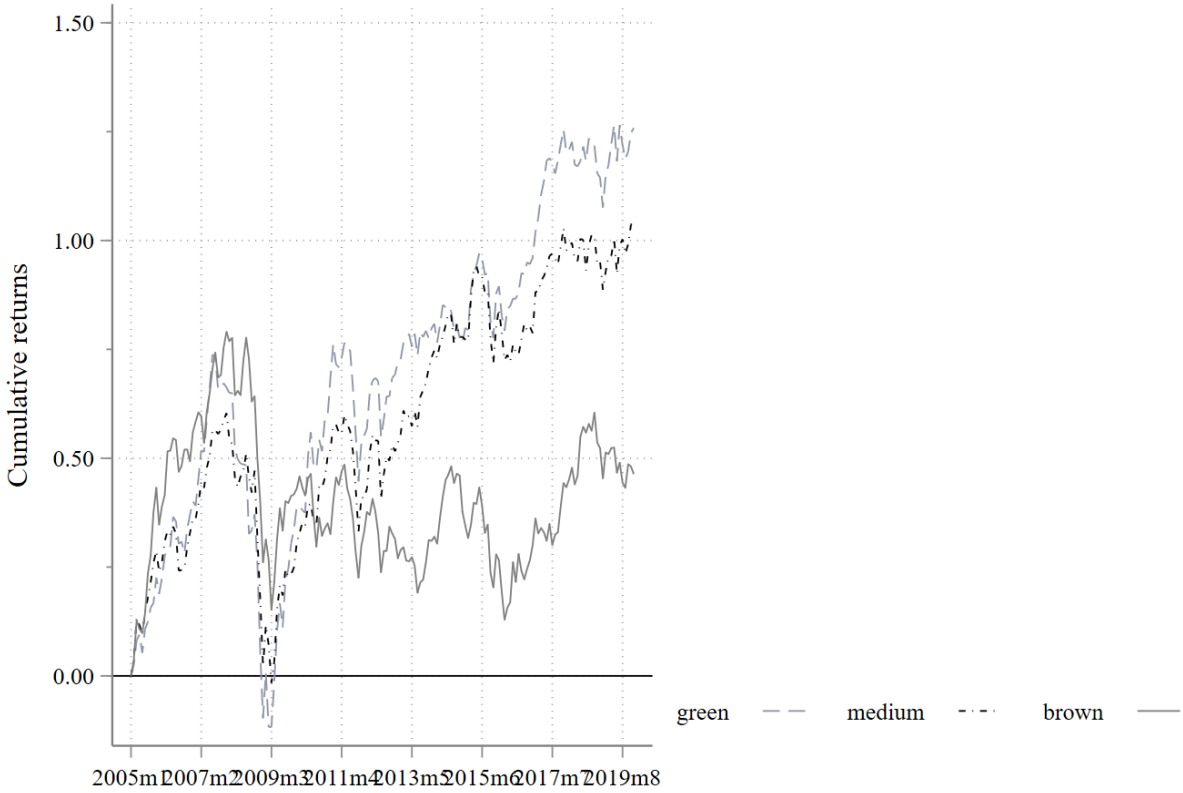
group	N	Mean	Min	Max	SD	p25	p75
0	84.000	0.006	-0.112	0.103	0.040	-0.014	0.033
1	84.000	0.006	-0.108	0.095	0.040	-0.016	0.034
2	84.000	0.002	-0.111	0.092	0.041	-0.025	0.027
Total	252.000	0.005	-0.112	0.103	0.040	-0.017	0.032

4.5. FIGURE 2: CUMULATIVE RETURNS OF THE THREE CARBON PORTFOLIOS ON THE OVERALL OBSERVATION PERIOD (ALL EU-ETS PHASES)

Original:

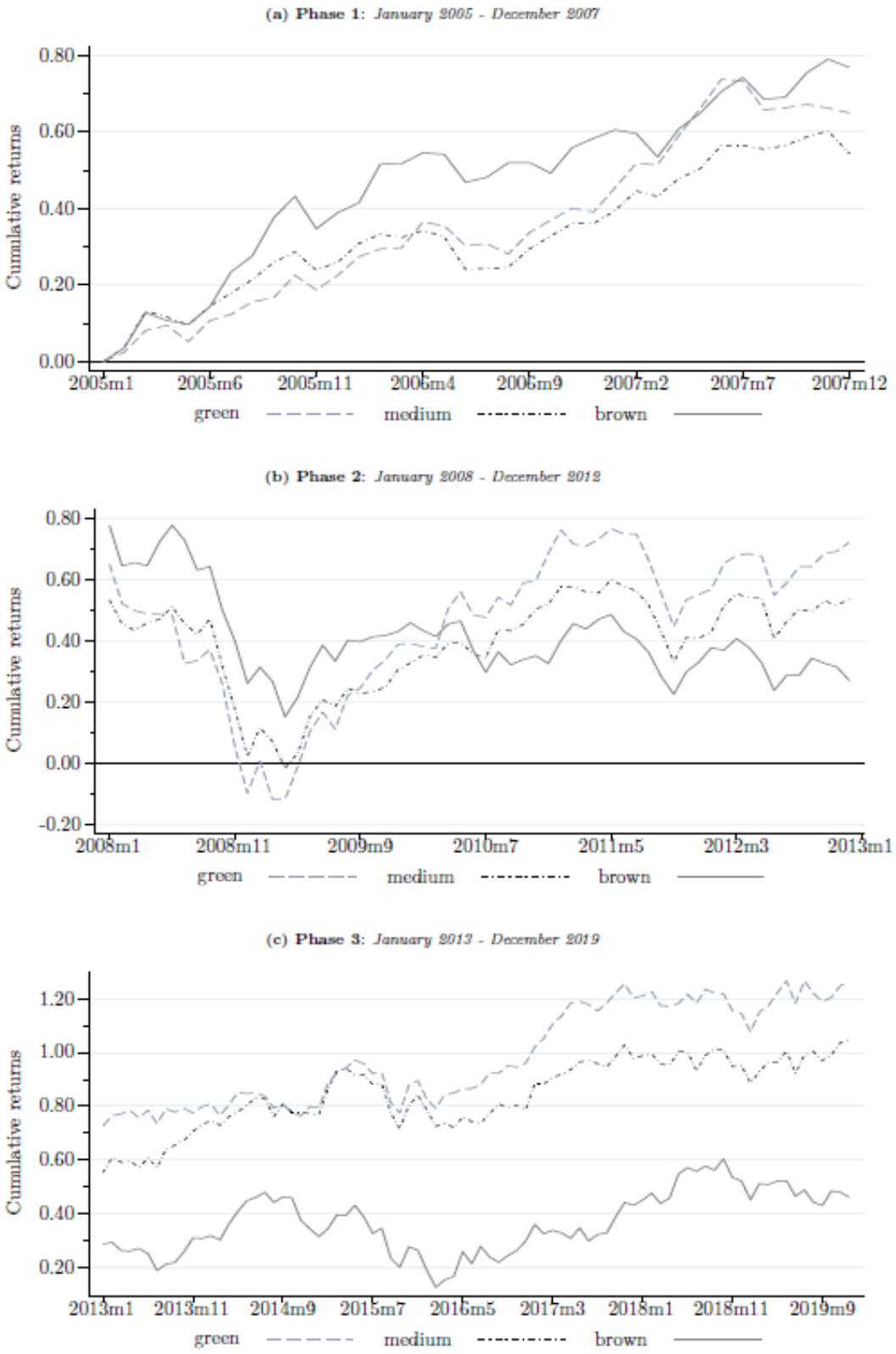


Reproduced:



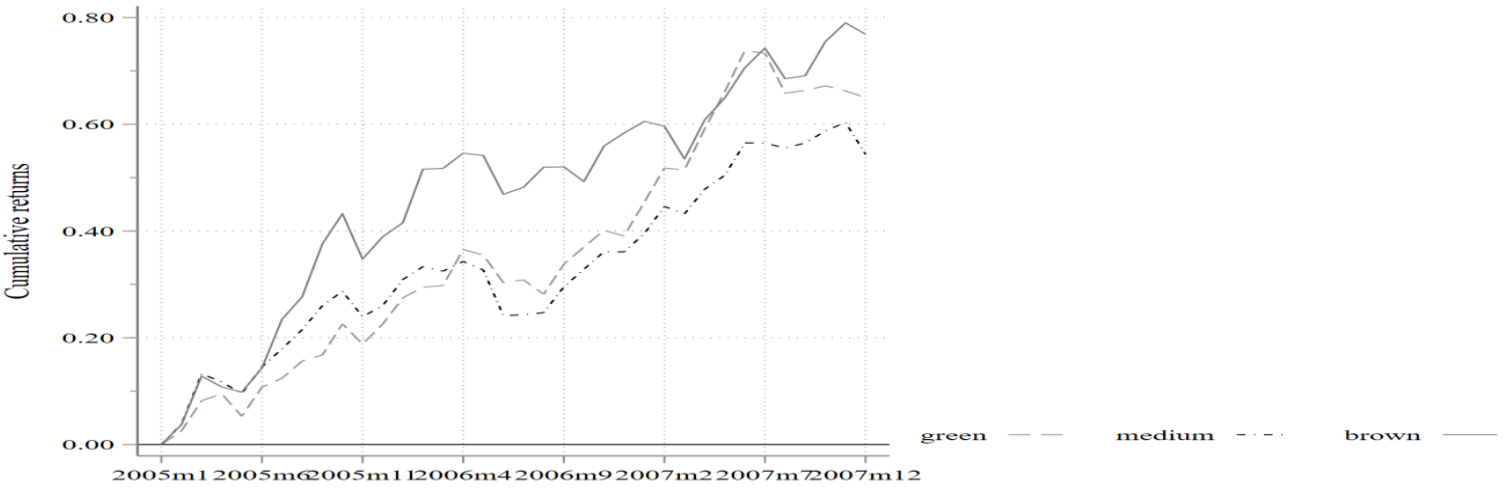
4.6. FIGURE 3: CUMULATIVE CARBON PORTFOLIOS RETURNS FOR THE THREE PHASES OF THE EU ETS

Original:

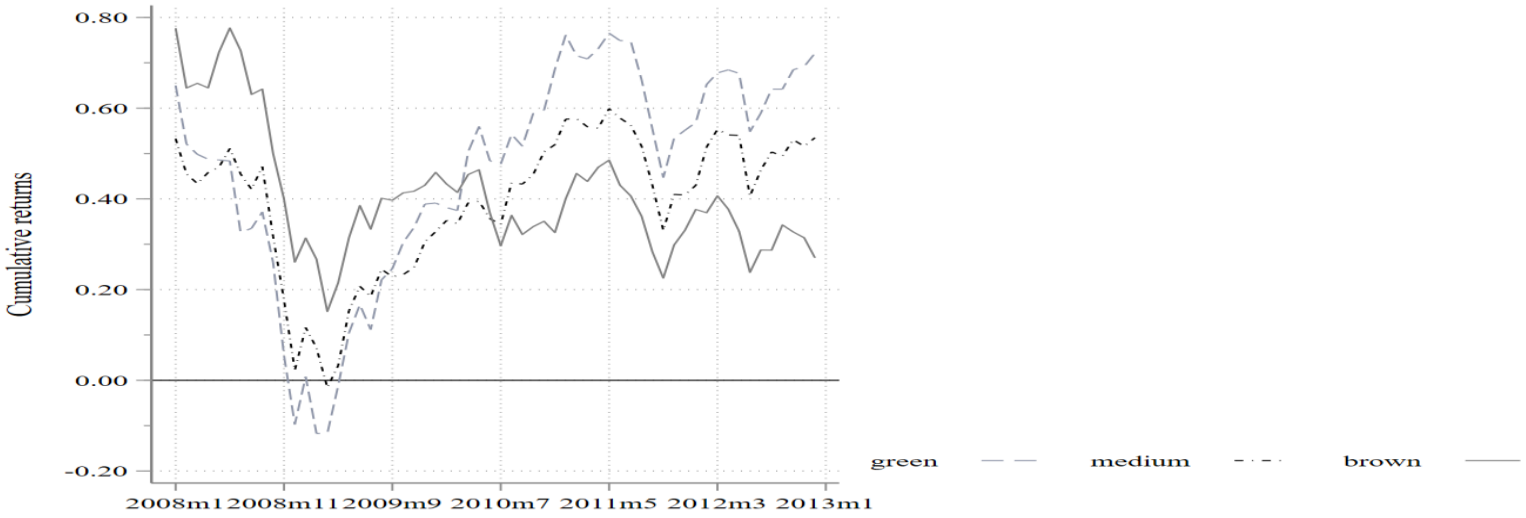


Reproduced:

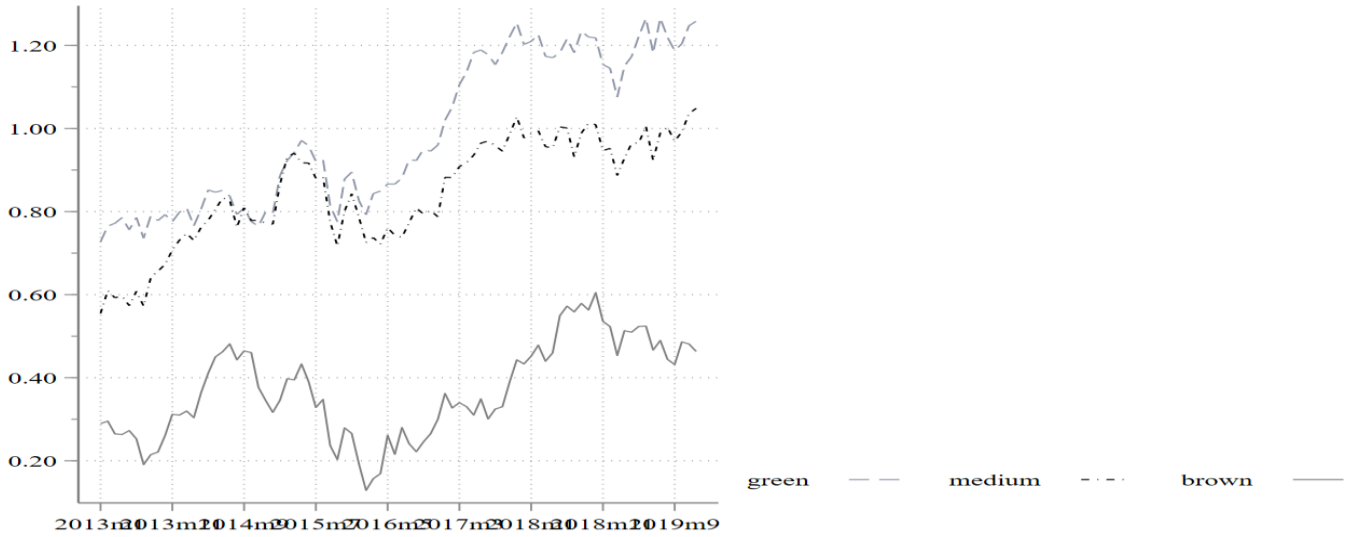
(a) Phase 1:



(b) Phase 2:



(c) Phase 3:



4.7. TABLE 4: ESTIMATION RESULTS FOR THE FOUR FACTOR MODEL

Original:

	FF3			FF4		
Variables	(1) Green	(2) Medium	(3) Brown	(1) Green	(2) Medium	(3) Brown
MKT	0.27832**	0.20589*	0.17759*	0.26785**	0.22487*	0.18549*
	(0.0914)	(0.0872)	(0.0807)	(0.0970)	(0.0877)	(0.0844)
SMB	1.05556***	1.01420***	0.84513***	1.05521***	1.01483***	0.84540***
	(0.2707)	(0.2283)	(0.2198)	(0.2719)	(0.2285)	(0.2207)
HML	0.04779	-0.08012	0.11260	0.00565	-0.00369	0.14439
	(0.2046)	(0.1694)	(0.1837)	(0.2093)	(0.1839)	(0.1983)
MOM				-0.06695	0.12143	0.05050
				(0.1046)	(0.0992)	(0.1205)
Constant	-0.00392	-0.00554	-0.00866*	-0.00347	-0.00636	-0.00900*
	(0.0039)	(0.0035)	(0.0038)	(0.0041)	(0.0037)	(0.0040)
Observations	179	179	179	179	179	179
R^2	0.187	0.178	0.127	0.188	0.183	0.128

Reproduced:

	FF3F			FF4F		
	Green	Medium	Brown	Green	Medium	Brown
Mkt_euri	0.27832**	0.20589*	0.17759*	0.26785**	0.22487*	0.18549*
	(0.0914)	(0.0872)	(0.0807)	(0.0970)	(0.0877)	(0.0844)
SMB	1.05556***	1.01420***	0.84513***	1.05521***	1.01483***	0.84540***
	(0.2707)	(0.2283)	(0.2198)	(0.2719)	(0.2285)	(0.2207)
HML	0.04779	-0.08012	0.11260	0.00565	-0.00369	0.14439
	(0.2046)	(0.1694)	(0.1837)	(0.2093)	(0.1839)	(0.1983)
MOM				-0.06695	0.12143	0.05050
				(0.1046)	(0.0992)	(0.1205)
_cons	-0.00392	-0.00554	-0.00866*	-0.00347	-0.00636	-0.00900*
	(0.0039)	(0.0035)	(0.0038)	(0.0041)	(0.0037)	(0.0040)
N	179	179	179	179	179	179
R^2	0.187	0.178	0.127	0.188	0.183	0.128

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.8. TABLE 5: ESTIMATION RESULTS FOR THE FOUR FACTOR MODEL

Original:

	Phase 1 (January 2005 - December 2007)			Phase 2 (January 2008 - December 2012)			Phase 3 (January 2012 - December 2019)		
	Portfolios								
Variables	(1) Green	(2) Medium	(3) Brown	(1) Green	(2) Medium	(3) Brown	(1) Green	(2) Medium	(3) Brown
MKT	0.1699	0.1721	0.1605	0.2999*	0.2528	0.2140	0.0131	-0.0153	-0.0616
	(0.275)	(0.378)	(0.334)	(0.141)	(0.128)	(0.113)	(0.125)	(0.112)	(0.123)
SMB	1.0549*	0.6259*	0.7761	1.3493*	1.2605**	1.0939**	0.6160*	0.7346**	0.4026
	(0.391)	(0.268)	(0.425)	(0.533)	(0.411)	(0.384)	(0.253)	(0.269)	(0.255)
HML	0.4141	0.3185	0.2793	0.1730	0.0370	0.0388	-0.0018	0.1342	0.2841
	(0.723)	(1.004)	(0.948)	(0.452)	(0.394)	(0.379)	(0.194)	(0.182)	(0.240)
MOM	-0.2731	-0.0115	0.0175	0.0261	0.1368	0.0683	-0.1575	0.2116	-0.1281
	(0.496)	(0.616)	(0.596)	(0.162)	(0.136)	(0.174)	(0.200)	(0.179)	(0.191)
Constant	-0.0093	-0.0154	-0.0094	-0.0101	-0.0131	-0.0217**	0.0074	0.0043	0.0045
	(0.013)	(0.017)	(0.017)	(0.009)	(0.008)	(0.008)	(0.005)	(0.005)	(0.005)
Observations	35	35	35	60	60	60	84	84	84
R^2	0.272	0.159	0.119	0.229	0.238	0.192	0.059	0.102	0.048

Note: This table provides estimated coefficients α, β, γ, ϕ, θ from the time series regression for the three carbon portfolios. The estimated regression models cover the period from 2005 to 2019. Newey-West standard errors are in parentheses. The symbols *** denotes significance at 1% level; ** denotes significance at 5% level; * denotes significance at 10% level.

Reproduced:

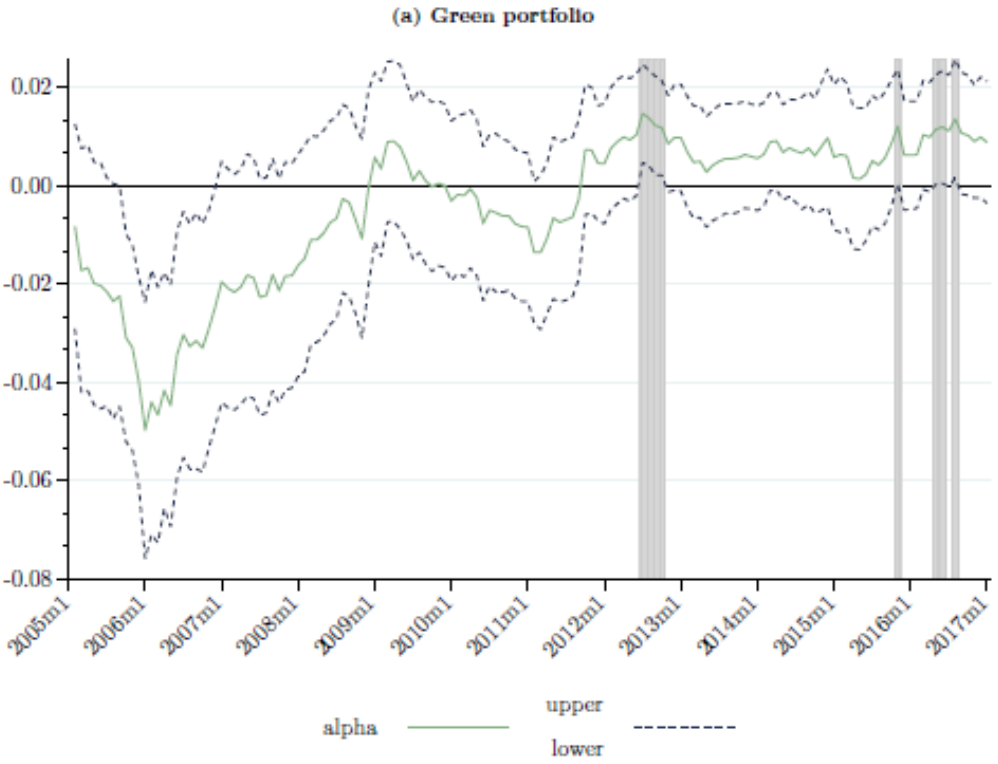
	Phase 1			Phase 2			Phase 3		
	Green	Medium	Brown	Green	Medium	Brown	Green	Medium	Brown
Mkt_euri	0.1699	0.1721	0.1605	0.2999*	0.2528	0.2140	0.0131	-0.0153	-0.0616
	(0.275)	(0.378)	(0.334)	(0.141)	(0.128)	(0.113)	(0.125)	(0.112)	(0.123)
SMB	1.0549*	0.6259*	0.7761	1.3493*	1.2605**	1.0939**	0.6160*	0.7346**	0.4026
	(0.391)	(0.268)	(0.425)	(0.533)	(0.411)	(0.384)	(0.253)	(0.269)	(0.255)
HML	0.4141	0.3185	0.2793	0.1730	0.0370	0.0388	-0.0018	0.1342	0.2841
	(0.723)	(1.004)	(0.948)	(0.452)	(0.394)	(0.379)	(0.194)	(0.182)	(0.240)
MOM	-0.2731	-0.0115	0.0175	0.0261	0.1368	0.0683	-0.1575	0.2116	-0.1281
	(0.496)	(0.616)	(0.596)	(0.162)	(0.136)	(0.174)	(0.200)	(0.179)	(0.191)
_cons	-0.0093	-0.0154	-0.0094	-0.0101	-0.0131	-0.0217**	0.0074	0.0043	0.0045
	(0.013)	(0.017)	(0.017)	(0.009)	(0.008)	(0.008)	(0.005)	(0.005)	(0.005)
N	35	35	35	60	60	60	84	84	84
R^2	0.272	0.159	0.119	0.229	0.238	0.192	0.059	0.102	0.048

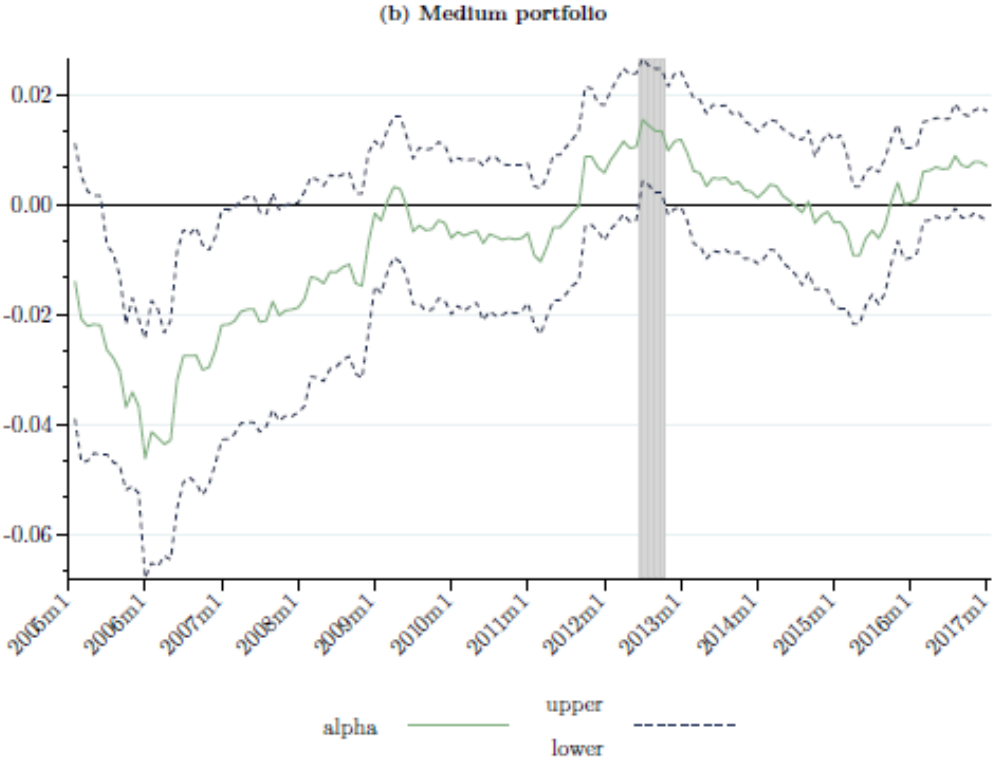
Standard errors in parentheses

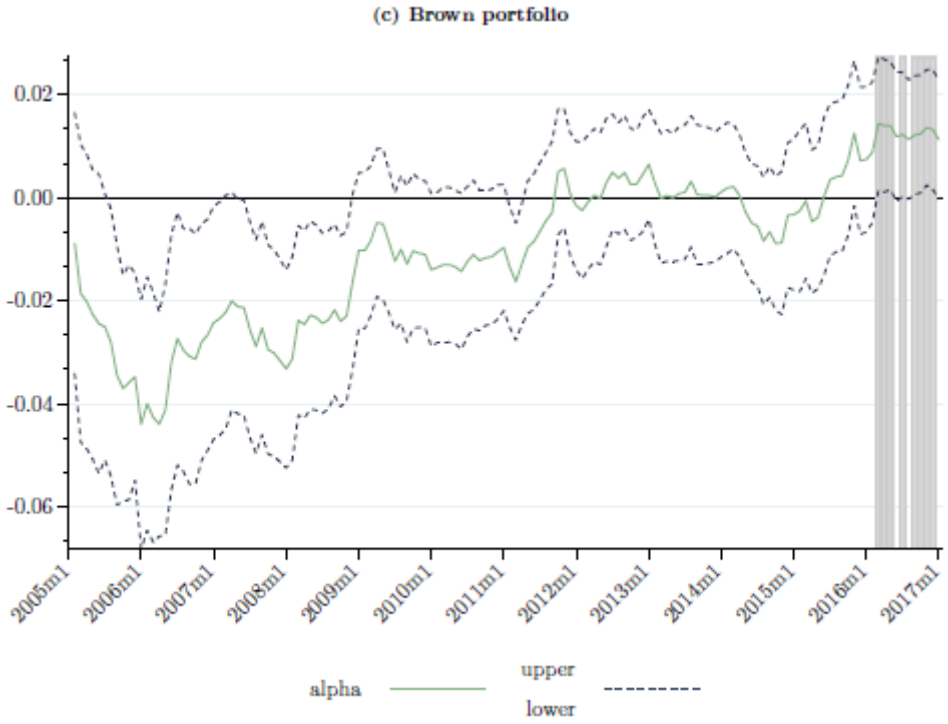
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.9. FIGURE 4: ALPHA PLOT OF THE THREE CARBON PORTFOLIOS WITH A 3-YEAR ROLLING WINDOW

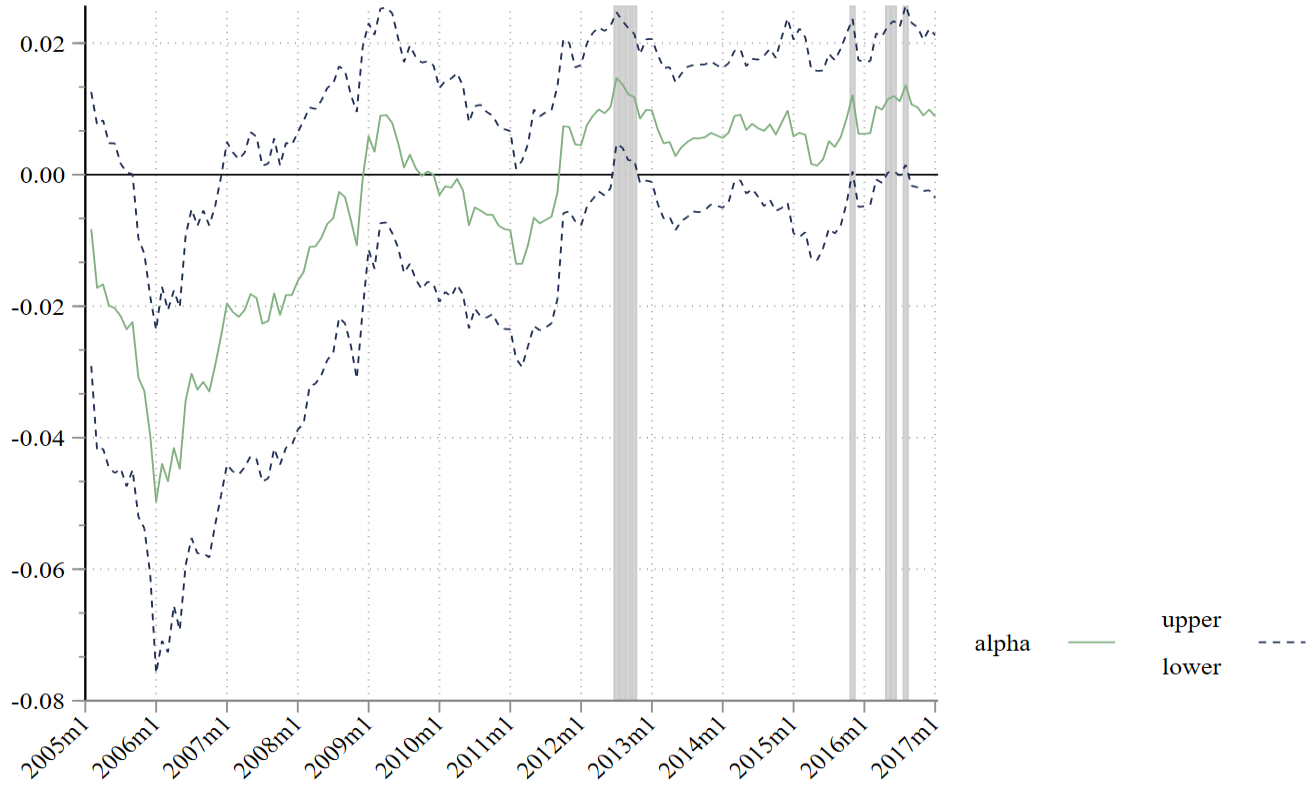
Original:



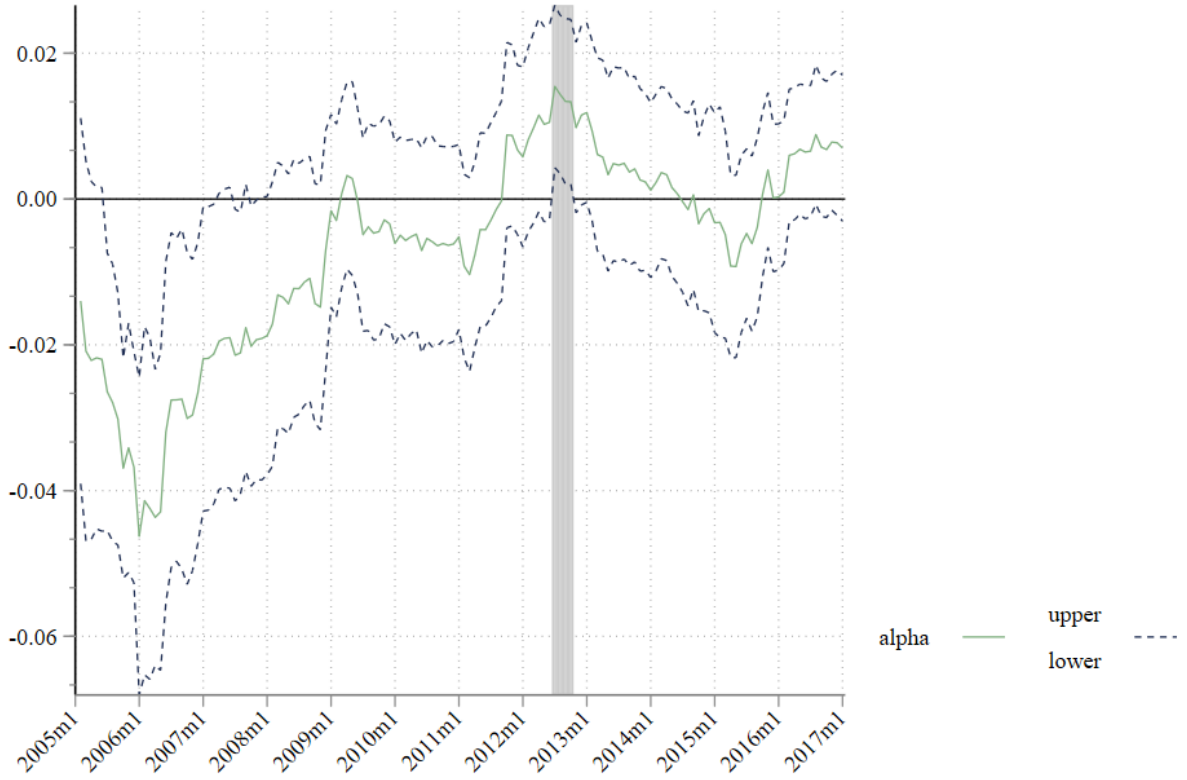




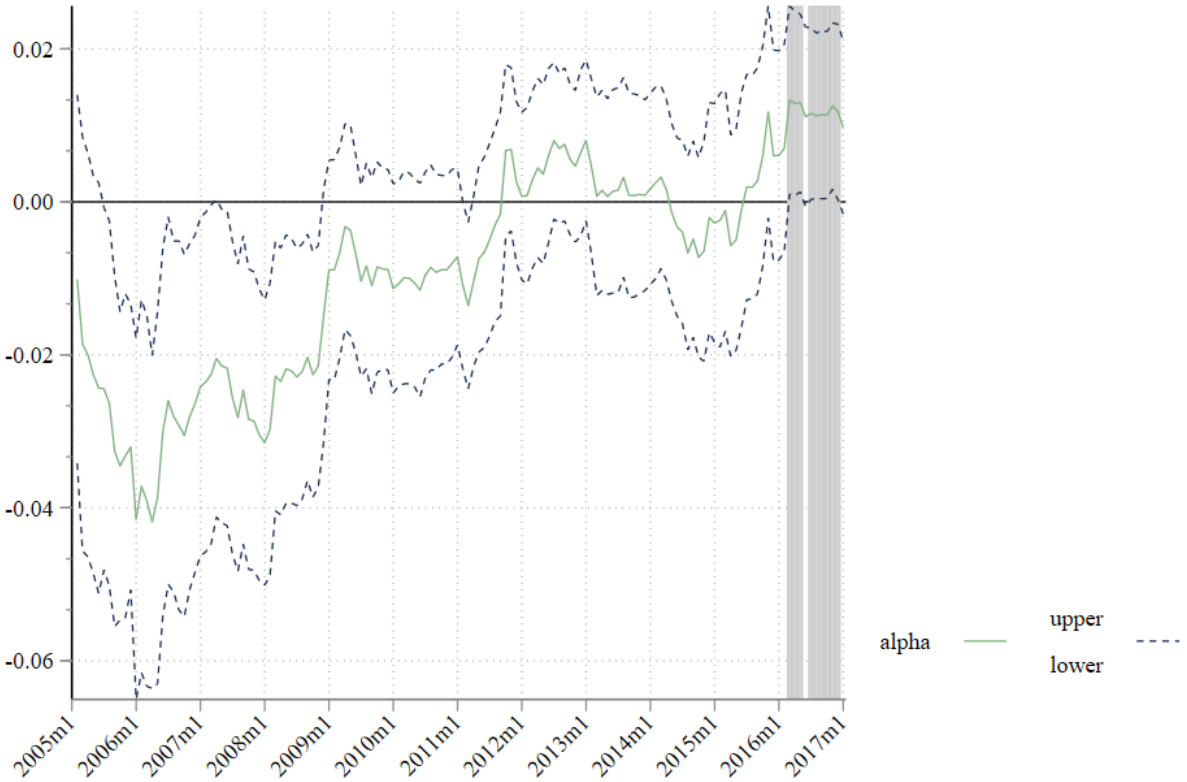
Reproduced:
(a) Green portfolio:



(b) Medium portfolio:

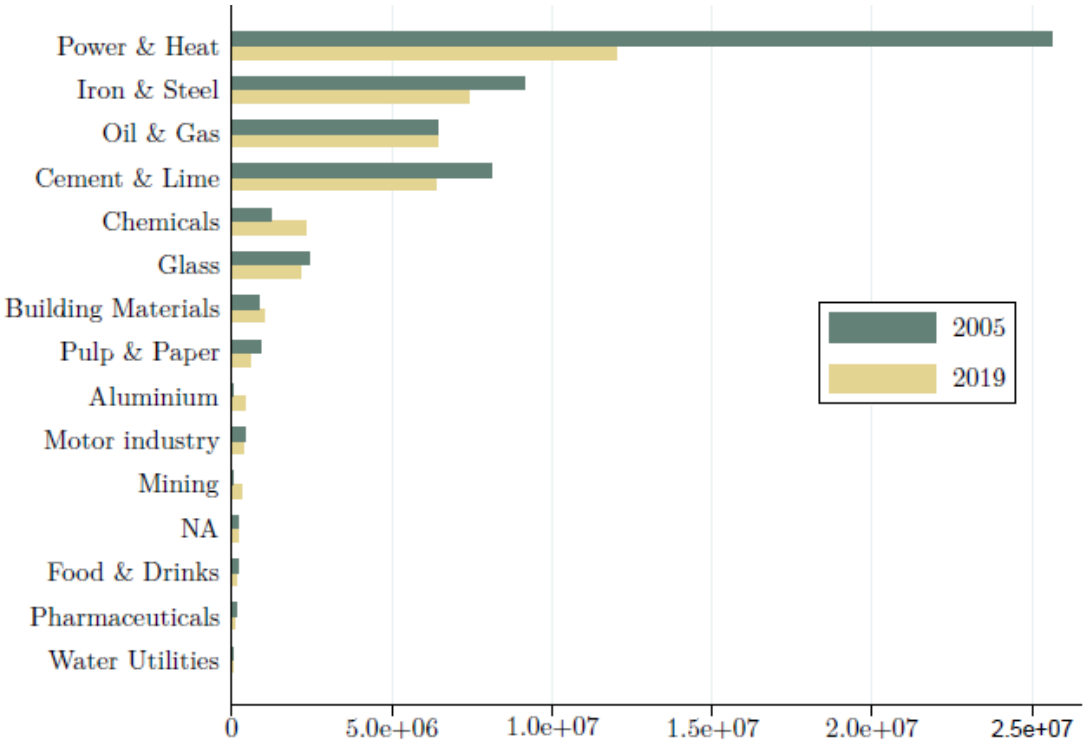


(c) Brown portfolio:

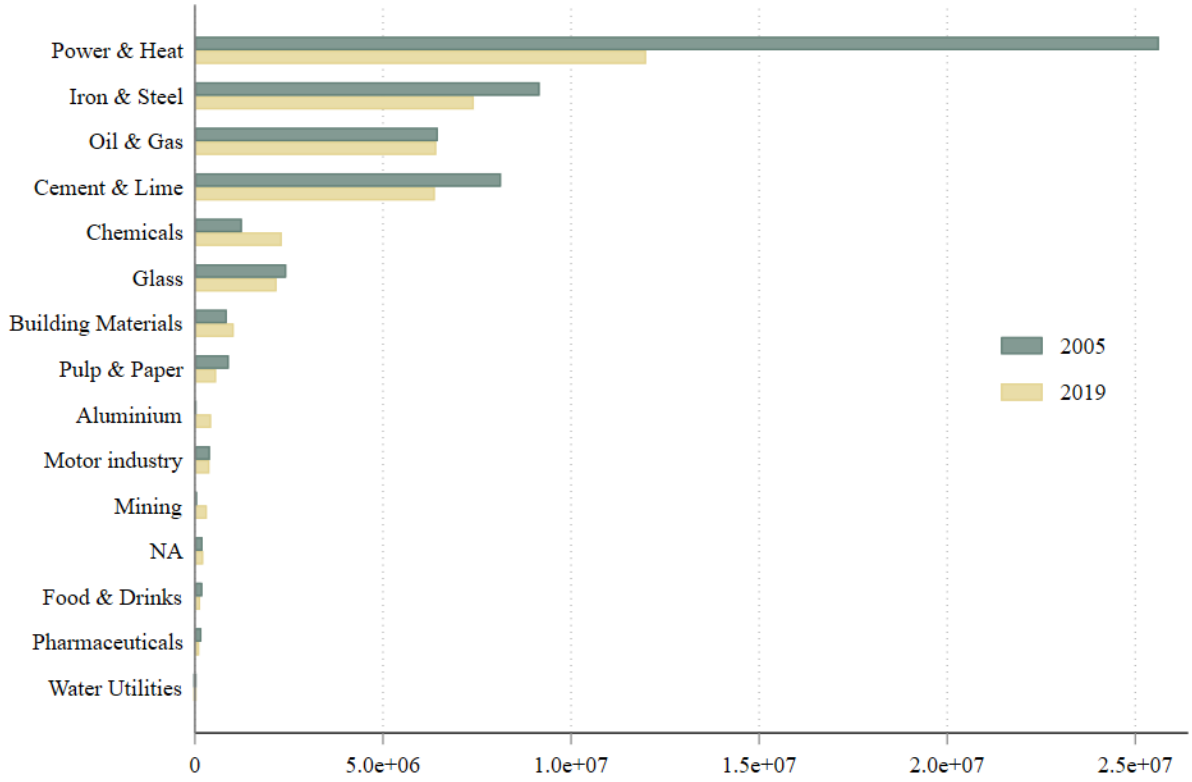


4.10. FIGURE 5: ANNUAL AVERAGE OF VERIFIED EMISSIONS BY SECTOR

Original:



Reproduced:



4.11. TABLE 6: ESTIMATION RESULTS FOR THE FOUR FACTOR MODEL

Original:

	Phase 1 (January 2005 - December 2007)			Phase 2 (January 2008 - December 2012)			Phase 3 (January 2012 - December 2019)		
	Portfolios								
Variables	(1) Green	(2) Medium	(3) Brown	(1) Green	(2) Medium	(3) Brown	(1) Green	(2) Medium	(3) Brown
MKT	0.2328	0.0616	0.1675	0.3500*	0.2460*	0.2189	0.0401	0.0382	-0.0647
	(0.319)	(0.285)	(0.330)	(0.161)	(0.118)	(0.110)	(0.124)	(0.094)	(0.124)
SMB	1.1939***	0.7147	0.5548	1.2597*	1.4750**	1.1067**	0.6632*	0.5452**	0.4778
	(0.268)	(0.392)	(0.395)	(0.513)	(0.452)	(0.379)	(0.273)	(0.188)	(0.253)
HML	0.0790	0.9275	0.2734	0.0857	0.0625	0.0754	0.2008	-0.1048	0.2252
	(0.909)	(0.761)	(0.911)	(0.514)	(0.400)	(0.356)	(0.193)	(0.162)	(0.222)
MOM	-0.2816	0.1070	0.0380	0.0144	0.1523	0.0928	0.2082	-0.1600	-0.1237
	(0.630)	(0.476)	(0.593)	(0.178)	(0.150)	(0.171)	(0.183)	(0.165)	(0.189)
Constant	-0.0059	-0.0184	-0.0103	-0.0127	-0.0152	-0.0197*	0.0050	0.0086*	0.0046
	(0.018)	(0.013)	(0.016)	(0.010)	(0.008)	(0.008)	(0.005)	(0.004)	(0.005)
Observations	35	35	35	60	60	60	84	84	84
R^2	0.226	0.209	0.104	0.217	0.253	0.208	0.081	0.074	0.050

Note: This table provides estimated coefficients α, β, γ, ϕ, θ from the time series regression for the three carbon portfolios. The estimated regression models cover the period from 2005 to 2019. Newey-West standard errors are in parentheses. The symbols *** denotes significance at 1% level; ** denotes significance at 5% level; * denotes significance at 10% level.

Reproduced:

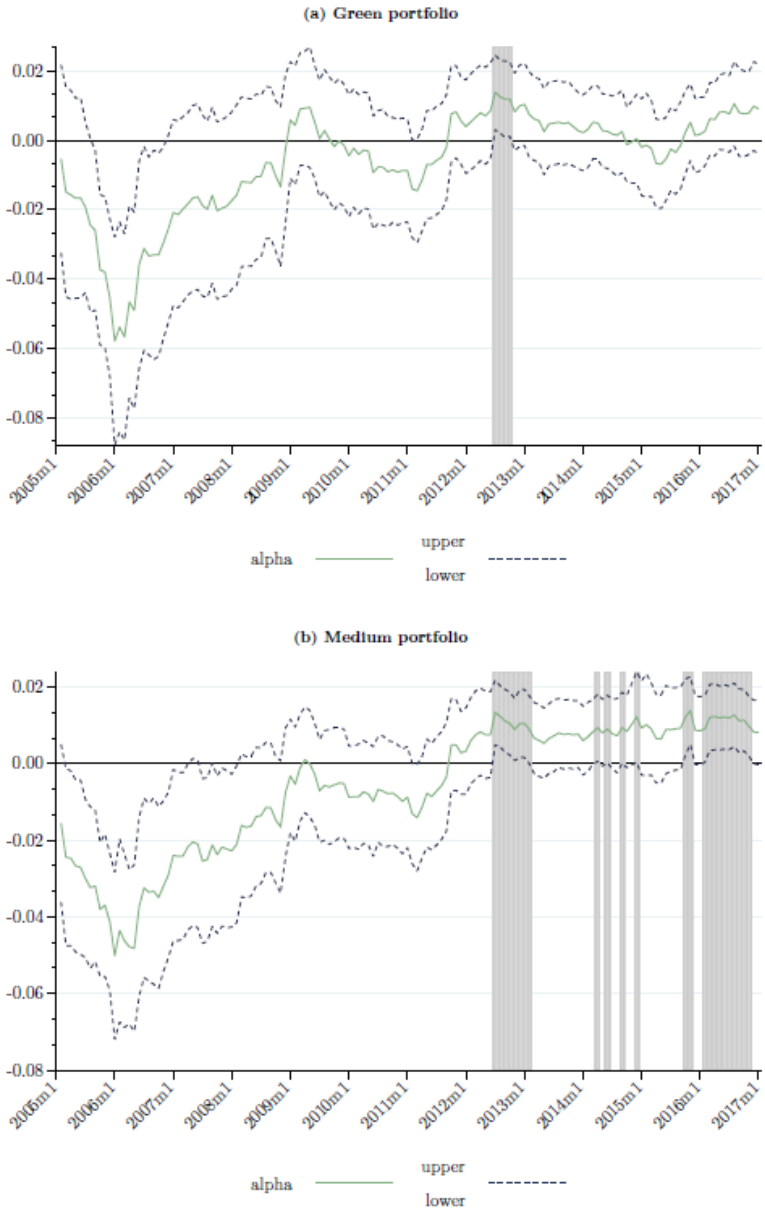
	Phase 1			Phase 2			Phase 3		
	Green	Medium	Brown	Green	Medium	Brown	Green	Medium	¿ column1cBrown
Mkt_euri	0.2328	0.0616	0.1675	0.3500*	0.2460*	0.2189	0.0401	0.0382	-0.0647
	(0.319)	(0.285)	(0.330)	(0.161)	(0.118)	(0.110)	(0.124)	(0.094)	(0.124)
SMB	1.1939***	0.7147	0.5548	1.2597*	1.4750**	1.1067**	0.6632*	0.5452**	0.4778
	(0.268)	(0.392)	(0.395)	(0.513)	(0.452)	(0.379)	(0.273)	(0.188)	(0.253)
HML	0.0790	0.9275	0.2734	0.0857	0.0625	0.0754	0.2008	-0.1048	0.2252
	(0.909)	(0.761)	(0.911)	(0.514)	(0.400)	(0.356)	(0.193)	(0.162)	(0.222)
MOM	-0.2816	0.1070	0.0380	0.0144	0.1523	0.0928	0.2082	-0.1600	-0.1237
	(0.630)	(0.476)	(0.593)	(0.178)	(0.150)	(0.171)	(0.183)	(0.165)	(0.189)
_cons	-0.0059	-0.0184	-0.0103	-0.0127	-0.0152	-0.0197*	0.0050	0.0086*	0.0046
	(0.018)	(0.013)	(0.016)	(0.010)	(0.008)	(0.008)	(0.005)	(0.004)	(0.005)
N	35	35	35	60	60	60	84	84	84
R^2	0.226	0.209	0.104	0.217	0.253	0.208	0.081	0.074	0.050

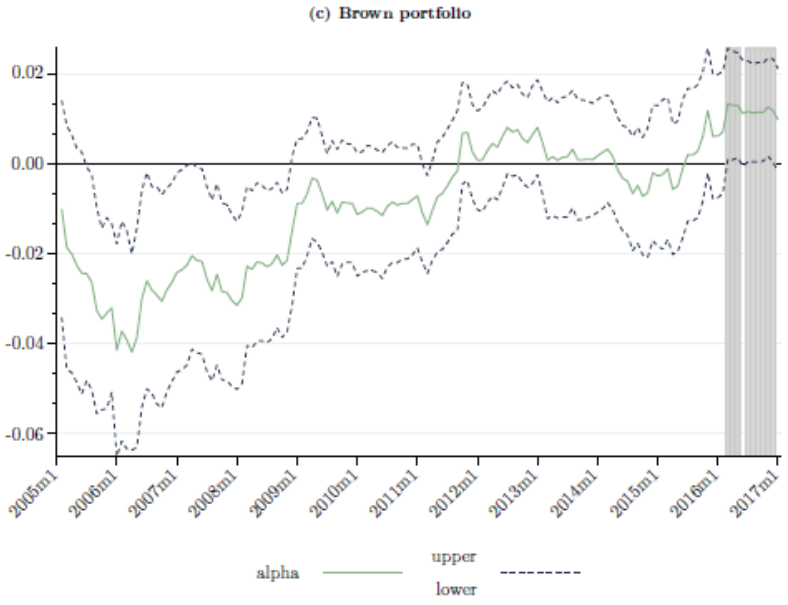
Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.12. FIGURE 6: ALPHA PLOT OF THE THREE CARBON PORTFOLIOS WITH A 3-YEAR ROLLING WINDOW

Original:

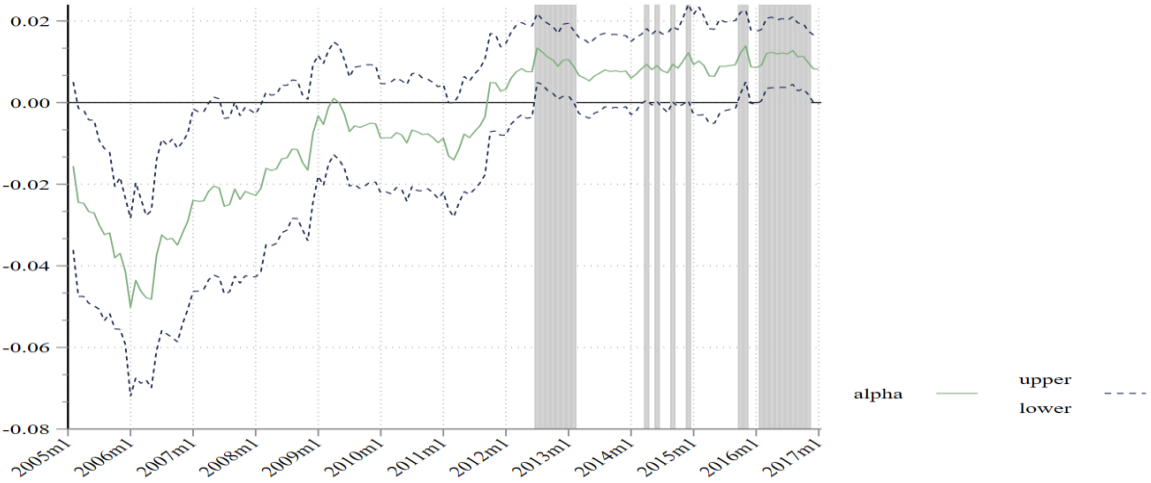




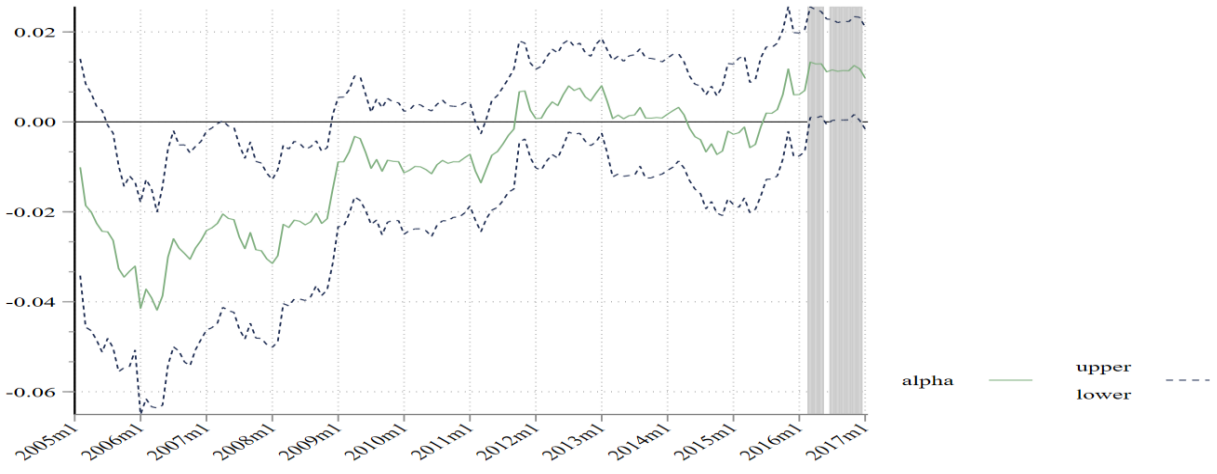
Reproduced:

(a) Green portfolio

(b) Medium portfolio



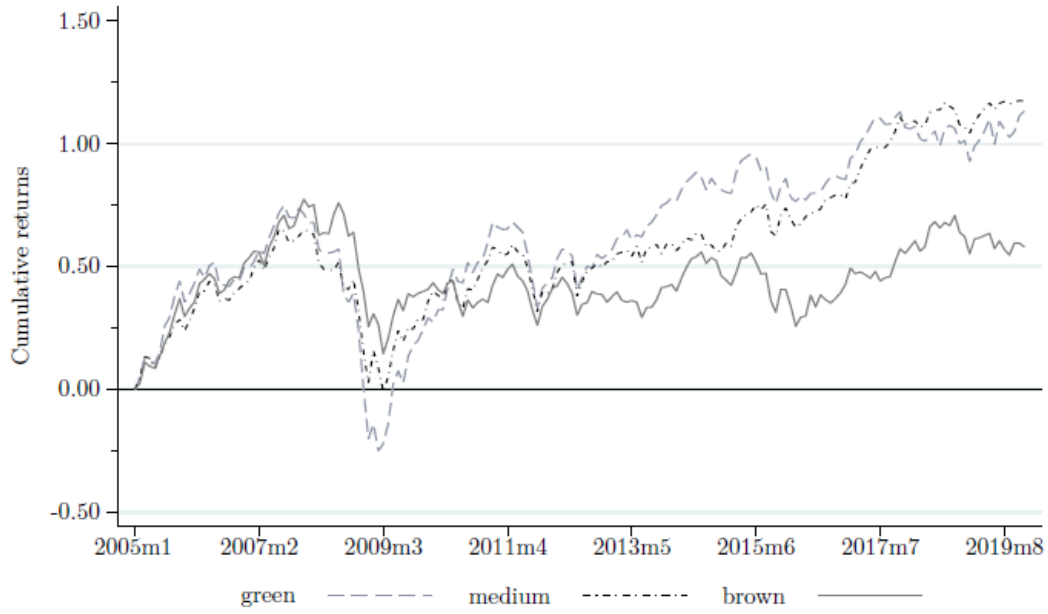
(c) Brown portfolio



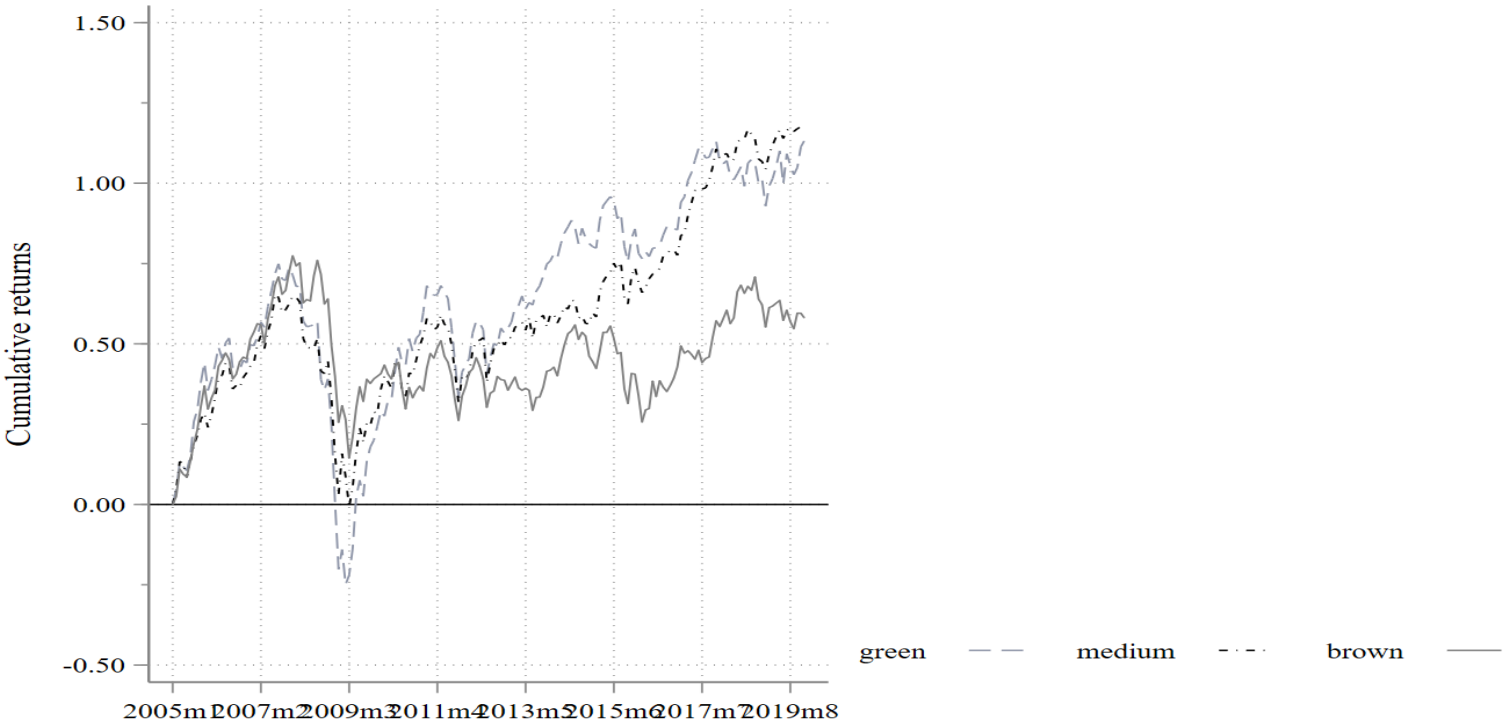
4.13. FIGURE 7: CUMULATIVE RETURNS OF THE THREE CARBON PORTFOLIOS ON THE OVERALL OBSERVATION PERIOD (ALL EU-ETS PHASES)

Original:

Figure 7: Cumulative returns of the three carbon portfolios on the overall observation period (all EU-ETS phases)

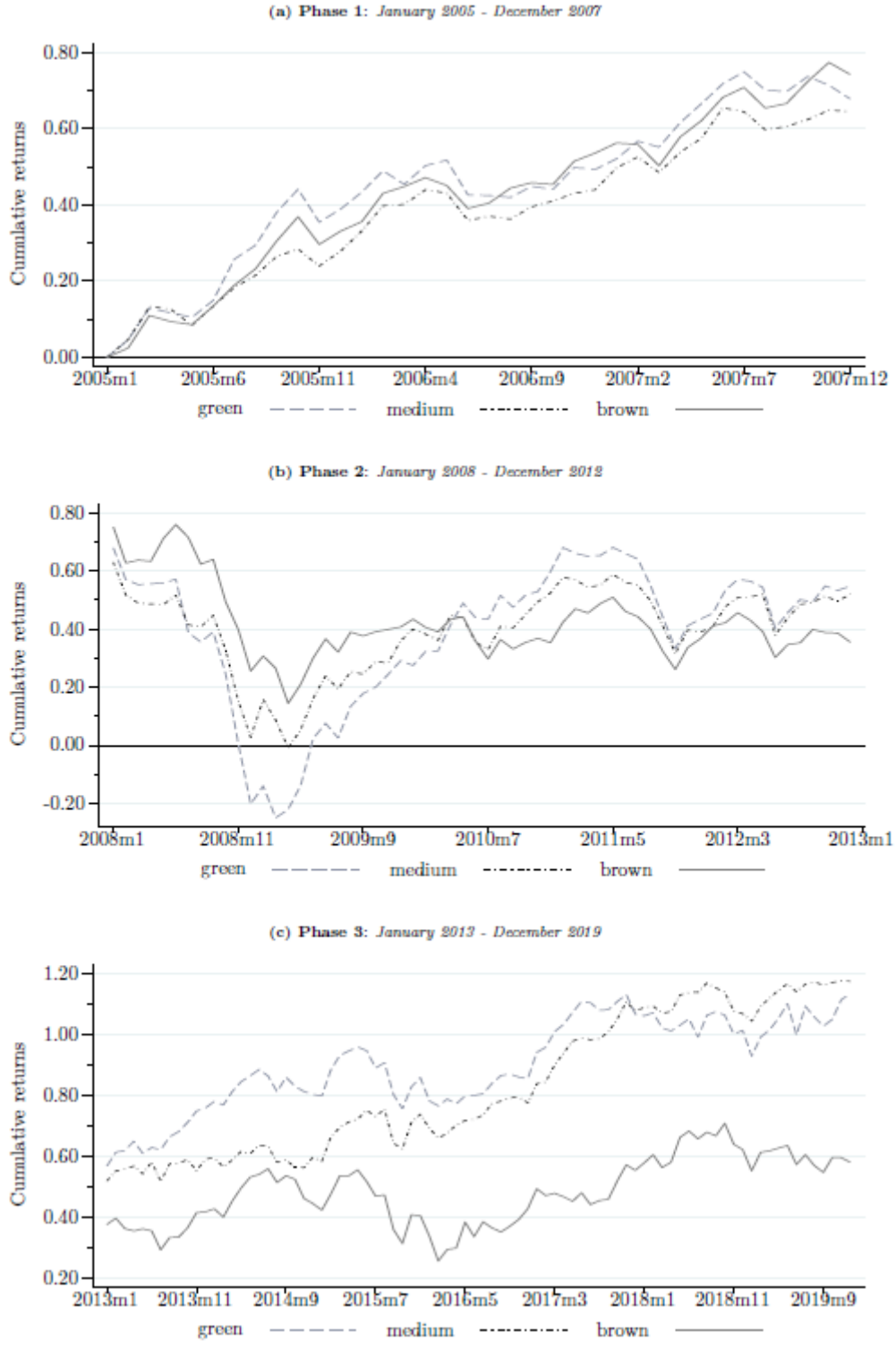


Reproduced:



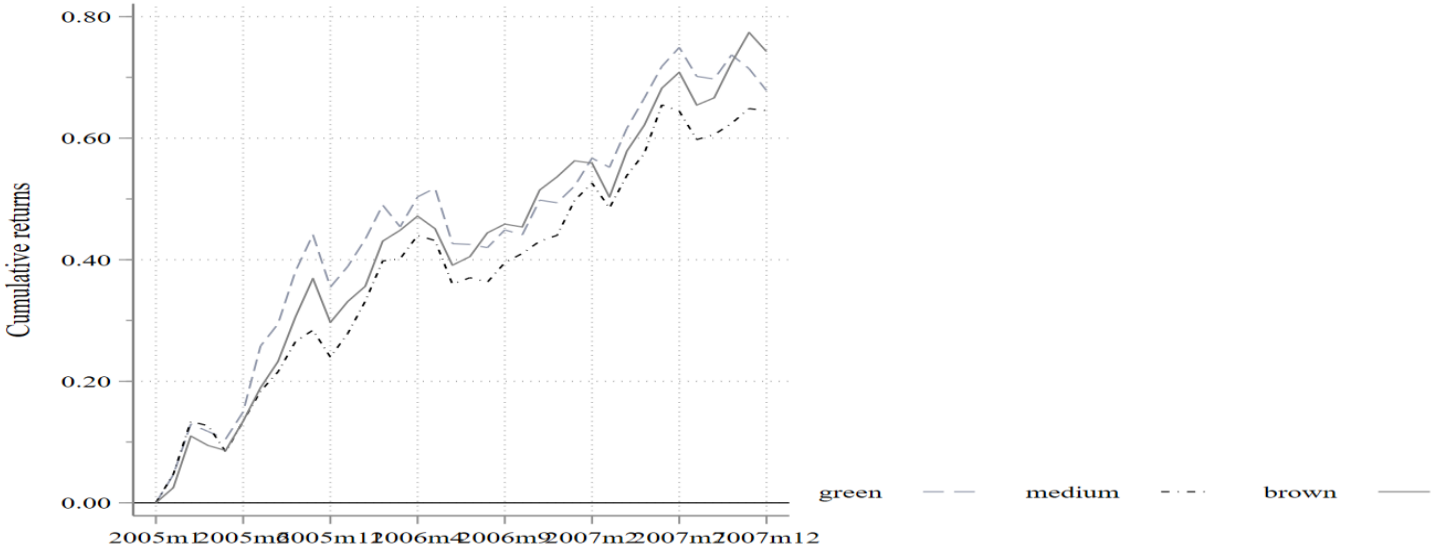
4.14. FIGURE 8: CUMULATIVE CARBON PORTFOLIOS RETURNS FOR THE THREE PHASES OF THE EU ETS

Original:

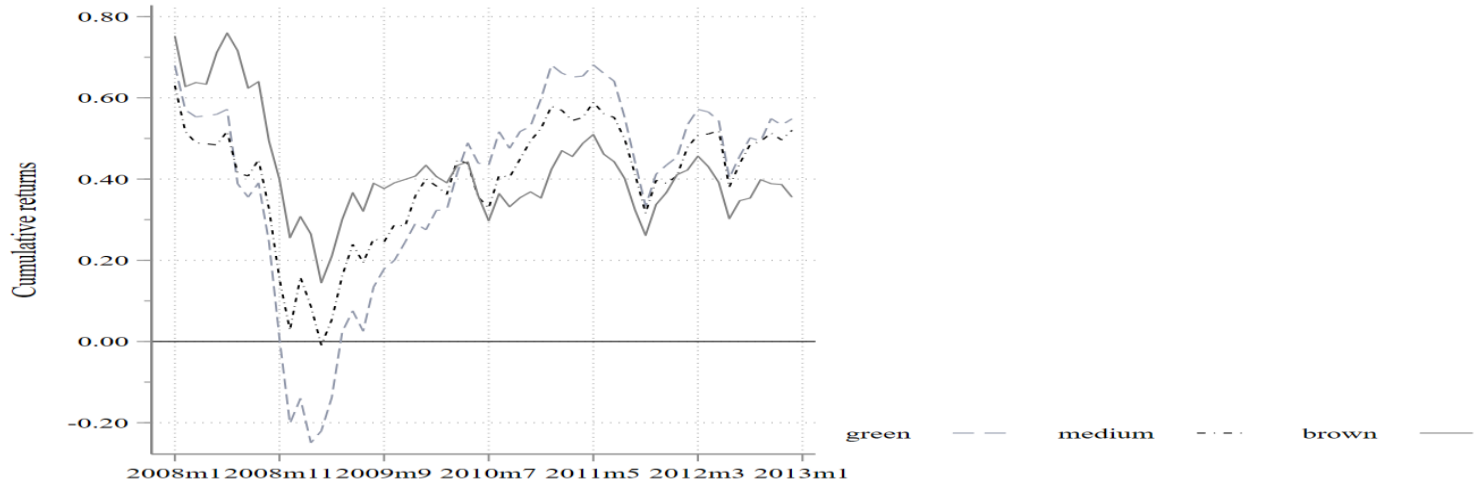


Reproduced:

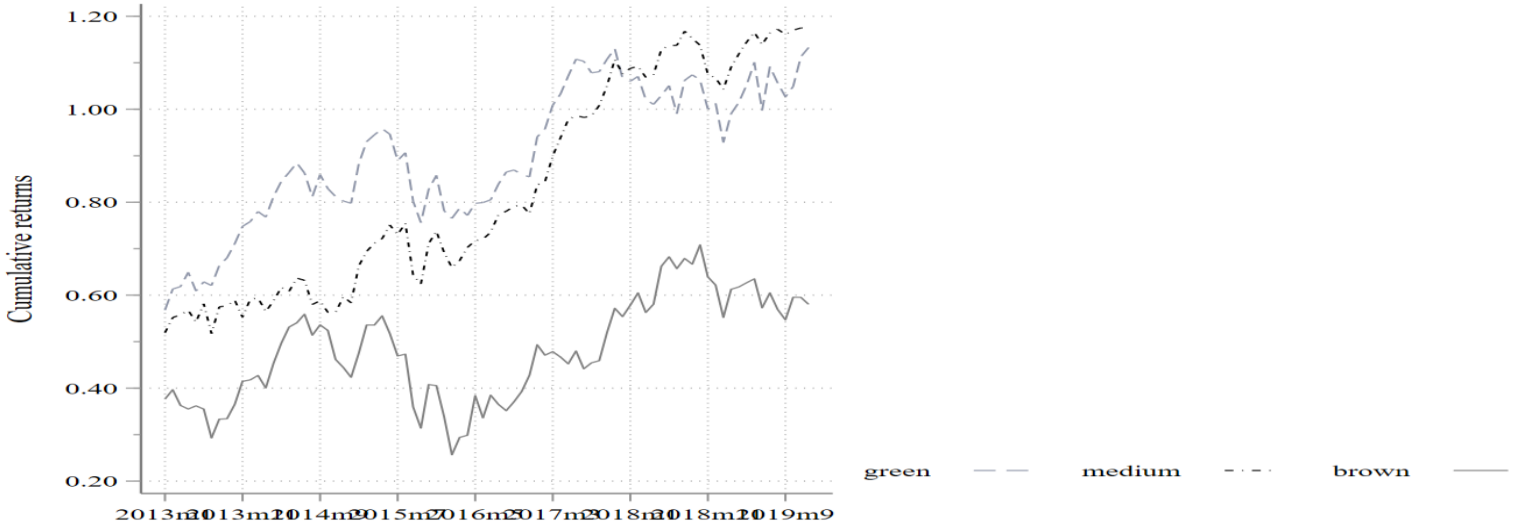
(a) Phase 1



(b) Phase 2



(c) Phase 3



4.15. TABLE 9: ESTIMATION RESULTS FOR THE FOUR FACTOR MODEL

Original:

	FF3			FF4		
Variables	(1) Green	(2) Medium	(3) Brown	(1) Green	(2) Medium	(3) Brown
MKT	0.30700**	0.23222**	0.17842*	0.31215**	0.23968**	0.18638*
	(0.1014)	(0.0791)	(0.0802)	(0.1066)	(0.0820)	(0.0836)
SMB	1.07532***	1.04881***	0.83473***	1.07549***	1.04906***	0.83499***
	(0.2664)	(0.2410)	(0.2182)	(0.2670)	(0.2416)	(0.2191)
HML	0.05997	-0.12527	0.08049	0.08068	-0.09520	0.11255
	(0.2118)	(0.1714)	(0.1738)	(0.2272)	(0.1831)	(0.1852)
MOM				0.03291	0.04776	0.05094
				(0.1176)	(0.0997)	(0.1189)
Constant	-0.00448	-0.00477	-0.00801*	-0.00470	-0.00509	-0.00836*
	(0.0042)	(0.0034)	(0.0036)	(0.0045)	(0.0036)	(0.0038)
Observations	179	179	179	179	179	179
R^2	0.185	0.196	0.134	0.185	0.196	0.135

Reproduced:

	FF3			FF4		
	Green	Medium	Brown	Green	Medium	Brown
Mkt_euri	0.30700**	0.23222**	0.17842*	0.31215**	0.23968**	0.18638*
	(0.1014)	(0.0791)	(0.0802)	(0.1066)	(0.0820)	(0.0836)
SMB	1.07532***	1.04881***	0.83473***	1.07549***	1.04906***	0.83499***
	(0.2664)	(0.2410)	(0.2182)	(0.2670)	(0.2416)	(0.2191)
HML	0.05997	-0.12527	0.08049	0.08068	-0.09520	0.11255
	(0.2118)	(0.1714)	(0.1738)	(0.2272)	(0.1831)	(0.1852)
MOM				0.03291	0.04776	0.05094
				(0.1176)	(0.0997)	(0.1189)
_cons	-0.00448	-0.00477	-0.00801*	-0.00470	-0.00509	-0.00836*
	(0.0042)	(0.0034)	(0.0036)	(0.0045)	(0.0036)	(0.0038)
N	179	179	179	179	179	179
R^2	0.185	0.196	0.134	0.185	0.196	0.135

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$