Green versus Brown Initial Public Offerings: How do green IPOs fare?

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Introduction

- CF and clean energy finance prominent issue
- Energy transition (ET) requires huge investment
  - Financing issue (primary markets)
  - CERES 'Clean Trillion' & IPCC (2018) 2.4 trillion p.a
- Burgeoning CF literature
  - Mainly focussed on secondary markets
  - Primary market research mainly focusses on debt (green bonds)
- Debt and project finance (asset rollout) largest
- But (risk) equity (skin in the game) needed to raise debt
- So new equity (new firms) raising equity critically important
- 'green' IPO's
- But ET is going to be multi-decadal so new generation of 'brown' firms will continue to emerge (IPO)?
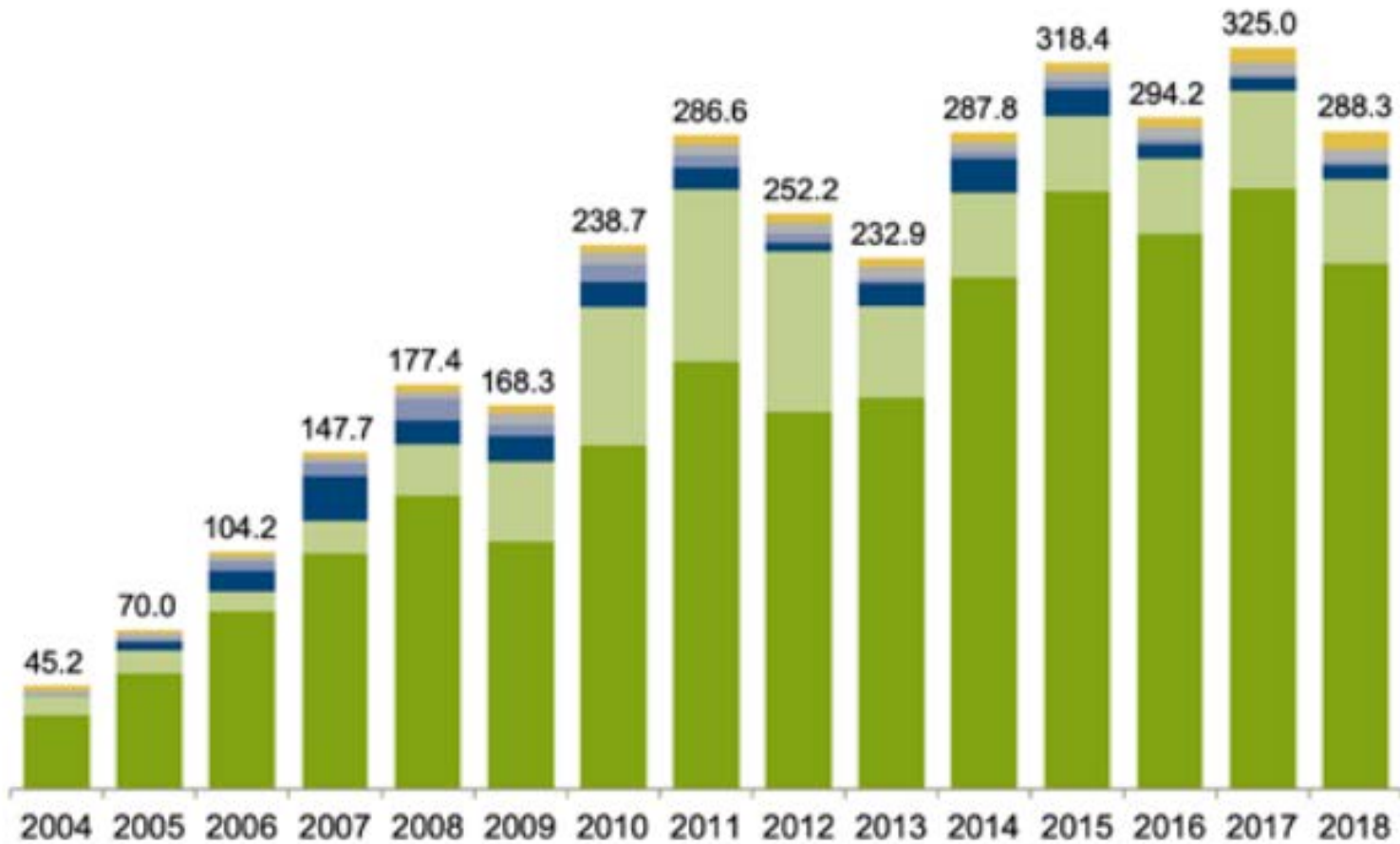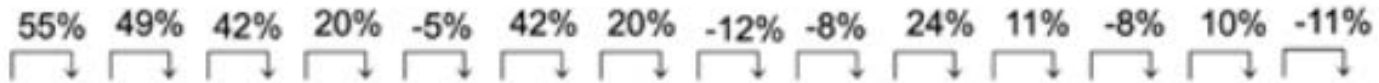
Financing Continuum
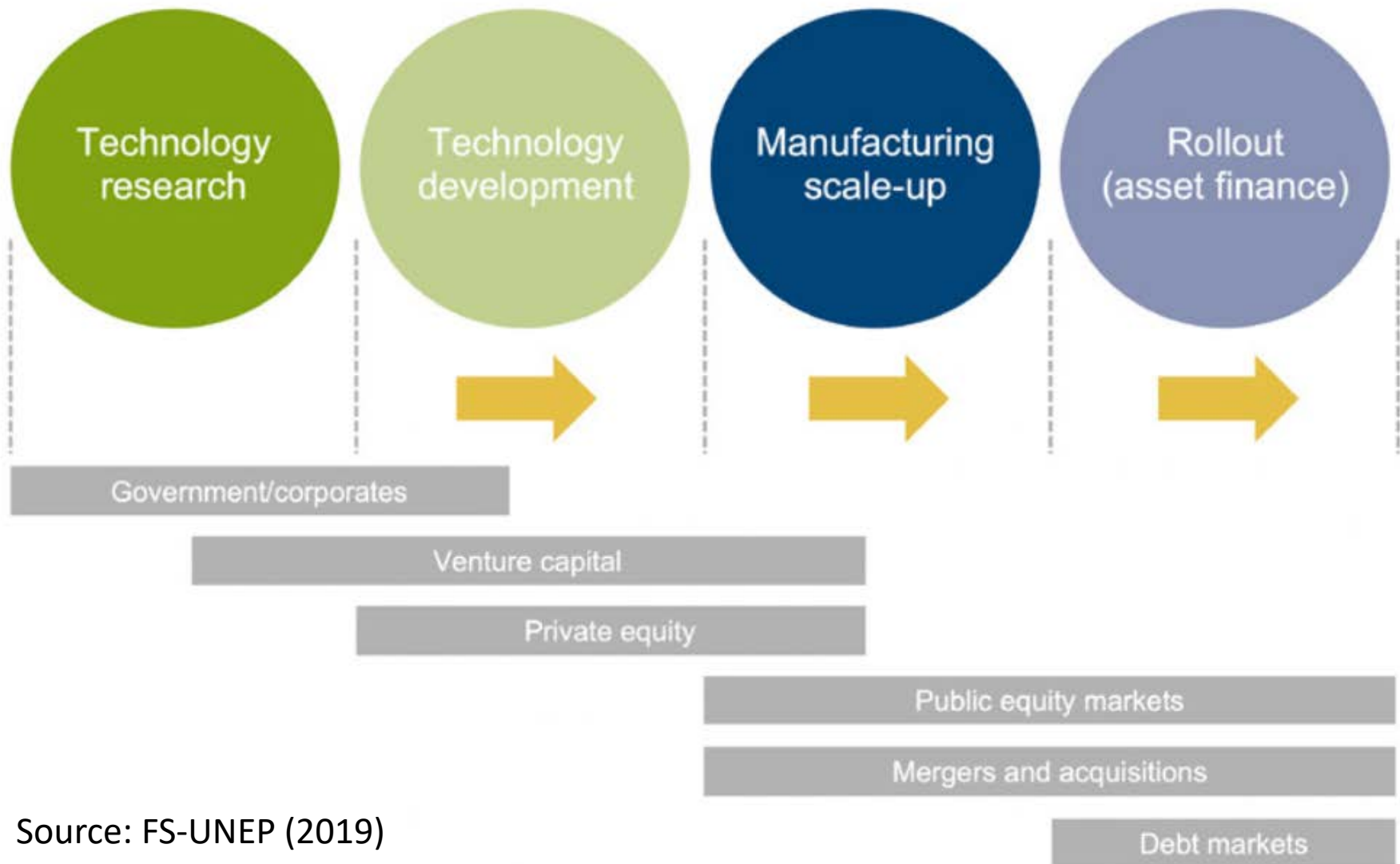
Source: FS-UNEP (2019)

Global Investment In RES

Growth: 55% 49% 42% 20% -5% 42% 20% -12% -8% 24% 11% -8% 10% -11%

Legend: Asset finance* ■ Small distributed capacity ■ Public markets ■ VC/PE ■ Government R&D ■ Corporate R&D

Values by year: 45.2 (2004), 70.0 (2005), 104.2 (2006), 147.7 (2007), 177.4 (2008), 168.3 (2009), 238.7 (2010), 286.6 (2011), 252.2 (2012), 232.9 (2013), 287.8 (2014), 318.4 (2015), 294.2 (2016), 325.0 (2017), 288.3 (2018)

Source: FS-UNEP (2019)

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Contribution

- Green vs Grown IPOs: Unique dataset of European IPO market
- 2001-2015 – Europe 563bn vs US 529bn (in USD)(Helbing et al. 2019)
- Anderloni and Tanda (2017) non-RES more under-priced and perform better (n=144 between 2000 to 2014)
- Research Questions
  - Are green IPO's taking over? [Descriptive]
  - Are green IPOs more likely to be withdrawn?
    - Negative market signal
    - Kaplan-Meier survival estimates
  - Do green IPOs have more favourable ownership characteristics?
    - Retention by insiders and 'smart' money (VC vs. PE (value))
  - How do green perform relative to brown post-IPO?
    - BHARs & four factor time series models
    - Performance during COVID crisis

Hypotheses

- Hypothesis 1a: Green IPOs are likely to have greater VC involvement, whilst brown IPOs are likely to have more PE involvement.
  - VC high-risk capital for new ventures (Randjelovic et al. 2003)
  - PE mature firms with operating/financial issues (Gompers et al., 2016)
- Hypothesis 1b: Green IPOs will have more retained ownership than Brown IPOs
  - Growth vs. selling out
- Hypothesis 2: Green IPOs have a greater likelihood of being withdrawn than brown IPOs
  - Leete et al. (2013) Green = more risk
  - Hong et al. (2019) Markets under pricing to climate risk
- Hypothesis 3: Green firms have a worse post-IPO performance than brown firms.
  - Green underperformance: Rezec and Scholtens (2017); Climent and Soriano (2011); Fernandez et al. (2019); Anderloni and Tanda (2017)

Data and Methods

- 2001-2017 - 3,014 IPOs (UK, France, Germany, Spain, Italy, Scandinavia) - Helbing et al (2019)

- 2,658 successfully, 356 withdrawn

- Bloomberg industry classifications - energy, transport and building materials sectors (n=310)

- Coding of green (n=90), brown (n=194) or ambiguous (n=26)
  - *A firm with a majority (over 50%) of their operations (as measured by revenues) focused on renewable, GHG neutral or reducing methods, technologies and associate enabling 'green' services and technologies. This includes renewable energies, carbon-neutral buildings, building materials, electrification of transport and enabling technologies such as Smart Grid and Smart Grid Edge Technologies*
  - Used IPO prospectus, Capital IQ, Bloomberg, or other public sources
  - Double checked

- Of the n=284 green & brown IPO's, n=38 were withdrawals

| Variable | Green IPO filings | | Brown IPO filings | | | |
	Mean	St. Dev	Mean	St. Dev	t-stat	p-value
Market Characteristics						
IPO Withdrawal	0.19	0.39	0.11	0.31	-1.86	0.0636*
AIM	0.29	0.46	0.57	0.50	4.50	0.0000***
Market Hotness	0.56	0.50	0.70	0.46	2.42	0.0163**
Trading Volume	0.46	0.50	0.52	0.50	0.94	0.3492
Negative News	0.09	0.29	0.09	0.29	0.11	0.9160
Firm and Offer Characteristics						
Offer Size (abs)	149.84	538.36	852.30	8943.69	0.74	0.4576
Primary Shares	0.82	0.31	0.82	0.32	-0.02	0.9874
Secondary Shares	0.18	0.31	0.18	0.32	0.02	0.9874
Greenshoe Option	0.05	0.07	0.04	0.07	-1.77	0.0781*
Debt Retirement	0.24	0.43	0.15	0.36	-1.95	0.0527*
Private Equity	0.18	0.38	0.08	0.28	-2.38	0.0181**
Venture Capital	0.12	0.33	0.05	0.21	-2.34	0.0201**
Intellectual Capital	0.34	0.48	0.45	0.50	1.74	0.0833*
Underwriter	0.22	0.27	0.20	0.24	-0.63	0.5283
Firm Size (abs)	462.34	2731.66	2720.82	19655.25	1.08	0.2792
Age (abs)	8.18	15.27	11.85	23.75	1.34	0.1815
CapEx	0.10	0.13	0.35	3.64	0.64	0.5199
Return on Assets	-0.28	0.69	-0.26	0.76	0.12	0.9013
Debt	0.75	1.44	0.53	0.65	-1.78	0.0770*
High-Tech	0.19	0.39	0.29	0.46	1.88	0.0612*
Multinationality	0.30	0.17	0.28	0.19	-0.66	0.5079
Retained Ownership	0.60	0.25	0.54	0.29	-1.60	0.1104
Lock-up (days)	238.43	161.47	265.28	166.26	1.28	0.2025
Board Size	5.64	2.80	5.85	2.91	0.56	0.5749
Board Independence	0.25	0.29	0.26	0.26	0.19	0.8527
Female Board Members	0.09	0.13	0.08	0.14	-0.31	0.7589
CEO Duality	0.22	0.42	0.12	0.32	-2.28	0.0233**
N		90		194		

Models

Ownership: Probit model with Green Dummy dependent variable
- **VC and PE dummies (H1a)** and **Retained Ownership (H1b)**
- firm, offer and market controls

Withdrawal: Probit model with Withdraw dummy dependent variable
- **green dummy (H2)** + firm, offer and market controls
- **Survival Analysis** semi-parametric Cox proportional hazards model (Kartsonaki, 2016)
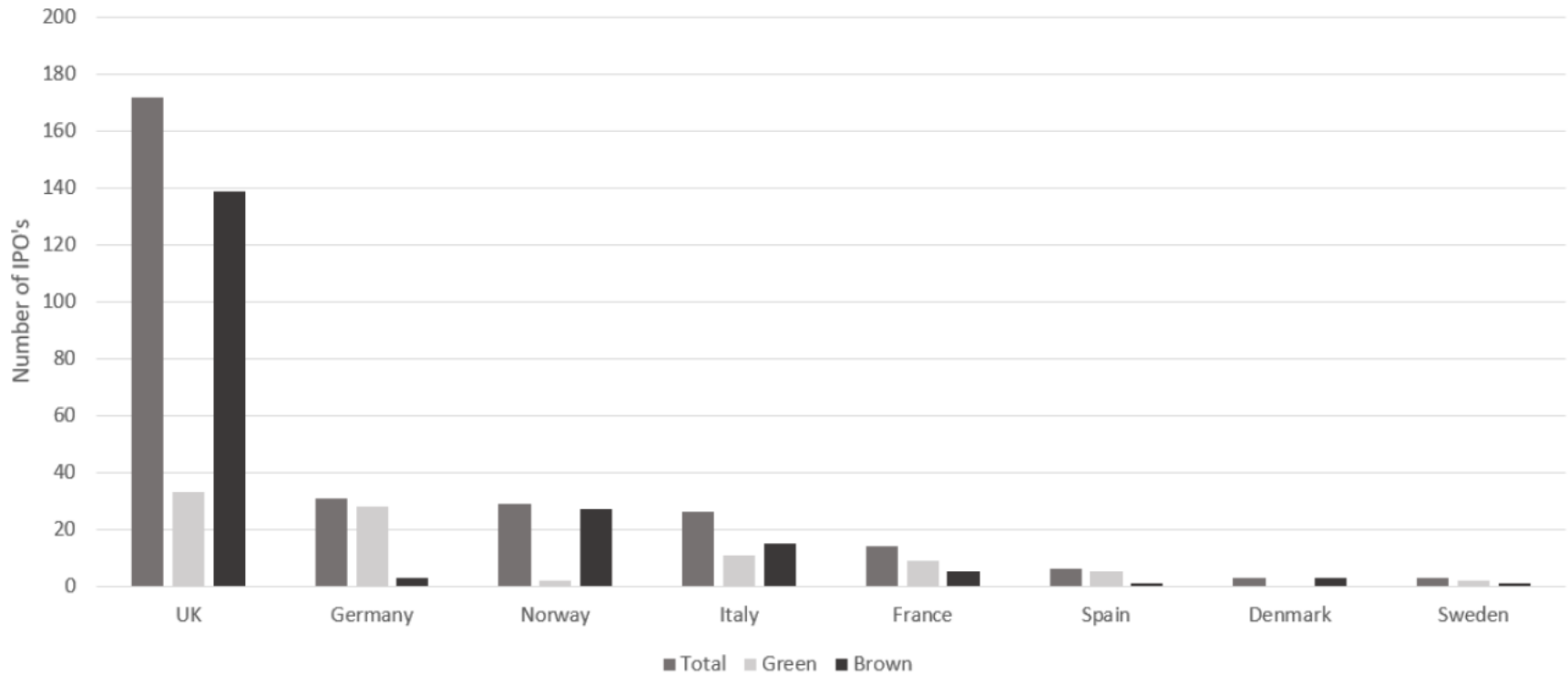
Post-IPO performance (H3)

$$BHAR(t_1, t_2) = \Pi_{t=t_1}^{t_2}[(1 + R_{it})] - \Pi_{t=t_1}^{t_2}[(1 + R_{mt})]$$

$$r_{it} - r_{ft} = \alpha_{iT}^{4F} + b_{iT}MktRF_t + s_{iT}SMB + h_{iT}HML_t$$

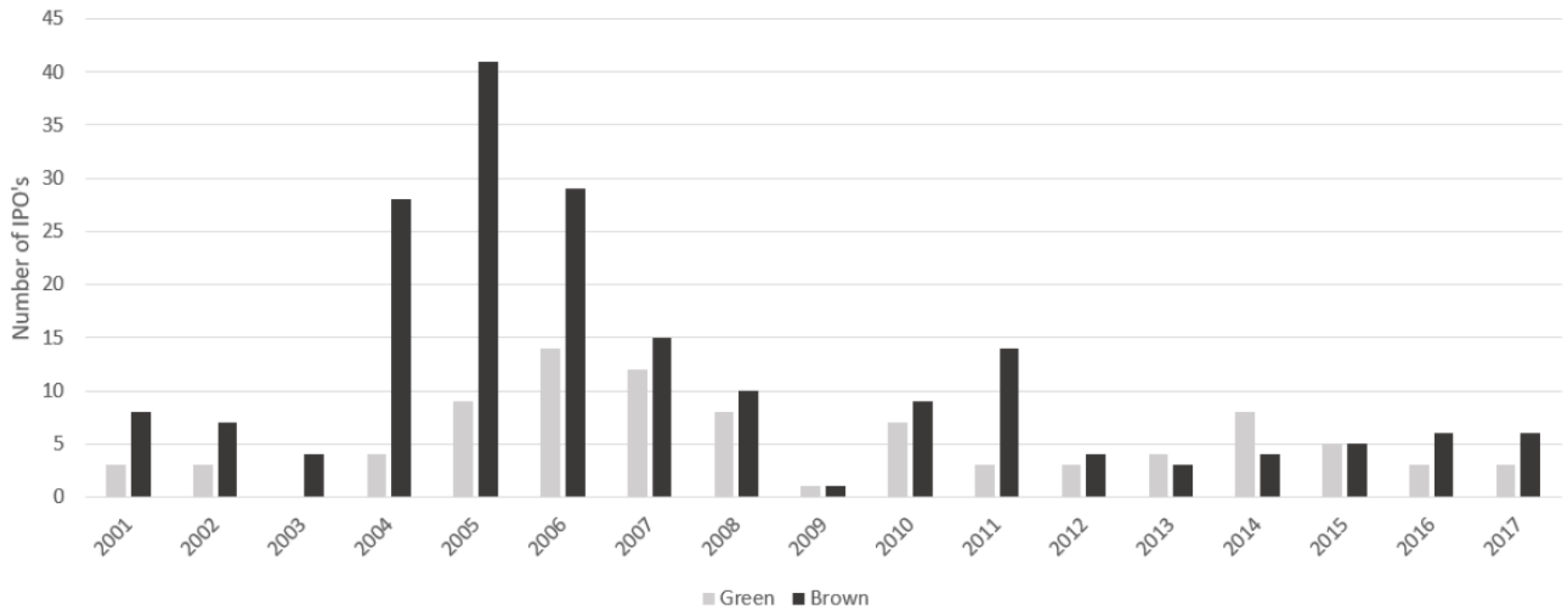$$+ p_{iT}WML_t + e_{it}$$

Results - Descriptive

Figure 1: This figure shows the total absolute number of IPOs by country in the dataset from 2001 to 2017.

Energy IPOs - Evolution Over Time

Figure 2: This figure shows the absolute number of green and brown IPOs for all countries across the whole sample period from 2001 to 2017.

Ownership: Green Dependent Variable

VC (H1a) and PE (contrary H1a) involvement

Higher retained ownership (H1b)

Variable	Model One Coefficient	ME (%)	Model Two Coefficient	ME (%)	Model Three Coefficient	ME (%)
Market Characteristics						
Intercept	-0.832***		-0.180		-0.443	
IPO Withdrawal	0.219	0.0796			0.017	0.0057
AIM			-0.947***	-0.3108	-0.940***	-0.3031
Hotness					-0.360***	-0.1236
Trading Volume					0.1	0.0167
European Oil Price					-0.2896	-0.0992
Negative News					-0.1	-0.0346
Firm and Offer Characteristics						
Offer Size					0.0	0.0094
Primary Shares	0.143	0.0500			0.370	0.1236
Greenshoe Option					0.682	0.2278
Debt Retirement					0.103	0.0352
Private Equity	0.663***	0.2520	0.529**	0.1957	0.380	0.1363
Venture Capital	0.774***	0.2968	0.738**	0.2797	0.756**	0.2846
Intellectual Capital	-0.351**	-0.1207	-0.516***	-0.1699	-0.573***	-0.1844
Underwriter					0.3094	0.1034
Firm Size			-0.097***	-0.0329	-0.101**	-0.0336
Firm Age					-0.0222	-0.0074
CAPEX					-0.01958	-0.0065
ROA					0.1016	0.0339
Debt					0.1153	0.0385
High-tech					-0.2146	-0.0694
Multinationality					0.4778	0.1596
Retained Ownership	0.642**	0.2250	1.01***	0.3427	1.065***	0.3558
Lockup Period	-0.0006	-0.0002			0.0005	0.0002
Board Size					-0.0139	-0.0046
Board Independence					0.1027	0.0343
Female Board Members					-0.4993	-0.1668
CEO Duality					0.2483	0.0868
HL Statistic	15.25	(0.0545)	1.94	(0.9828)	7.53	(0.4809)
Pseudo R2	0.0650		0.1529		0.1929	
N	284		284		284	

Withdrawal Analysis

green (marginally) less likely to be withdrawn

Contrary to H2

but pre-2011 Green interaction consistent with with H2

Variable	Model One Coefficient	ME (%)	Model Two Coefficient	ME (%)	Model Three Coefficient	ME (%)
Market Characteristics						
Intercept	0.293		-0.281		0.519	
AIM					-0.007	-0.0005
Hotness					0.052	0.0042
Trading Volume					0.121	0.001
Negative News			0.902**	0.1589	0.990**	0.159
European Oil Price	-0.722***	-0.1471	-0.900***	-0.1188	-0.929***	-0.1047
Green Oil Price Interaction	0.661	0.1476	1.189**	0.2124	1.205**	0.1888
Firm and Offer Characteristics						
Offer Size			0.134*	0.0134	0.108	0.0089
Primary Shares	-0.853***	-0.1490			-0.654*	-0.0537
Greenshoe Option					0.152	0.0125
Debt Retirement					0.095	0.0083
Private Equity	0.519*	0.1153			0.603	0.0746
Venture Capital	0.571	0.1328			0.516	0.0622
Intellectual Capital	-0.568**	-0.0943	-0.509*	-0.0484	-0.478	-0.0374
Underwriter			0.861*	0.0862	0.773	0.0635
Firm Size			-0.156***	-0.0156	-0.155***	-0.0128
Firm Age					0.057	0.0047
CAPEX					-0.004	0.0003
ROA			0.506**	0.0507	0.433	0.0356
Debt			0.310***	0.031	0.274**	0.0225
High-tech					-0.366	-0.026
Multinationality					-0.481	-0.0395
Retained Ownership	-0.543	-0.0943			-0.373	-0.0306
Lockup Period			-0.004***	-0.0004	-0.003***	-0.0003
Board Size			0.132***	0.0132	0.118***	0.0097
Board Independence			-1.781***	-0.1782	-2.024***	-0.1662
Female Board Members					0.484	0.0397
CEO Duality					-0.539	-0.0322
Green Firm Dummy	-0.886*	-0.1282	-0.770*	-0.0637	-1.204*	-0.0767
Pre-2011 Green Interaction	0.941**	0.2240			0.486	0.0514
HL Statistic	13.25	(0.1035)	2.09	(0.9781)	7.34	(0.5003)
Pseudo R2	0.1546		0.3817		0.4216	
N	284		284		284	

Withdrawal Outcomes

Outcome	Private	Inactive	M&A	Trading
Brown IPO Withdrawals				
Average Months	150	56	17	20
Outcome	6	4	8	3
Percentage	28.57%	19.05%	38.10%	14.29%
Green IPO Withdrawals				
Average Months	139	88	44	0
Outcome	7	3	7	0
Percentage	41.18%	17.65%	41.18%	0.00%
Sample IPO Withdrawals				
Average Months	144	70	30	20
Outcome	13	7	15	3
Percentage	34.21%	18.42%	39.47%	7.89%
EU dataset	36.53%	22.46%	32.93%	8.08%

Kaplan-Meier survival for M&A post-IPO withdrawal
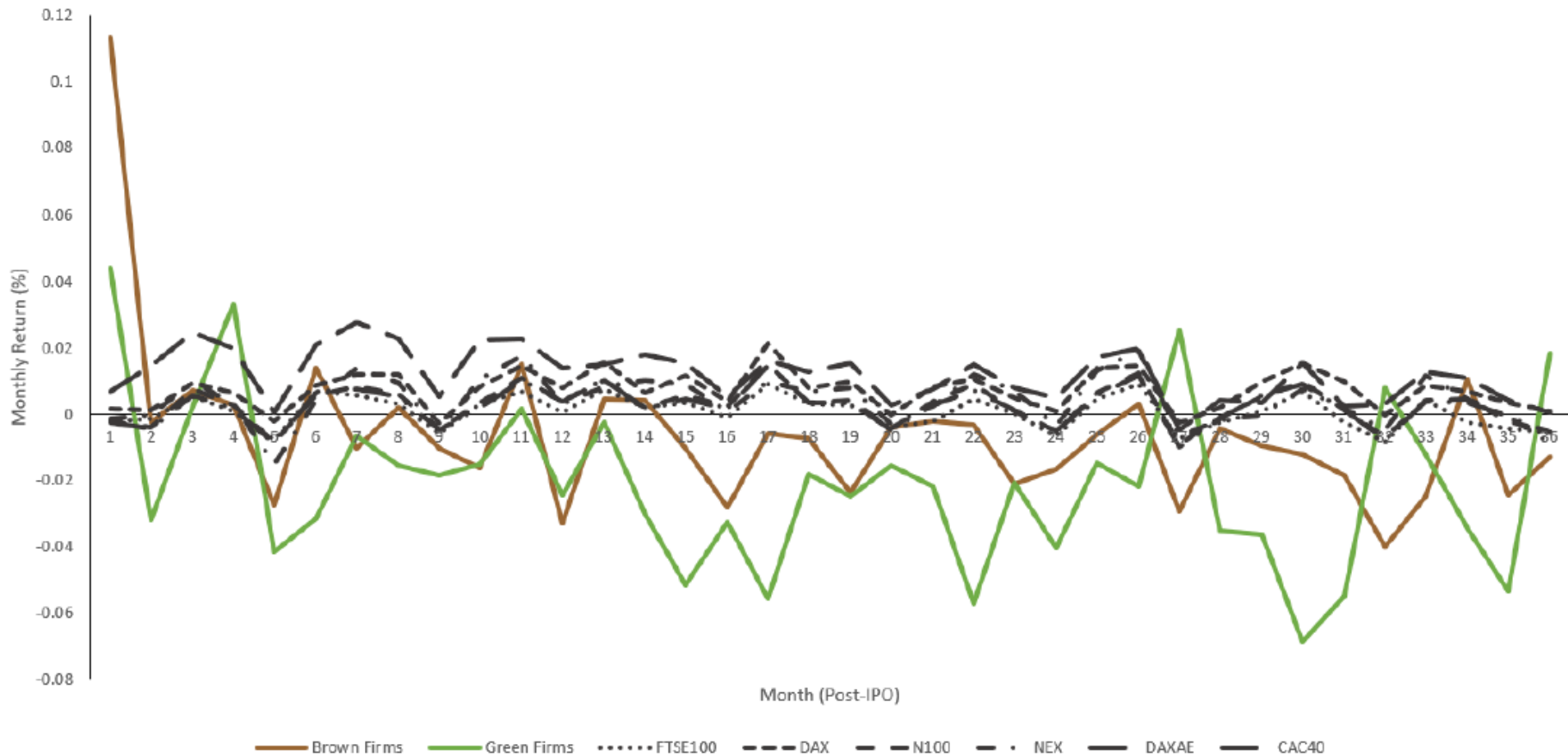
Brown firms being sold a lot quicker
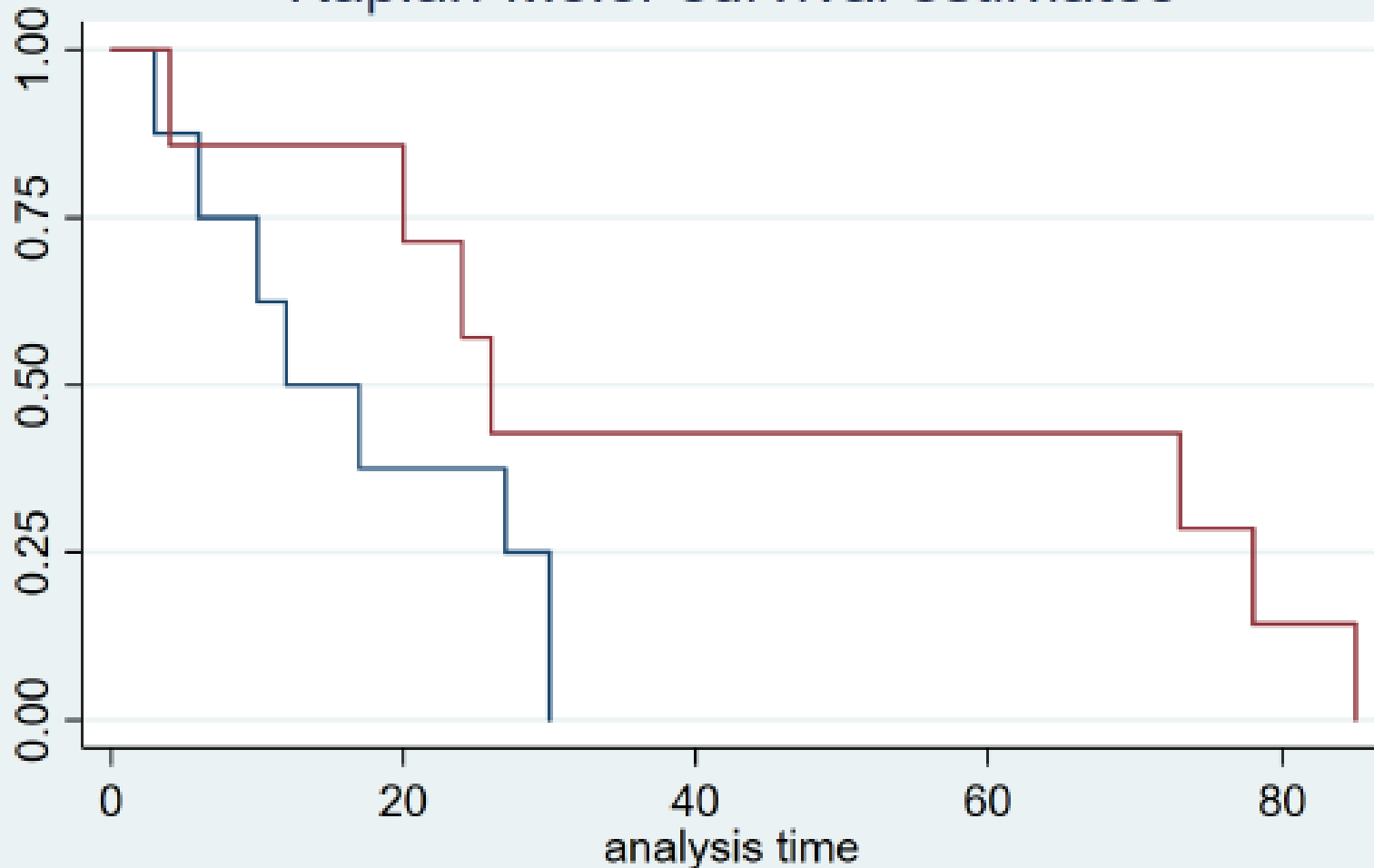
Post-IPO Performance

Brown IPOs heavily discounted but green seem to underperform from about 12months in

Equally Weighted Post-IPO Returns to Brown and Green Firms

Post-IPO BHARs

2001 to 2017 - 73 green and 173 brown IPOs

Green IPO's relative underperform (**GIPORU**)

Consistent with H3

Equivalent results for four factor model

Panel A: All IPOs						
Month	FTSE100	DAX	N100	DAXAE	NEX	CAC40
12	0.0012	-0.0454	0.0026	-0.1503	-0.0244	0.0107
	(0.06)	(-0.30)	(0.07)	(-1.06)	(-0.14)	(0.14)
24	-0.2161	-0.3058	-0.2066	-0.4346	-0.2697	-0.1938
	(-1.68)**	(-2.29)**	(-1.61)*	(-3.05)***	(-2.01)**	(-1.51)*
36	-0.3735	-0.5111	-0.3443	-0.6420	-0.4339	-0.3291
	(-3.13)***	(-4.00)***	(-2.91)***	(-4.65)***	(-3.45)***	(-2.80)***

Panel B: Brown IPOs						
Month	FTSE100	DAX	N100	DAXAE	NEX	CAC40
12	0.0496	0.0098	0.0559	-0.1205	0.0282	0.0629
	(0.40)	(0.12)	(0.45)	(-0.72)	(0.25)	(0.50)
24	-0.1544	-0.2426	-0.1447	-0.4146	-0.2213	-0.1311
	(-1.01)	(-1.55)*	(-0.94)	(-2.47)***	(-1.40)*	(-0.85)
36	-0.3203	-0.4698	-0.2977	-0.6658	-0.4342	-0.2807
	(-2.28)**	(-3.12)***	(-2.12)**	(-4.02)***	(-2.86)***	(-2.01)**

Panel C: Green IPOs						
Month	FTSE100	DAX	N100	DAXAE	NEX	CAC40
12	-0.1033	-0.1659	-0.1133	-0.2121	-0.1387	-0.1026
	(-0.96)	(-1.52)*	(-1.05)	(-1.90)**	(-1.26)	(-0.95)
24	-0.3352	-0.4280	-0.3260	-0.4643	-0.3590	-0.3148
	(-3.14)***	(-3.82)***	(-3.05)***	(-3.98)***	(-3.22)***	(-2.97)***
36	-0.4738	-0.5850	-0.4301	-0.5847	-0.4234	-0.4188
	(-4.24)***	(-4.90)***	(-3.91)***	(-4.82)***	(-3.72)***	(-3.83)***

Panel D: Green versus Brown IPOs			
	12-months	24-months	36-months
BHAR	-0.1679	-0.2407	-0.2236
Differential	(-1.00)	(-1.62)*	(-1.69)**

Is GIPORU due to Brown IPO discount?

Baseline (2001 - 2017)

	12-months	24-months	36-months
BHAR	-0.1679	-0.2407	-0.2236
Differential	(-1.00)	(-1.62)*	(-1.69)**

2001 – 2017 results excluding first day

	12-months	24-months	36-months
BHAR	-0.0921	-0.2096	-0.1936
Differential	(-1.19)	(-2.66)***	(-2.54)***

Is GIPORU weakening over time?

Baseline (2001 - 2017)

	12-months	24-months	36-months
BHAR	-0.1679	-0.2407	-0.2236
Differential	(-1.00)	(-1.62)*	(-1.69)**

Post Kyoto subsample (2005 - 2017)

	12-months	24-months	36-months
BHAR	-0.1343	-0.2019	-0.1485
Differential	(-0.85)	(-1.46)*	(-1.25)

Split sample – first half (2001 - 2008)

	12-months	24-months	36-months
BHAR	-0.2179	-0.3702	-0.3897
Differential	(-1.02)	(-1.94)**	(-2.35)***

Split sample – second half (2010 - 2007)

	12-months	24-months	36-months
BHAR	-0.0618	0.0185	0.1252
Differential	(-0.51)	(0.13)	(1.01)

COVID Shock (Jan-March 2020)

Equally Weighted Post-IPO Returns to Green and Brown Firms
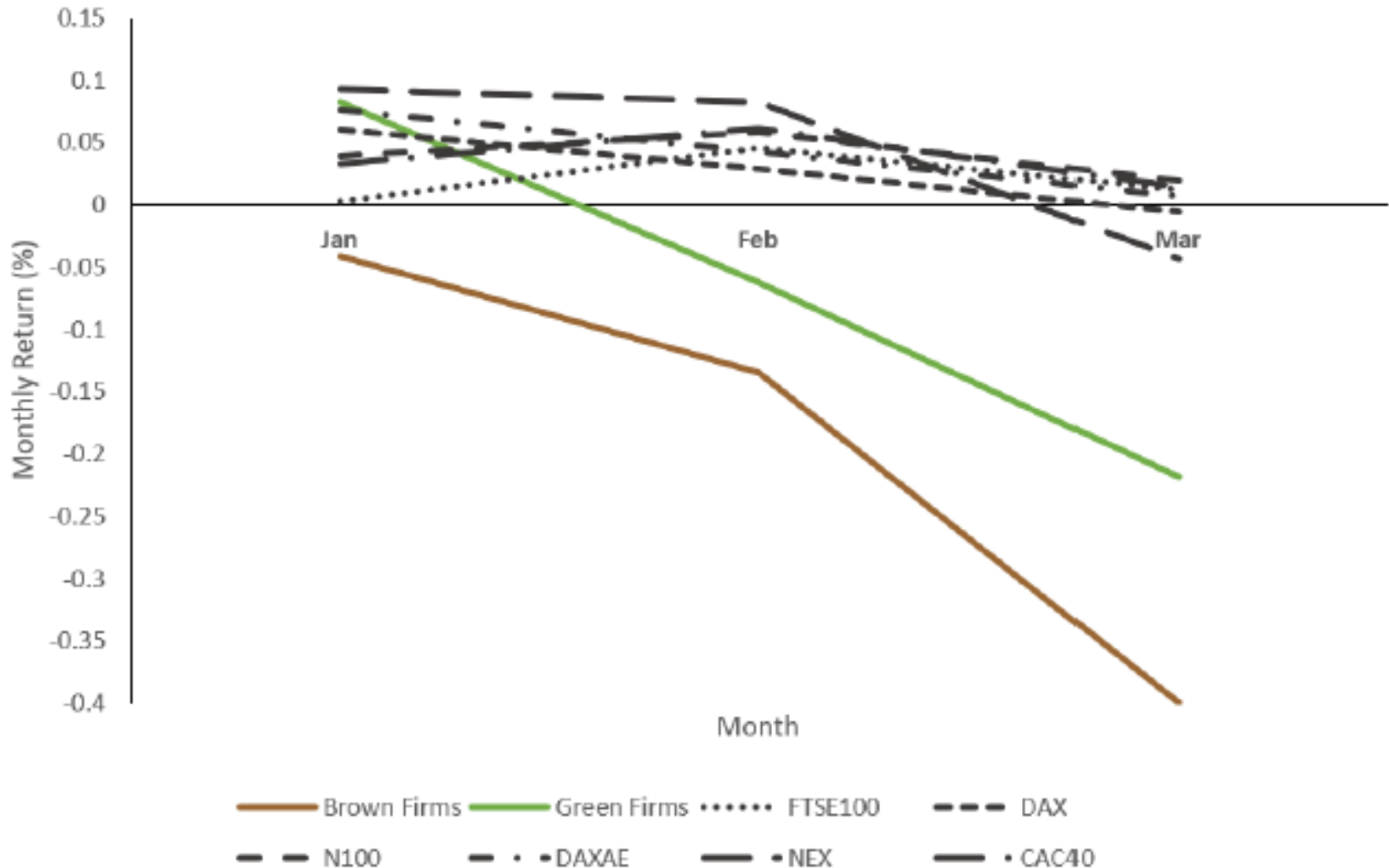
COVID Shock (Jan-March 2020)

Panel A: January – March 2020						
	FTSE100	DAX	N100	DAXAE	NEX	CAC40
All IPO Firms	-0.4892	-0.5115	-0.5480	-0.5575	-0.5579	-0.5399
	(-1.74)	(-1.79)	(-1.92)	(-1.93)	(-1.82)	(-1.89)
Brown IPO Firms	-0.5627	-0.5850	-0.6216	-0.6311	-0.6314	-0.6134
	(-1.97)	(-2.02)	(-2.14)*	(-2.15)*	(-2.03)*	(-2.11)
Green IPO Firms	-0.2687	-0.2910	-0.3276	-0.3371	-0.3374	-0.3194
	(-0.99)	(-1.06)	(-1.20)	(-1.22)	(-1.13)	(-1.17)

Panel B: Green versus Brown IPOs	
	3-months
BHAR	0.2940
Differential	(0.91)

Conclusions

- **Withdrawal**
  - Green firms marginally are less likely to withdraw, indicating a positive market sentiment toward these firms.
  - Survival analysis – Brown firms sold quicker
- **Ownerships**
  - More PE and VC involvement for green firms
    - Smart money going green vs more internal cash flows?
    - PE result surprising
  - Higher levels of retained ownership for green IPOs.
  - Overall results indicate a poor LT outlook for brown firms
- **Post-IPO performance:** Green firms underperform post-IPO.
  - Sig. more negative BHARs (vs. benchmark indices and brown) But effect (1) weakening over time, (2) brown IPOs are more heavily discounted and (3) have been more severely impacted by the COVID-19 crisis.

Questions

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https://blogs.otago.ac.nz/cefg/

Figure 1: This figure shows the total absolute number of IPOs by country in the dataset from 2001 to 2017.
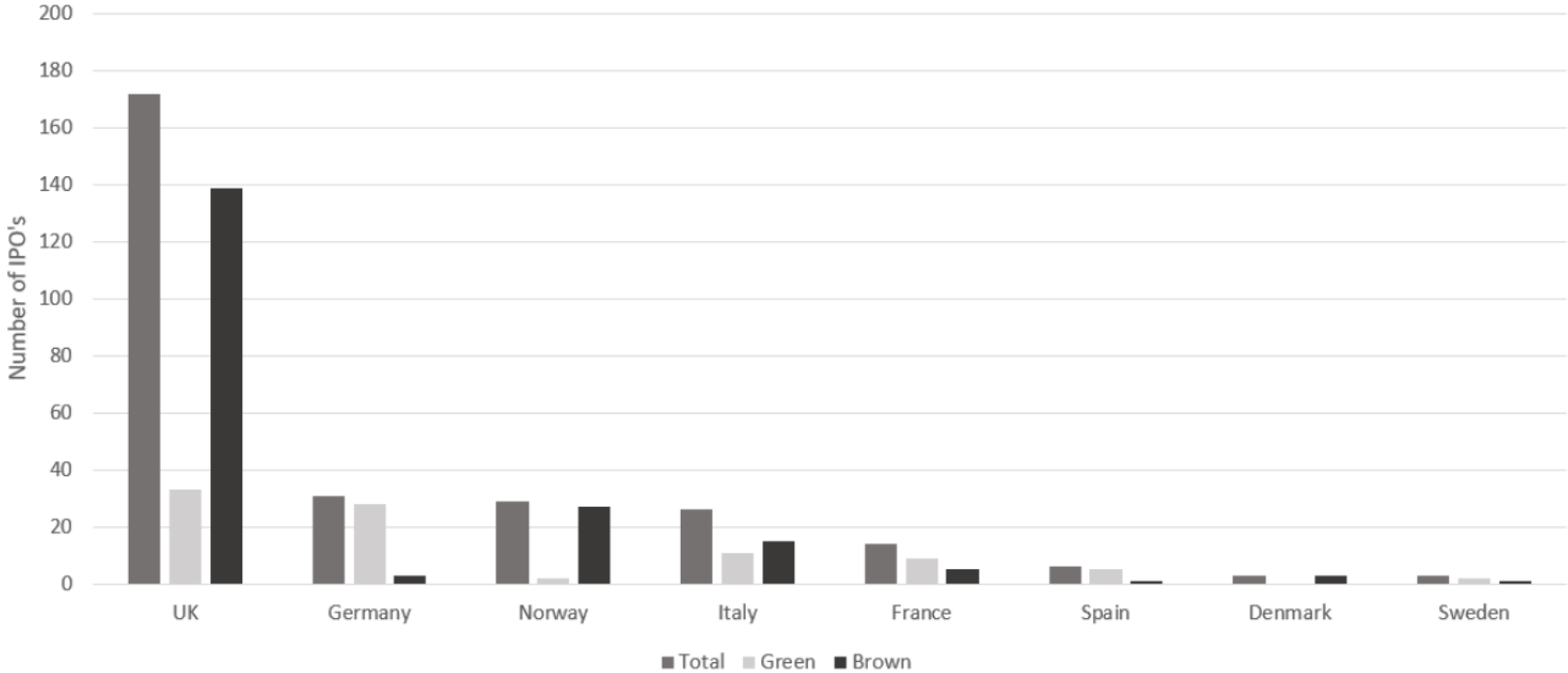
Post-IPO Four-Factor Model

- 2001 to 2017 - 73 green and 173 brown IPOs

$(R_{it} - R_{ft})$	Brown Firms				Green Firms			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Intercept	-0.0258	-0.0258	-0.0218	-0.0244	-0.0262	-0.0262	-0.0255	-0.0258
	(-9.94)***	(-9.91)***	(-8.47)***	(-9.06)***	(-8.03)***	(-8.05)***	(-7.84)***	(-7.79)***
MktRF	0.1229	0.1228	0.1656	0.1172	0.1175	0.1264	0.1203	0.1248
	(11.29)***	(11.27)***	(15.38)***	(9.14)***	(10.70)***	(9.70)***	(8.98)***	(8.09)***
SMB	0.2397	0.2407	0.2809	0.2385	0.1730	0.1772	0.1591	0.1743
	(8.83)***	(8.82)***	(11.42)***	(8.74)***	(5.39)***	(5.29)***	(5.06)***	(5.18)***
HML			-0.0243	-0.0278			-0.0277	-0.0274
			(-0.83)	(-0.84)			(-0.78)	(-0.71)
WML			-0.0162	-0.0299			-0.0094	-0.0151
			(-1.15)	(-1.96)**			(-0.52)	(-0.80)
EUCRBRDT	0.2472	0.2464		0.2539		-0.0370		-0.0338
Index	(7.85)***	(7.80)***		(7.96)***		(-0.99)		(-0.90)
EUETS Index		0.0010		0.0006		-0.0067		-0.0068
		(0.34)		(0.20)		(-1.83)*		(-1.87)*
Adj. R2	0.0920	0.0920	0.0728	0.0916	0.0549	0.056	0.0531	0.0555
N (monthly)	5,016	5,016	5,813	5,016	2,361	2,361	2,475	2,361