Discussion of *Pollution Haven and Corruption Paradise* by Fabien Candau & Elisa Dienesch (2017)

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Background

- **Pollution haven** is described by lax environmental regulations, good market access to high-income countries and abundance of corruption opportunities.
- Prior to early 2000's PHH has been viewed as a myth.
  1. Environmental costs are small part of costs when deciding plant's location.
  2. Polluting industries are capital-intensive and hard to relocate.
- Globalization erodes the advantage of locating plants close to the point of consumption.
- Corruption Paradise Hypothesis (CPH) assumes that corruption allows lax environmental standards.

Question

Research Question

Do pollution havens exist, and if so, are they also corruption paradises?

Motivation

- The PHH has not been confirmed, however new data gives a rise to new research opportunities.
- Primarily the data from US has been used to prove the PHH.
  - Analysis of European data has been neglected.
- Europe and its neighborhood have changed:
  - Post-communist economies and countries in Maghreb have now reached an intermediate level of bad governance.
- No study has captured the effect that corruption has on polluting firms.

What are the findings?

1. A positive effect of the bilateral market access offered by each European member.
2. A positive effect of market access from the destination(European partners) towards the rest of the world, and a negative effect of market access from European countries themselves.
3. A multilateral gain provided by the destination.
4. Relocation is motivated by the market potential offered by European nations themselves.
5. Corruption indirectly increases the number of relocations of polluting firms to pollution havens.

Model

- The model is based on *Fujita and Thisse (2006)* model.
- Individual utility:

$$U = M^{\mu} A^{1-\mu}$$
$$M = \Big[\int_0^n q(z)^{\frac{\sigma-1}{\sigma}} dz \Big]^{\frac{\sigma}{\sigma-1}}$$
$$\mu \in [0,1], \sigma > 1$$

- Budget is given by:

$$PM + p_A A = Y$$
$$P = \Big[\int_0^n p(z)^{1-\sigma} dz \Big]^{\frac{1}{1-\sigma}}$$

Model

- The total demand to a firm producing a variety z:

$$q(z) = \mu Y P^{\sigma-1} p(z)^{-\sigma}$$

- Transaction costs:
  - varieties are exchanged between countries under positive costs
  - agricultural good is costlessly traded with $p_A = 1$
- Each firm has:
  - skilled workers employed at the only headquarter (HQ)
  - unskilled workers employed at the only plant

Model

- The total cost of producing q units:

$$TC_{ij}(z) = c_j + f_i w_i^H + v_i e_j w_j^L q(z)$$
$$z \in [0, n], c_j \in [0, 1], e_j \geq 1$$

c_i is fixed cost of production in country i (bears corruption costs)
f, v are requirement of unskilled and skilled labor
e_i is environmental standard in country i

Model

- The equilibrium profit for a firm with HQ and plant in i:

$$\pi_{ii}^{*} = p_i^{1-\sigma} MA_i - c_i - f_i w_i^H$$
$$MA_i = MAd_i + MAf_i$$
$$MAd_i = \frac{Y_i}{P_i^{1-\sigma}} \tau_{ii}^{1-\sigma}$$
$$MAf_i = \sum_j MAb_{ij}$$
$$MAb_{ij} = \frac{Y_j}{P_j^{1-\sigma}} \tau_{ij}^{1-\sigma}$$

- The equilibrium profit of a multinational firm:

$$\pi_{ij}^{*} = p_j^{1-\sigma} MA_j - c_j - f_i w_i^H$$
$$p_{ij}^{*}(z) = \tau_{ij} p_i^{*}(z)$$
$$\tau_{ij} \geq 1$$

Model Results

- Assume 2 countries: North and South
- All HQs/skilled-workers agglomerated in the North
- Bad governance in South: $c_S > c_N$
- Stricter regulations in North: $e_N > e_S$
- Incomes: $Y_N = Hw_N^H + w_N^L L_N, Y_s = w_S^L L_S$
- $H = 1, L_S + L_N = 1$
- $f_i = f_j = 1$

Model Results

- The profit of a firm that keeps its plants in the North:

$$\pi_{NN} = \frac{\mu}{\sigma n}\left(\frac{Y_N}{s_N + \phi s_S \zeta} + \phi \frac{Y_S}{\phi S_N + S_S \zeta}\right) - c_N - w_N^H$$

- The profit of a firm that keeps its plants in the South:

$$\pi_{NS} = \frac{\mu}{\sigma n}\zeta\left(\phi \frac{Y_N}{s_N + \phi s_S \zeta} + \frac{Y_S}{\phi S_N + S_S \zeta}\right) - c_S - w_N^H$$

where $\zeta = (\frac{e_N}{e_S})^{\sigma - 1}$ is the relative environmental norm for the North
and $\phi = \tau^{1-\sigma}$ is the trade openness
$s_N = n_N/n$ is the share of firms localized in the North

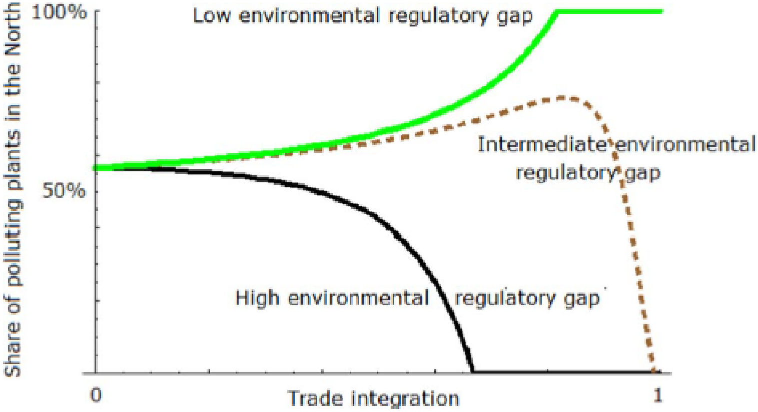
Proposition 1

Assume any given positive value of trade costs and no corruption. Agglomeration is sustainable in the North even when the environmental policy gap increases, but only until the following critical threshold:

$$\zeta = \frac{2\phi}{1 - b + \phi^2(1 + b)}$$

after that level, the PHH is verified.

Environmental regulation and trade integration



Northern share of plants, openness and environmental regulation.

Corollary 1

If corruption is not a sunk cost, but rather makes environmental standards in the South less stringent, then polluting plants are attracted by bad governance.

Data

- Outward Foreing AffiliaTes Statistics (FATS)
  - number of affiliates, associated turnover, number of employees
  - sector-level data
- Focus is on foreign-controlled firms owned by a single investor
- Period covered: 2007-2010

Data Description

Table 6
Total number of non European Affiliates and their economic activity, 2008.

	Nb of firms (× 1000)	Turnover (bn €)	Employment (× 1000)
Germany	11.3	682	2309
France	10.3	443	1785
Italy	7.8	142	739
Netherlands	6.1	295	666
Sweden	4.2	88	658
Denmark	2.9	n.a.	250
Finland	1.5	67	214
Slovenia	1.5	3	47
Belgium	1.2	19	110
Austria	1.0	35	153

Estimation strategy

$$\nu_{NS}^{kt} = exp(A + \Phi + \xi + \Omega + \lambda_{NS} + \lambda_t + \lambda_k)$$

- ν_{NS}^{kt} is the number of foreign-controlled firms relocating from N to S in industry k at time t
- N refers to 25 European countries
- S refers to 145 recorded destinations (partners)
- Φ is a vector of market capacities
- ξ captures the effect of environmental policies
- Ω captures the corruption effects
- λ_{NS} is the country-pair fixed effects
- λ_t is time fixed effects
- λ_k is sector fixed effects

Core variables

- **Trade effects and the market access**

$$\Phi = a_1 ln(MAb_{SN}) + a_2 ln(MA_N) + a_3 ln(MA_S)$$

- **Environmental policy**

$$\xi = a_4 ln(E_N^{kt}) + a_5 ln(E_N^t) + a_6 ln(E_S^t)$$

- **Effects of Corruption**

$$\Omega = a_7 c_S^t$$

Corruption effects

- **Interaction effects**
  - Three dummy variables for corruption level: $corrupt_S$
  - Interaction with the gap, ζ_{NS}
- **IV application**
  - Environmental regulation can be endogenously influenced by corruption: $cov(E_S^t; c_S^t) \neq 0$

$$E_S^t = \varphi E_S^1 971 + \varrho c_S^t + i_S^t$$

Baseline results

	s_{NS}^{kz} Pooled ($\lambda_{NS} = obs$)				s_{NS}^{kz} ($\lambda_{NS} = FE$)	T_{NS}^{kz} ($\lambda_{NS} = obs$)
	(1)	(2)	(3)	(4)	(5)	(6)
Dep variable						
Bilateral MA	0.091	0.087	0.094	0.120	0.073	0.093
$ln\left(MAb_{SN}^{kz}\right)$	0.008^{a}	0.008^{a}	0.008^{a}	0.008^{a}	0.008^{a}	0.011^{a}
MA from the origin	−0.249	−0.236	−0.468		−0.337	0.987
$ln\left(MA_{N}^{kz}\right)$	0.068^{a}	0.070^{a}	0.063^{a}		0.066^{a}	0.146^{a}
MA from the destination	0.888	0.856	0.830		0.423	0.157
$ln\left(MA_{S}^{kz}\right)$	0.060^{a}	0.061^{a}	0.058^{a}		0.656^{a}	0.019^{a}
foreign MA from the origin				−0.337		
$ln\left(MAf_{N}^{kz}\right)$				0.084^{a}		
foreign MA from the dest.				0.428		
$ln\left(MAf_{S}^{kz}\right)$				0.013^{a}		
Environmental regulation						
Env expenditures	0.551	0.549	0.542	0.475	0.646	0.431
at the industry-level $ln\left(E_{N}^{kz}\right)$	0.015^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.024
Env. regulation in the origin	0.046		0.108	0.108	0.041	0.013
at the country-level E_N	0.005^{a}		0.007^{a}	0.007^{a}	0.006^{a}	0.012
Env regulation in the dest.	−0.032		−0.010	−0.019	−0.035	−0.019
at the country-level E_S	0.002^{b}		0.002^{a}	0.002^{a}	0.002^{a}	0.004^{a}
Env regulation gap		0.375				
$\zeta_{NS} = \frac{E_N}{E_S}$		0.046^{a}				
Corruption effects						
Corruption index c_S^{ξ}	−0.101	−0.097	−0.047	−0.079	−0.756	−0.058
	0.025^{a}	0.018^{a}	0.023^{b}	0.025^{a}	0.215^{a}	0.023^{b}
Inflation model	Logit	Logit	Logit	Logit	logit	logit
Country-pair λ_{NS}	obs	obs	obs	obs	pair_FE	obs
Pseudo-R^2	0.82	0.82	0.82	0.82	0.88	0.83
Log Likelihood	−20543	−20821	−20525	−20709	−19737	−35054
Wald Chi-2	3468.75^{c}	3149.77^{1}	3447.21^{c}	2943.56^{c}	-	1245.48^{a}
Likelihood-ratio test	$4.9e+05^{c}$	$4.9e+05^{c}$	$4.9e+05^{c}$	$4.9e+05^{c}$	$4.9e+05^{c}$	$2.07e+07^{c}$
Vuong test	95.20^{c}	95.20^{c}	95.20^{c}	95.20^{c}	95.20^{c}	18.44^{c}
Overdispersion test (alpha)	1.185^{c}	1.185^{c}	1.185^{c}	1.185^{c}	1.185^{c}	2.651^{c}
Zero observations	6277	6277	6277	6277	7902	6277
Observations	10507	10507	10507	10507	11869	10507

Baseline results

	s_{NS}^{kt} Pooled ($\lambda_{NS} = obs$)				s_{NS}^{kt} ($\lambda_{NS} = FE$)	T_{NS}^{kt} ($\lambda_{NS} = obs$)
	(1)	(2)	(3)	(4)	(5)	(6)
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foreign MA from the origin				−0.337		
$ln\left(MAf_{N}^{kt}\right)$				0.084[a]		
foreign MA from the dest.				0.428		
$ln\left(MAf_{S}^{kt}\right)$				0.013[a]		

Baseline results

Environmental regulation						
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at the country-level E_S	0.002[b]		0.002[a]	0.002[a]	0.002[a]	0.004[a]
Env regulation gap		0.375				
$\zeta_{NS} = \frac{E_N}{E_S}$		0.046[a]				

Baseline results

Corruption effects						
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Corruption effects

Dep variable	s^t_{NS}			T^t_{NS}		
Country group	Bad	Middle	Good	Bad	Middle	Good
$\zeta_{NS} corrupt_S$	−1.342	0.110	−0.012	−1.803	0.590	0.534
RSE	0.124[a]	0.008[a]	0.100	0.167[a]	0.161[a]	0.146[a]
Obs	2438	3456	4613	2438	3456	4613

The econometric specification is an augmented version of Eq. (16). s.

[a] Significance at the 1 level.

PHH and CPH results

Dependent variable	(1) s_{NS}^t	(2)	(3)	(4) T_{NS}^t
Destination group	*Baseline*	IV	IV	IV
Bilateral Market Access	0.120	0.090	0.090	0.093
$ln(MAB_{SN}^{kt})$	0.008[a]	0.008[a]	0.008[a]	0.011[a]
Market Access from the origin	-0.337	-0.188	-0.188	0.987
$ln(MA_N^{kt})$	0.084[a]	0.084[a]	0.084[a]	0.146[a]
Market Access from the destination	0.428	0.214	0.214	0.157
$ln(MA_S^{kt})$	0.013[a]	0.013[a]	0.013[a]	0.019[a]
Environmental expenditures E_N^{kt}	0.475	0.408	0.397	0.431
at the industry-level	0.014[a]	0.018[a]	0.011[a]	0.024
Home environmental regulation E_N^t	0.108	0.085	0.085	0.013
at the country-level	0.007[a]	0.006[a]	0.006[a]	0.012
Host environmental regulation E_S^t	-0.019			-0.019
at the country-level	0.002[a]			0.004[a]
Predicted Host env regulation $\hat{\varphi} E_S^{t-1}$		-0.137	-0.265	
at the country-level		0.028[a]	0.044[a]	
Direct effect of corruption (c_S^t)	−0.079	-0.303		
	0.025[a]	0.096[b]		
Indirect effect of corruption ($\hat{\varrho} c_S^t$)			0.282	0.080
			0.060[a]	0.007[a]
First-step coefficients				
IV past regulation E_S^{t-1}	0.334	0.334	0.334	0.334
using POPs regulation in 1971	0.020[a]	0.020[a]	0.020[a]	0.012[a]
Corruption index c_S^t	-4.337	-4.337	-4.337	-4.337
	0.055[a]	0.055[a]	0.055[a]	0.055[a]
First-step coefficient of determination	0.45	0.45	0.45	0.45
Overidentification test p-value	0.51	0.51	0.51	0.65
First-step Fisher coefficient	4233.22[a]	4233.22[a]	4233.22[a]	4233.22[a]
First-step Root MSE	7.40	7.40	7.40	7.40
Log Likelihood	8.3e+05[c]	8.2e+05[c]	7.2e+05[c]	7.6e+07[c]
Wald Chi-2	1719.01[c]	1688.65[c]	1674.32[c]	1306.97[a]
Observations	10,507	10,507	10,507	10,507

PHH and CPH results

Dependent variable	(1) s^t_{NS}	(2)	(3)	(4) T^t_{NS}
Destination group	*Baseline*	IV	IV	IV
Bilateral Market Access	0.120	0.090	0.090	0.093
$ln(MAB^{kt}_{SN})$	0.008[a]	0.008[a]	0.008[a]	0.011[a]
Market Access from the origin	-0.337	-0.188	-0.188	0.987
$ln(MA^{kt}_N)$	0.084[a]	0.084[a]	0.084[a]	0.146[a]
Market Access from the destination	0.428	0.214	0.214	0.157
$ln(MA^{kt}_S)$	0.013[a]	0.013[a]	0.013[a]	0.019[a]
Environmental expenditures E^{kt}_N	0.475	0.408	0.397	0.431
at the industry-level	0.014[a]	0.018[a]	0.011[a]	0.024
Home environmental regulation E^t_N	0.108	0.085	0.085	0.013
at the country-level	0.007[a]	0.006[a]	0.006[a]	0.012
Host environmental regulation E^t_S	-0.019			-0.019
at the country-level	0.002[a]			0.004[a]
Predicted Host env regulation $\hat{\varphi}E^{t-1}_S$		-0.137	-0.265	
at the country-level		0.028[a]	0.044[a]	

PHH and CPH results

Direct effect of corruption (c_S^t)	−0.079	-0.303		
	0.025[a]	0.096[b]		
Indirect effect of corruption (∂c_S^t)			0.282	0.080
			0.060[a]	0.007[a]
First-step coefficients				
IV past regulation E_S^{t-1}	0.334	0.334	0.334	0.334
using POPs regulation in 1971	0.020[a]	0.020[a]	0.020[a]	0.012[a]
Corruption index c_S^t	-4.337	-4.337	-4.337	-4.337
	0.055[a]	0.055[a]	0.055[a]	0.055[a]
First-step coefficient of determination	0.45	0.45	0.45	0.45
Overidentification test p-value	0.51	0.51	0.51	0.65
First-step Fisher coefficient	4233.22[a]	4233.22[a]	4233.22[a]	4233.22[a]
First-step Root MSE	7.40	7.40	7.40	7.40
Log Likelihood	8.3e+05[c]	8.2e+05[c]	7.2e+05[c]	7.6e+07[c]
Wald Chi-2	1719.01[c]	1688.65[c]	1674.32[c]	1306.97[a]
Observations	10,507	10,507	10,507	10,507

Sector-based analysis

Dep variable	(1) s^{kt}_{NS}	(2)	(3)	(4)
Sectors	*All*	*Less polluting*	*Chemicals*	*Transport equ.*
Bilateral MA	0.090	0.078	0.101	0.081
$\ln\left(MAb^{kt}_{SN}\right)$	0.008[a]	0.005[a]	0.003[a]	0.005[a]
MA from the origin	-0.188	-0.067	-0.026	-0.011
$\ln\left(MA^{kt}_{N}\right)$	0.084[a]	0.014[a]	0.014	0.014
MA from the destination	0.214	0.113	0.301	0.093
$\ln\left(MA^{kt}_{S}\right)$	0.013[a]	0.010[a]	0.014[a]	0.010[a]
*Environmental regulation** polluting sector (dummy)				
Env expenditures * polluting sector	0.589	0.459	0.350	0.448
at the industry-level $\ln\left(E^{kt}_{N}\right)$	0.017[a]	0.011[a]	0.041[a]	0.051[a]
Env. regulation in the origin * polluting sector	0.118	0.008	0.138	0.098
at the country-level E_N	0.008[a]	0.011	0.019[a]	0.026[a]
Predicted Host env regulation $\hat{\varphi}E^{t-1}_{S}$ * polluting sector	-0.301	-0.022	-0.275	0.009
at the country-level E_S	0.040[a]	0.027	0.022[a]	0.012
Corruption effects				
Indirect effect of corruption $(\hat{\partial}c^{t}_{S})$	0.282	0.115	0.243	0.116
	0.060[a]	0.109	0.046[a]	0.109
Pseudo-R^2	0.82	0.82	0.82	0.82
Log Likelihood	1674.32[b]	-20,821	-20,525	-20,709
Wald Chi-2	7.2e+05[b]	3149.77[b]	3447.21[b]	2943.56[b]
Observations	10,507	3036	566	548

Conclusion

- A theoretical and empirical analysis of the PHH regarding the location of the European affiliates over three years: 2007-2010
- Evidence that PHH and CPH are not myths
- A gap in environmental regulation magnifies a positive influence of trade integration on the relocation of firms to pollution havens
- Evidence for the need of global coordinated environmental policy standards, trade integration, and governance