

7 th European User Conference for EU-Microdata

March 25 – 26, 2021

Eco-Innovation: Drivers, Barriers and Effects – A European Perspective

Sandra M. Leitner

Motivation

- Innovations are key to economic outcomes (Schumpeter, 1934)
 - engine of economic growth and the development of economies
 - prerequisite for the survival and growth of firms
- Innovation – and with it environmental/eco-innovation (EI) – has been moved into the centre of the **Europe 2020 strategy** for smart, sustainable and inclusive growth and job creation; it also plays a key role in the **European Green Deal** for the EU to become the world's first climate-neutral continent by 2050
- EI plays an important role due to two key advantages it generates, namely
 - tackles climate change, helps to improve environmental protection & resource efficiency of the economy or to guarantee secure, clean and efficient energy
 - contributes strongly to the EU's competitiveness and growth
- Hence, the uptake of EI needs to be fostered and facilitated & existing barriers need to be dismantled and effective policies implemented

Important drivers and barriers of EIs

- **Demand pull factors:**

Actual & expected demand (Horbach, 2008), *consumers' environmental consciousness* (Doran and Ryan, 2012; Triguero et al., 2015), *cost-saving motive on the part of the firm* (Horbach, 2008; Horbach et al., 2012; Kesidou and Demirel, 2012), *international market outreach* (Horbach, 2008; Ghisetti et al., 2015).

- **Technology push factors:**

(continuous) R&D investments (Horbach, 2008; Horbach et al., 2012; Ghisetti et al., 2015; De Marchi, 2012), *highly qualified workforce* (Borghesi et al., 2011), *complementary investments in machinery and equipment and software* (De Marchi, 2012; Horbach et al., 2012), *good access to external information and knowledge* (Triguero et al., 2013), *R&D cooperations* (Horbach et al., 2012), *competition* (Horbach et al., 2012).

Important drivers and barriers of EIs

- **Public policy:** *regulations, public policies, environmental policies* (Doran and Ryan, 2012; Horbach, 2008; Horbach et al., 2012; Horbach et al., 2013; Kammerer, 2007).
- **Firm characteristics:** *firm size* (Horbach et al., 2013; De Marchi, 2012; Kesidou and Demirel, 2012; Triguero et al., 2013), *affiliation to either a domestic or a foreign parent company* (Ghisetti et al. (2015)).
- **Performance effects:** *higher labour productivity* (Marin, 2012; Marin and Lotti, 2014; Doran and Ryan, 2012), *higher firm growth* (Colombelli et al., 2015), *higher profits* (Rexhäuser and Rammer, 2013; Lanoie et al., 2011), *higher employment* (Horbach, 2010; Licht and Peters, 2013 and 2014)

Model: Drivers, barriers and performance effects

3-stage CDM model (Crépon et al., 1998)

- **Selection & R&D intensity (2-step Heckman selection model)**

$$\text{Selection equation: } Drd_i = \begin{cases} 1 & \text{if } Drd_i^* = X_i' \alpha + \varepsilon_i > \bar{c} \\ 0 & \text{if } Drd_i^* = X_i' \alpha + \varepsilon_i \leq \bar{c} \end{cases} \quad (1a)$$

$$\text{Innovation intensity: } RD_i = \begin{cases} RD_i^* = X_i' \beta + \epsilon_i \\ 0 & \text{if } RD_i = 0 \end{cases} \quad (1b)$$

- **Innovation output**

$$I_i = \widehat{RD}_i \gamma + Z_i' \delta_1 + u_{1i} \quad (2a)$$

$$EI_i = \widehat{RD}_i \gamma + Z_i' \delta_1 + u_{2i} \quad (2b)$$

- **Productivity effects**

$$\ln LP_i = \hat{I}_i \theta_1 + W_i' \theta_3 + v_{1i} \quad (3a)$$

$$\ln LP_i = \widehat{EI}_i \theta_2 + W_i' \theta_3 + v_{2i} \quad (3b)$$

Model: Drivers, barriers and performance effects

3-stage CDM model (Crépon et al., 1998)

- **Selection & R&D intensity (2-step Heckman selection model)**

$$\text{Selection equation: } Drd_i = \begin{cases} 1 & \text{if } Drd_i^* = X_i' \alpha + \varepsilon_i > \bar{c} \\ 0 & \text{if } Drd_i^* = X_i' \alpha + \varepsilon_i \leq \bar{c} \end{cases} \quad (1a)$$

$$\text{Innovation intensity: } RD_i = \begin{cases} RD_i^* = X_i' \beta + \varepsilon_i \\ 0 & \text{if } RD_i = 0 \end{cases} \quad (1b)$$

- **Innovation output**

$$I_i = \widehat{RD}_i \gamma + Z_i' \delta_1 + u_{1i} \quad (2a)$$

$$EI_i = \widehat{RD}_i \gamma + Z_i' \delta_1 + u_{2i} \quad (2b)$$

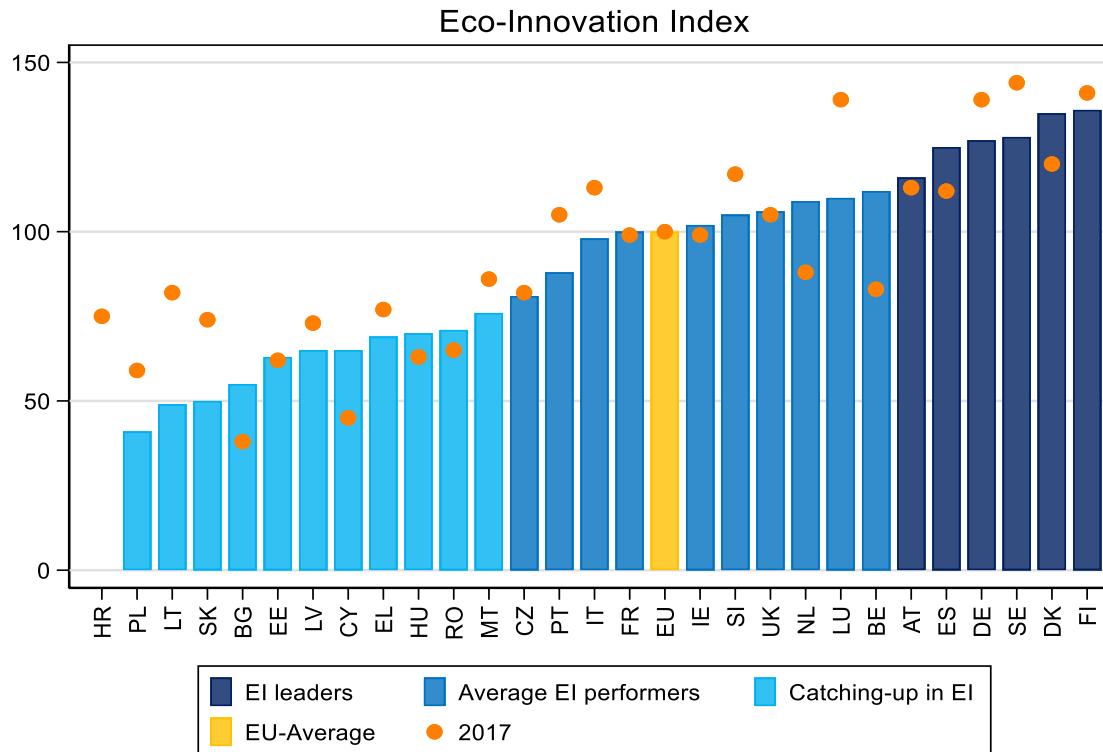
- **Productivity effects**

$$\ln LP_i = \hat{I}_i \theta_1 + W_i' \theta_3 + v_{1i} \quad (3a)$$

$$\ln LP_i = \widehat{EI}_i \theta_2 + W_i' \theta_3 + v_{2i} \quad (3b)$$

Data source: CIS-2014 (pertains to 2012-2014)

- Country groups:
 - EI-leaders (**ECO-1**): Finland, Germany, Sweden
 - Average EI performers (**ECO-2**): Czechia, France, Italy, Luxembourg
 - Catching up on EI (**ECO-3**): Bulgaria, Croatia, Cyprus, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Romania, Slovakia



Determinants of innovation output: general & EIs

Variables	TOT		ECO-1		ECO-2		ECO-3	
	Innov (1)	EI (2)	Innov (3)	EI (4)	Innov (5)	EI (6)	Innov (7)	EI (8)
R&D intensity	0.060*** (12.005)	0.209*** (23.500)	0.199*** (11.593)	0.179*** (10.594)	0.015*** (3.053)	0.183*** (15.881)	-0.008* (-1.744)	0.149*** (10.966)
Size	-0.007*** (-6.685)	0.034*** (14.248)	-0.037*** (-10.773)	-0.007 (-1.629)	-0.000 (-0.027)	0.059*** (16.690)	0.005*** (2.871)	0.048*** (10.160)
Domestic group	-0.013*** (-3.342)	-0.067*** (-8.060)	-0.105*** (-6.840)	-0.119*** (-6.225)	0.001 (0.223)	-0.059*** (-5.049)	0.018*** (3.064)	-0.043*** (-2.706)
Foreign group	0.006 (1.268)	-0.004 (-0.444)	-0.104*** (-5.561)	-0.087*** (-4.279)	0.020*** (2.874)	-0.016 (-1.046)	0.027*** (4.267)	-0.001 (-0.049)
International markets	-0.025*** (-4.609)	-0.154*** (-14.760)	-0.066*** (-3.706)	-0.091*** (-4.607)	-0.000 (-0.013)	-0.172*** (-10.427)	0.008 (1.429)	-0.113*** (-6.760)
Investment intensity	-0.001 (-0.805)	-0.001 (-0.673)	-0.010* (-1.919)	-0.027*** (-5.769)	-0.001 (-0.709)	0.008** (2.489)	0.001 (0.652)	0.019*** (5.532)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	32,807	33,349	7,688	7,754	14,396	14,396	10,723	11,199
Log likelihood	-7470	-20303	-2465	-4766	-2937	-8723	-1887	-6706

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Determinants of innovation output: general & EIs

Variables	TOT		ECO-1		ECO-2		ECO-3	
	Innov (1)	EI (2)	Innov (3)	EI (4)	Innov (5)	EI (6)	Innov (7)	EI (8)
R&D intensity	0.060*** (12.005)	0.209*** (23.500)	0.199*** (11.593)	0.179*** (10.594)	0.015*** (3.053)	0.183*** (15.881)	-0.008* (-1.744)	0.149*** (10.966)
Size	-0.007*** (-6.685)	0.034*** (14.248)	-0.037*** (-10.773)	-0.007 (-1.629)	-0.000 (-0.027)	0.059*** (16.690)	0.005*** (2.871)	0.048*** (10.160)
Domestic group	-0.013*** (-3.342)	-0.067*** (-8.060)	-0.105*** (-6.840)	-0.119*** (-6.225)	0.001 (0.223)	-0.059*** (-5.049)	0.018*** (3.064)	-0.043*** (-2.706)
Foreign group	0.006 (1.268)	-0.004 (-0.444)	-0.104*** (-5.561)	-0.087*** (-4.279)	0.020*** (2.874)	-0.016 (-1.046)	0.027*** (4.267)	-0.001 (-0.049)
International markets	-0.025*** (-4.609)	-0.154*** (-14.760)	-0.066*** (-3.706)	-0.091*** (-4.607)	-0.000 (-0.013)	-0.172*** (-10.427)	0.008 (1.429)	-0.113*** (-6.760)
Investment intensity	-0.001 (-0.805)	-0.001 (-0.673)	-0.010* (-1.919)	-0.027*** (-5.769)	-0.001 (-0.709)	0.008** (2.489)	0.001 (0.652)	0.019*** (5.532)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	32,807	33,349	7,688	7,754	14,396	14,396	10,723	11,199
Log likelihood	-7470	-20303	-2465	-4766	-2937	-8723	-1887	-6706

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Determinants of innovation output: general & EIs

Variables	TOT		ECO-1		ECO-2		ECO-3	
	Innov (1)	EI (2)	Innov (3)	EI (4)	Innov (5)	EI (6)	Innov (7)	EI (8)
R&D intensity	0.060*** (12.005)	0.209*** (23.500)	0.199*** (11.593)	0.179*** (10.594)	0.015*** (3.053)	0.183*** (15.881)	-0.008* (-1.744)	0.149*** (10.966)
Size	-0.007*** (-6.685)	0.034*** (14.248)	-0.037*** (-10.773)	-0.007 (-1.629)	-0.000 (-0.027)	0.059*** (16.690)	0.005*** (2.871)	0.048*** (10.160)
Domestic group	-0.013*** (-3.342)	-0.067*** (-8.060)	-0.105*** (-6.840)	-0.119*** (-6.225)	0.001 (0.223)	-0.059*** (-5.049)	0.018*** (3.064)	-0.043*** (-2.706)
Foreign group	0.006 (1.268)	-0.004 (-0.444)	-0.104*** (-5.561)	-0.087*** (-4.279)	0.020*** (2.874)	-0.016 (-1.046)	0.027*** (4.267)	-0.001 (-0.049)
International markets	-0.025*** (-4.609)	-0.154*** (-14.760)	-0.066*** (-3.706)	-0.091*** (-4.607)	-0.000 (-0.013)	-0.172*** (-10.427)	0.008 (1.429)	-0.113*** (-6.760)
Investment intensity	-0.001 (-0.805)	-0.001 (-0.673)	-0.010* (-1.919)	-0.027*** (-5.769)	-0.001 (-0.709)	0.008** (2.489)	0.001 (0.652)	0.019*** (5.532)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	32,807	33,349	7,688	7,754	14,396	14,396	10,723	11,199
Log likelihood	-7470	-20303	-2465	-4766	-2937	-8723	-1887	-6706

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Determinants of innovation output: general & EIs

Variables	TOT		ECO-1		ECO-2		ECO-3	
	Innov (1)	EI (2)	Innov (3)	EI (4)	Innov (5)	EI (6)	Innov (7)	EI (8)
R&D intensity	0.060*** (12.005)	0.209*** (23.500)	0.199*** (11.593)	0.179*** (10.594)	0.015*** (3.053)	0.183*** (15.881)	-0.008* (-1.744)	0.149*** (10.966)
Size	-0.007*** (-6.685)	0.034*** (14.248)	-0.037*** (-10.773)	-0.007 (-1.629)	-0.000 (-0.027)	0.059*** (16.690)	0.005*** (2.871)	0.048*** (10.160)
Domestic group	-0.013*** (-3.342)	-0.067*** (-8.060)	-0.105*** (-6.840)	-0.119*** (-6.225)	0.001 (0.223)	-0.059*** (-5.049)	0.018*** (3.064)	-0.043*** (-2.706)
Foreign group	0.006 (1.268)	-0.004 (-0.444)	-0.104*** (-5.561)	-0.087*** (-4.279)	0.020*** (2.874)	-0.016 (-1.046)	0.027*** (4.267)	-0.001 (-0.049)
International markets	-0.025*** (-4.609)	-0.154*** (-14.760)	-0.066*** (-3.706)	-0.091*** (-4.607)	-0.000 (-0.013)	-0.172*** (-10.427)	0.008 (1.429)	-0.113*** (-6.760)
Investment intensity	-0.001 (-0.805)	-0.001 (-0.673)	-0.010* (-1.919)	-0.027*** (-5.769)	-0.001 (-0.709)	0.008** (2.489)	0.001 (0.652)	0.019*** (5.532)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	32,807	33,349	7,688	7,754	14,396	14,396	10,723	11,199
Log likelihood	-7470	-20303	-2465	-4766	-2937	-8723	-1887	-6706

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Determinants of innovation output: general & EIs

Variables	TOT		ECO-1		ECO-2		ECO-3	
	Innov (1)	EI (2)	Innov (3)	EI (4)	Innov (5)	EI (6)	Innov (7)	EI (8)
R&D intensity	0.060*** (12.005)	0.209*** (23.500)	0.199*** (11.593)	0.179*** (10.594)	0.015*** (3.053)	0.183*** (15.881)	-0.008* (-1.744)	0.149*** (10.966)
Size	-0.007*** (-6.685)	0.034*** (14.248)	-0.037*** (-10.773)	-0.007 (-1.629)	-0.000 (-0.027)	0.059*** (16.690)	0.005*** (2.871)	0.048*** (10.160)
Domestic group	-0.013*** (-3.342)	-0.067*** (-8.060)	-0.105*** (-6.840)	-0.119*** (-6.225)	0.001 (0.223)	-0.059*** (-5.049)	0.018*** (3.064)	-0.043*** (-2.706)
Foreign group	0.006 (1.268)	-0.004 (-0.444)	-0.104*** (-5.561)	-0.087*** (-4.279)	0.020*** (2.874)	-0.016 (-1.046)	0.027*** (4.267)	-0.001 (-0.049)
International markets	-0.025*** (-4.609)	-0.154*** (-14.760)	-0.066*** (-3.706)	-0.091*** (-4.607)	-0.000 (-0.013)	-0.172*** (-10.427)	0.008 (1.429)	-0.113*** (-6.760)
Investment intensity	-0.001 (-0.805)	-0.001 (-0.673)	-0.010* (-1.919)	-0.027*** (-5.769)	-0.001 (-0.709)	0.008** (2.489)	0.001 (0.652)	0.019*** (5.532)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	32,807	33,349	7,688	7,754	14,396	14,396	10,723	11,199
Log likelihood	-7470	-20303	-2465	-4766	-2937	-8723	-1887	-6706

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

By type of EI: total sample

Variables	Environmental process innovations					Environmental product innovations				
	Material/ Water (1)	Energy/ CO2 (2)	Emission (3)	Danger. Substance (4)	Fossil energy (5)	Recycling (6)	Energy/ CO2 (7)	Emission (8)	Recycling (9)	Lifetime (10)
R&D intensity	0.106*** (14.487)	0.135*** (16.053)	0.099*** (13.135)	0.096*** (13.537)	0.060*** (12.964)	0.082*** (10.625)	0.147*** (19.978)	0.115*** (16.992)	0.078*** (12.140)	0.110*** (17.040)
Size	0.055*** (26.014)	0.078*** (31.930)	0.055*** (25.149)	0.042*** (20.038)	0.028*** (20.565)	0.046*** (20.703)	0.040*** (18.924)	0.031*** (15.682)	0.024*** (12.561)	0.012*** (6.331)
Domestic group	-0.028*** (-3.842)	-0.037*** (-4.499)	-0.029*** (-3.850)	-0.043*** (-5.982)	-0.026*** (-5.557)	-0.026*** (-3.428)	-0.053*** (-7.182)	-0.042*** (-6.197)	-0.038*** (-5.859)	-0.046*** (-6.942)
Foreign group	0.018** (2.176)	-0.002 (-0.177)	-0.010 (-1.154)	-0.019** (-2.380)	-0.029*** (-5.322)	0.002 (0.293)	-0.018** (-2.147)	-0.023*** (-3.024)	-0.021*** (-2.814)	-0.034*** (-4.578)
Int'l markets	-0.076*** (-8.218)	-0.112*** (-10.873)	-0.082*** (-8.666)	-0.073*** (-8.215)	-0.051*** (-8.615)	-0.057*** (-5.948)	-0.123*** (-13.355)	-0.098*** (-11.456)	-0.060*** (-7.509)	-0.073*** (-8.881)
Invest. intensity	0.005*** (2.724)	0.012*** (6.144)	0.012*** (6.892)	0.001 (0.791)	0.002* (1.899)	0.008*** (4.416)	0.002 (1.351)	0.005*** (2.957)	0.003* (1.755)	-0.002 (-1.318)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	29,886	29,899	29,060	29,127	28,987	29,380	29,891	28,791	28,989	28,838
Log likelihood	-15447	-16867	-14986	-14566	-9119	-15491	-15761	-13780	-13250	-13237

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

By type of EI: total sample

Variables	Environmental process innovations					Environmental product innovations				
	Material/ Water (1)	Energy/ CO2 (2)	Emission (3)	Danger. Substance (4)	Fossil energy (5)	Recycling (6)	Energy/ CO2 (7)	Emission (8)	Recycling (9)	Lifetime (10)
R&D intensity	0.106*** (14.487)	0.135*** (16.053)	0.099*** (13.135)	0.096*** (13.537)	0.060*** (12.964)	0.082*** (10.625)	0.147*** (19.978)	0.115*** (16.992)	0.078*** (12.140)	0.110*** (17.040)
Size	0.055*** (26.014)	0.078*** (31.930)	0.055*** (25.149)	0.042*** (20.038)	0.028*** (20.565)	0.046*** (20.703)	0.040*** (18.924)	0.031*** (15.682)	0.024*** (12.561)	0.012*** (6.331)
Domestic group	-0.028*** (-3.842)	-0.037*** (-4.499)	-0.029*** (-3.850)	-0.043*** (-5.982)	-0.026*** (-5.557)	-0.026*** (-3.428)	-0.053*** (-7.182)	-0.042*** (-6.197)	-0.038*** (-5.859)	-0.046*** (-6.942)
Foreign group	0.018** (2.176)	-0.002 (-0.177)	-0.010 (-1.154)	-0.019** (-2.380)	-0.029*** (-5.322)	0.002 (0.293)	-0.018** (-2.147)	-0.023*** (-3.024)	-0.021*** (-2.814)	-0.034*** (-4.578)
Int'l markets	-0.076*** (-8.218)	-0.112*** (-10.873)	-0.082*** (-8.666)	-0.073*** (-8.215)	-0.051*** (-8.615)	-0.057*** (-5.948)	-0.123*** (-13.355)	-0.098*** (-11.456)	-0.060*** (-7.509)	-0.073*** (-8.881)
Invest. intensity	0.005*** (2.724)	0.012*** (6.144)	0.012*** (6.892)	0.001 (0.791)	0.002* (1.899)	0.008*** (4.416)	0.002 (1.351)	0.005*** (2.957)	0.003* (1.755)	-0.002 (-1.318)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	29,886	29,899	29,060	29,127	28,987	29,380	29,891	28,791	28,989	28,838
Log likelihood	-15447	-16867	-14986	-14566	-9119	-15491	-15761	-13780	-13250	-13237

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

By type of EI: total sample

Variables	Environmental process innovations						Environmental product innovations			
	Material/ Water (1)	Energy/ CO2 (2)	Emission (3)	Danger. Substance (4)	Fossil energy (5)	Recycling (6)	Energy/ CO2 (7)	Emission (8)	Recycling (9)	Lifetime (10)
R&D intensity	0.106*** (14.487)	0.135*** (16.053)	0.099*** (13.135)	0.096*** (13.537)	0.060*** (12.964)	0.082*** (10.625)	0.147*** (19.978)	0.115*** (16.992)	0.078*** (12.140)	0.110*** (17.040)
Size	0.055*** (26.014)	0.078*** (31.930)	0.055*** (25.149)	0.042*** (20.038)	0.028*** (20.565)	0.046*** (20.703)	0.040*** (18.924)	0.031*** (15.682)	0.024*** (12.561)	0.012*** (6.331)
Domestic group	-0.028*** (-3.842)	-0.037*** (-4.499)	-0.029*** (-3.850)	-0.043*** (-5.982)	-0.026*** (-5.557)	-0.026*** (-3.428)	-0.053*** (-7.182)	-0.042*** (-6.197)	-0.038*** (-5.859)	-0.046*** (-6.942)
Foreign group	0.018** (2.176)	-0.002 (-0.177)	-0.010 (-1.154)	-0.019** (-2.380)	-0.029*** (-5.322)	0.002 (0.293)	-0.018** (-2.147)	-0.023*** (-3.024)	-0.021*** (-2.814)	-0.034*** (-4.578)
Int'l markets	-0.076*** (-8.218)	-0.112*** (-10.873)	-0.082*** (-8.666)	-0.073*** (-8.215)	-0.051*** (-8.615)	-0.057*** (-5.948)	-0.123*** (-13.355)	-0.098*** (-11.456)	-0.060*** (-7.509)	-0.073*** (-8.881)
Invest. intensity	0.005*** (2.724)	0.012*** (6.144)	0.012*** (6.892)	0.001 (0.791)	0.002* (1.899)	0.008*** (4.416)	0.002 (1.351)	0.005*** (2.957)	0.003* (1.755)	-0.002 (-1.318)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	29,886	29,899	29,060	29,127	28,987	29,380	29,891	28,791	28,989	28,838
Log likelihood	-15447	-16867	-14986	-14566	-9119	-15491	-15761	-13780	-13250	-13237

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

By type of EI: total sample

Variables	Environmental process innovations					Environmental product innovations				
	Material/ Water (1)	Energy/ CO2 (2)	Emission (3)	Danger. Substance (4)	Fossil energy (5)	Recycling (6)	Energy/ CO2 (7)	Emission (8)	Recycling (9)	Lifetime (10)
R&D intensity	0.106*** (14.487)	0.135*** (16.053)	0.099*** (13.135)	0.096*** (13.537)	0.060*** (12.964)	0.082*** (10.625)	0.147*** (19.978)	0.115*** (16.992)	0.078*** (12.140)	0.110*** (17.040)
Size	0.055*** (26.014)	0.078*** (31.930)	0.055*** (25.149)	0.042*** (20.038)	0.028*** (20.565)	0.046*** (20.703)	0.040*** (18.924)	0.031*** (15.682)	0.024*** (12.561)	0.012*** (6.331)
Domestic group	-0.028*** (-3.842)	-0.037*** (-4.499)	-0.029*** (-3.850)	-0.043*** (-5.982)	-0.026*** (-5.557)	-0.026*** (-3.428)	-0.053*** (-7.182)	-0.042*** (-6.197)	-0.038*** (-5.859)	-0.046*** (-6.942)
Foreign group	0.018** (2.176)	-0.002 (-0.177)	-0.010 (-1.154)	-0.019** (-2.380)	-0.029*** (-5.322)	0.002 (0.293)	-0.018** (-2.147)	-0.023*** (-3.024)	-0.021*** (-2.814)	-0.034*** (-4.578)
Int'l markets	-0.076*** (-8.218)	-0.112*** (-10.873)	-0.082*** (-8.666)	-0.073*** (-8.215)	-0.051*** (-8.615)	-0.057*** (-5.948)	-0.123*** (-13.355)	-0.098*** (-11.456)	-0.060*** (-7.509)	-0.073*** (-8.881)
Invest. intensity	0.005*** (2.724)	0.012*** (6.144)	0.012*** (6.892)	0.001 (0.791)	0.002* (1.899)	0.008*** (4.416)	0.002 (1.351)	0.005*** (2.957)	0.003* (1.755)	-0.002 (-1.318)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	29,886	29,899	29,060	29,127	28,987	29,380	29,891	28,791	28,989	28,838
Log likelihood	-15447	-16867	-14986	-14566	-9119	-15491	-15761	-13780	-13250	-13237

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

By type of EI: total sample

Variables	Environmental process innovations					Environmental product innovations				
	Material/ Water (1)	Energy/ CO2 (2)	Emission (3)	Danger. Substance (4)	Fossil energy (5)	Recycling (6)	Energy/ CO2 (7)	Emission (8)	Recycling (9)	Lifetime (10)
R&D intensity	0.106*** (14.487)	0.135*** (16.053)	0.099*** (13.135)	0.096*** (13.537)	0.060*** (12.964)	0.082*** (10.625)	0.147*** (19.978)	0.115*** (16.992)	0.078*** (12.140)	0.110*** (17.040)
Size	0.055*** (26.014)	0.078*** (31.930)	0.055*** (25.149)	0.042*** (20.038)	0.028*** (20.565)	0.046*** (20.703)	0.040*** (18.924)	0.031*** (15.682)	0.024*** (12.561)	0.012*** (6.331)
Domestic group	-0.028*** (-3.842)	-0.037*** (-4.499)	-0.029*** (-3.850)	-0.043*** (-5.982)	-0.026*** (-5.557)	-0.026*** (-3.428)	-0.053*** (-7.182)	-0.042*** (-6.197)	-0.038*** (-5.859)	-0.046*** (-6.942)
Foreign group	0.018** (2.176)	-0.002 (-0.177)	-0.010 (-1.154)	-0.019** (-2.380)	-0.029*** (-5.322)	0.002 (0.293)	-0.018** (-2.147)	-0.023*** (-3.024)	-0.021*** (-2.814)	-0.034*** (-4.578)
Int'l markets	-0.076*** (-8.218)	-0.112*** (-10.873)	-0.082*** (-8.666)	-0.073*** (-8.215)	-0.051*** (-8.615)	-0.057*** (-5.948)	-0.123*** (-13.355)	-0.098*** (-11.456)	-0.060*** (-7.509)	-0.073*** (-8.881)
Invest. intensity	0.005*** (2.724)	0.012*** (6.144)	0.012*** (6.892)	0.001 (0.791)	0.002* (1.899)	0.008*** (4.416)	0.002 (1.351)	0.005*** (2.957)	0.003* (1.755)	-0.002 (-1.318)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
No of observations	29,886	29,899	29,060	29,127	28,987	29,380	29,891	28,791	28,989	28,838
Log likelihood	-15447	-16867	-14986	-14566	-9119	-15491	-15761	-13780	-13250	-13237

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Productivity effects

Variables	TOT		ECO-1		ECO-2		ECO-3	
	Innov (1)	EI (2)	Innov (3)	EI (4)	Innov (5)	EI (6)	Innov (7)	EI (8)
Innovation	0.188 (1.627)		-0.435* (-1.944)		11.920*** (15.007)		8.508*** (13.053)	
EI		0.330*** (3.228)		-1.439*** (-4.168)		0.566*** (2.919)		1.645*** (9.745)
Size, assets/employee, skills	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Constant	9.127*** (80.691)	9.203*** (116.672)	11.120*** (50.978)	11.925*** (40.135)	0.506 (0.677)	11.225*** (62.722)	1.893*** (3.404)	8.884*** (72.793)
No of observations	19,455	19,931	2,701	2,701	7,083	7,083	9,671	10,147
R ²	0.475	0.470	0.305	0.309	0.276	0.252	0.383	0.373

Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Summary and conclusions

- R&D expenditures & fixed capital investments are key drivers of EIs
 - R&D expenditures have the relative weakest effect in countries catching-up in EI → inefficiencies in the EI production process and insufficient innovation capabilities among firms located in these countries
- Larger firms are more likely to eco-innovate
 - This positive size-effect is strongest for firms located in countries with average eco-innovation performance or countries catching-up in eco-innovation
- In contrast, affiliation to a firm group is negatively related to EI → the necessary capabilities for eco-innovation are concentrated at the parent company
 - Particularly true for firms located in countries leading in eco-innovation

Summary and conclusions

- Firms which operate in international markets – as compared to firms which cater to domestic markets only – are less likely to introduce any type of innovation (eco- and otherwise) → no proof that fiercer competition in international markets encourages/necessitates innovation (eco- and otherwise)
- Differences across types of EI
- By and large, the productivity effects of eco-innovations are positive, which is a big incentive to undertake eco-innovative activities
 - However, for the group of countries leading in eco-innovation, both innovation and EI are associated with lower labour productivity

Thank you for your attention!

Follow us:

www.wiiw.ac.at



Determinants of innovation intensity

InRD expenditures	TOT	ECO-1	ECO-2	ECO-3
Domestic group	0.337*** (9.940)	0.414*** (5.597)	0.325*** (6.582)	0.479*** (6.561)
Foreign group	0.306*** (7.395)	0.389*** (4.814)	0.403*** (6.325)	0.524*** (6.253)
International markets	0.787*** (19.952)	0.720*** (9.143)	0.996*** (17.164)	0.772*** (9.620)
Local support	0.135*** (3.659)	0.163** (2.198)	0.121** (2.523)	0.004 (0.034)
National support	0.498*** (16.135)	0.553*** (8.952)	0.618*** (13.222)	0.562*** (9.603)
EU support	0.363*** (10.030)	0.693*** (9.375)	0.187*** (3.262)	0.381*** (5.995)
Coop: other enterprises	0.115*** (3.008)	0.002 (0.023)	0.232*** (4.312)	0.173** (2.132)
Coop: universities	0.156*** (4.156)	-0.020 (-0.253)	0.380*** (6.792)	0.297*** (4.160)
Coop: research institutes	0.146*** (3.558)	-0.008 (-0.108)	0.226*** (3.607)	0.138 (1.640)
Country FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
Constant	2.740*** (13.663)	5.731*** (16.423)	4.057*** (14.109)	1.663*** (4.687)
No of observations	101,390	14,217	33,602	53,571
Log likelihood	-67723	-15582	-30010	-22928
Rho	0.521	0.245	0.598	0.648
Wald test of independent equations	705.7	25.07	436.2	377.1
p-value	0.000	0.000	0.000	0.000

Robust z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1