

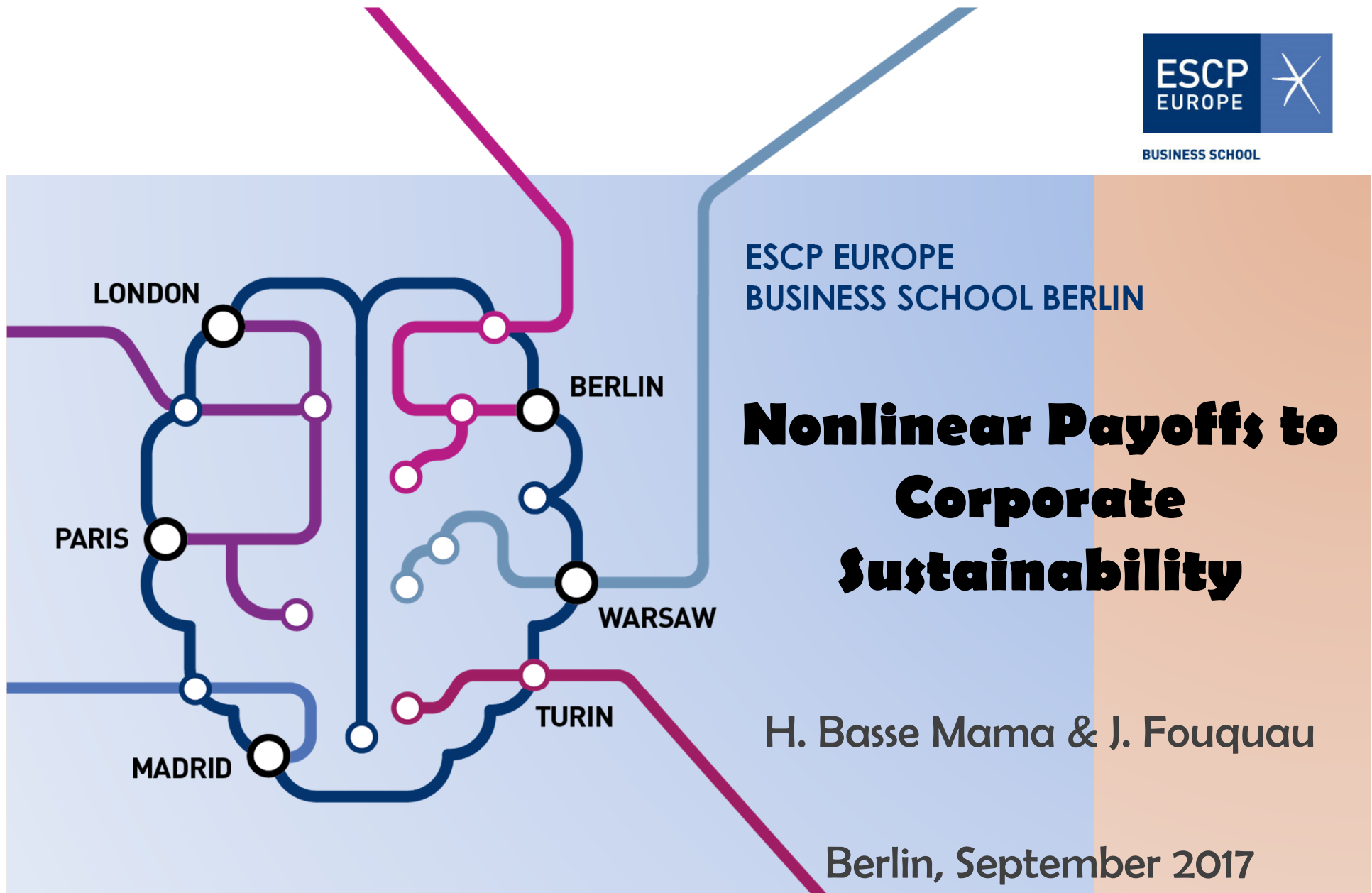


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Nonlinear Payoffs to Corporate Sustainability

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—○ WHAT'S THE STUDY ABOUT?

We address the following basic question:

- **What is the nature of the financial market payoffs to climate change mitigation technologies (CCMT) innovations?**
- Specifically, we ask:
 - Does the stock market assign valuations to firms depending on their propensity to engage in CCMT inventive activities?
 - Can corporate CCMT innovations act as a (potentially undervalued) “competitive moat” for the innovating firms?
 - Can linearity be upheld in the underlying relationship?
- Theory provides ambiguous predictions and there is cause for concern to impose linearity

—○ EMPIRICAL IDENTIFICATION STRATEGY

The empirical tests proceed in three main stages:

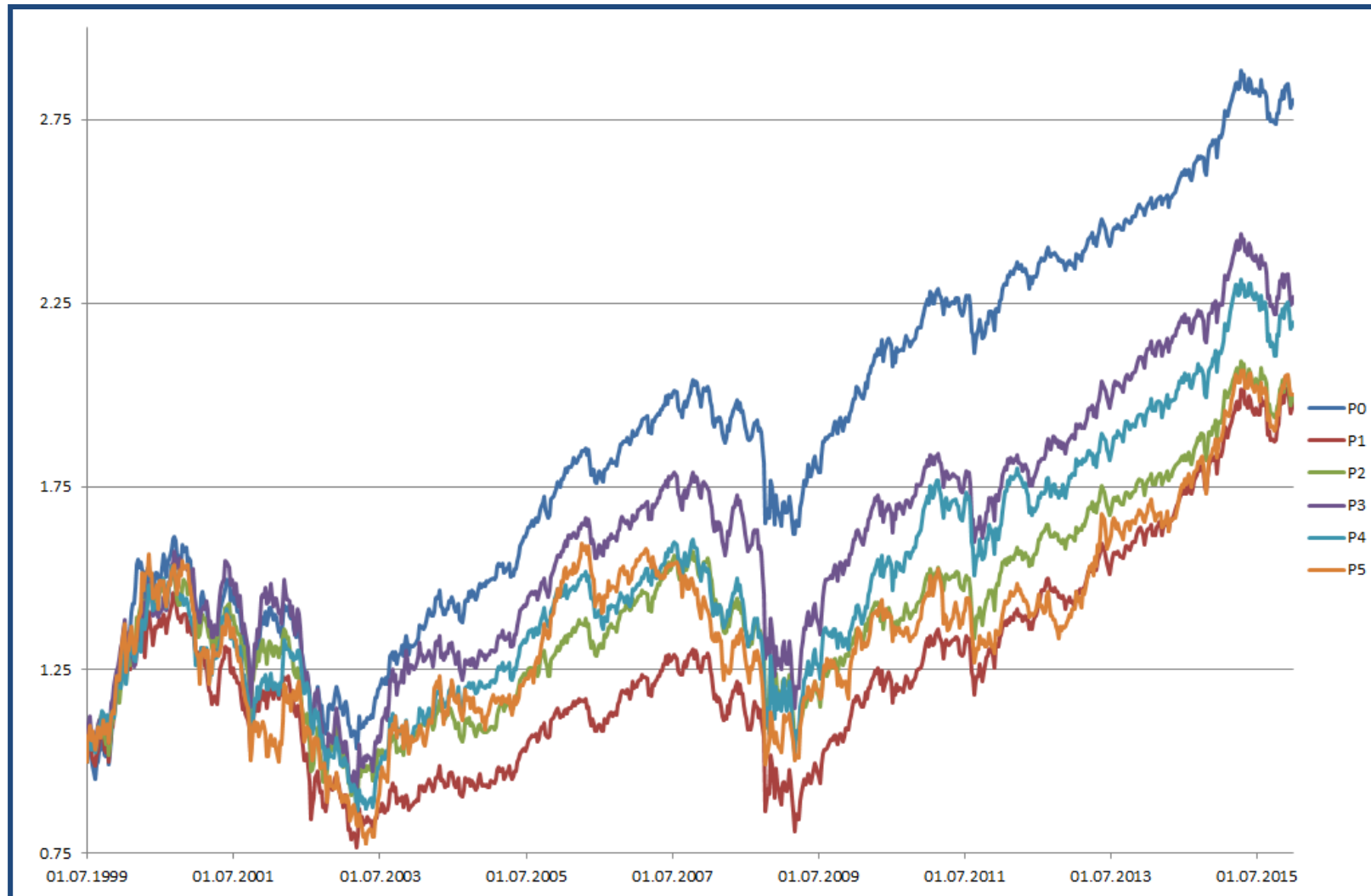
- **First**, portfolio analysis explores the relationship between characteristics of sustainable innovations (IQ) and stock returns
- **Second**, Fama-MacBeth (1973) regressions examine the direct contribution of sustainable innovations (i.e. CCMT) to stock market valuations
- **Third**, we use the PSTR framework to flexibly elucidate conditions under which firms are “rewarded” in the marketplace for externally negotiating a reputation of being concerned about sustainability when innovating
- **Identifying assumption**: *The CCMT-stock market payoff relationship obtains from a relationship between CCMT and future earnings*

How do we select the sample firms? What are the data sources?

- The initial sample consists of **2,950 firms listed in 16 countries**
 - (Large sample): The firms should have held at least one patent approved by the EPO over the period **1/1999-12/2015**
 - (Restricted sample): The firms should have held at least one sustainable patent approved by the EPO over the sample period
- **Data sources:**
 - Company-specific measures of patent attributes are derived from raw data obtained from a Hamburg-based Asset Management firm
 - Capital market and accounting data are from **Thomson Reuters Datastream** and **Wharton Research Data Services (WRDS)**
 - Data on analysts are collected from **I/B/E/S**




CCMT-BASED PORTFOLIO PERFORMANCE



CCMT-BASED PORTFOLIO PERFORMANCE*

Observed effects are resilient to known risk/mispricing factors

	P0	P1	P2	P3	P4	P5
<i>MKTRF</i>	0.7341*** (0.0000)	0.7117*** (0.0000)	0.6672*** (0.0000)	0.9184*** (0.0000)	0.7327*** (0.0000)	0.7035*** (0.0000)
<i>SMB</i>	-0.0358 (0.6541)	-0.4417*** (0.0000)	-0.3649*** (0.0000)	-0.4289*** (0.0000)	-0.1578 (0.1531)	-0.1232 (0.3324)
<i>HML</i>	-0.6229*** (0.0000)	-0.3130*** (0.0000)	-0.3114*** (0.0000)	-0.2331*** (0.0007)	-0.3113*** (0.0001)	-0.1914** (0.0398)
<i>WML</i>	-0.1407*** (0.0005)	-0.0565 (0.1382)	-0.0700 (0.1064)	-0.2042*** (0.0000)	-0.2331*** (0.0000)	-0.1409** (0.0280)
 <i>alpha</i>	0.0089*** (0.0000)	0.0041** (0.0150)	0.0043** (0.0272)	0.0056*** (0.0080)	0.0056** (0.0249)	0.0037 (0.2023)
<i>N</i>	198	198	198	198	198	198
<i>R-sq</i>	74%	72%	64%	73%	57%	42%

* P0 == no CCMT patent; P1 = = first quintile of firms with at least 1 CCMT patent; P2 == second quintile, ..., P5 == fifth quintile in the distribution of CCMT patents.

Preliminary results from Fama-MacBeth (1973) regressions - Excerpt

	$DV = \ln(1+MTB_{i,t})$		$DV = \ln(1+MTB_{i,t+1})$		
	(1)	(2)	(3)	(4)	(5)
CCMT	0.0011 (0.4518)	0.0216** (0.0163)	0.0001 (0.9049)	0.0389*** (0.0000)	0.0392*** (0.0000)
CCMT-square		-0.0263*** (0.0023)		-0.0344*** (0.0000)	-0.0345*** (0.0000)
Δ CCMT from $t-1$ to t	-0.0002 (0.6678)	-0.0026*** (0.0007)	0.0001 (0.9083)	-0.0034** (0.0231)	-0.0033** (0.0357)
Patents to R&D Capital	0.0046*** (0.0000)	0.0034** (0.0119)	0.0063*** (0.0038)	-0.0002 (0.8925)	-0.0032 (0.5467)
Patents to R&D Capital square					0.0026 (0.5300)
Δ MTB	0.3663*** (0.0016)	0.3369*** (0.0008)	0.1136*** (0.0022)	0.1892** (0.0216)	0.1899** (0.0216)
R&D Intensity	-0.1318*** (0.0000)	-0.1597*** (0.0000)	-0.1312*** (0.0002)	-0.1323*** (0.0004)	-0.1336*** (0.0005)
R&D Intensity square	0.1351*** (0.0000)	0.1648*** (0.0000)	0.1340*** (0.0002)	0.1330*** (0.0003)	0.1344*** (0.0004)
Constant	0.0169*** (0.0003)	0.0048 (0.4490)	0.0136*** (0.0019)	-0.0011 (0.7777)	-0.0003 (0.9293)
N	18,735	10,523	17,323	9,739	9,739
R-sq	0.53	0.60	0.15	0.27	0.27

PRELIMINARY CONCLUSIONS & CAVEATS

- **First**, firms that do not have CCMT patents at all (P0) on average earn higher abnormal returns than those with at least one CCMT patent
- **Second**, the propensity of firms to engage in CCMT inventive activities appears as a strong predictor of stock returns and future market valuations
 - However, the relationship is **nonlinear** (inverted U-shaped)
 - **Caveat**: Portfolio tests suggest the presence of a neutral zone, thus questioning our use of a quadratic specification
 - Panel smooth transition regressions (PSTR) are the natural candidate to address this concern.