# 6th Ethics Day

# Do exports to emerging markets influence environmental improvements in one's own country? Empirical evidence from globally integrated EU SMEs

Rhein-Waal University of Applied Sciences, Kamp-Lintfort, 6 May 2026

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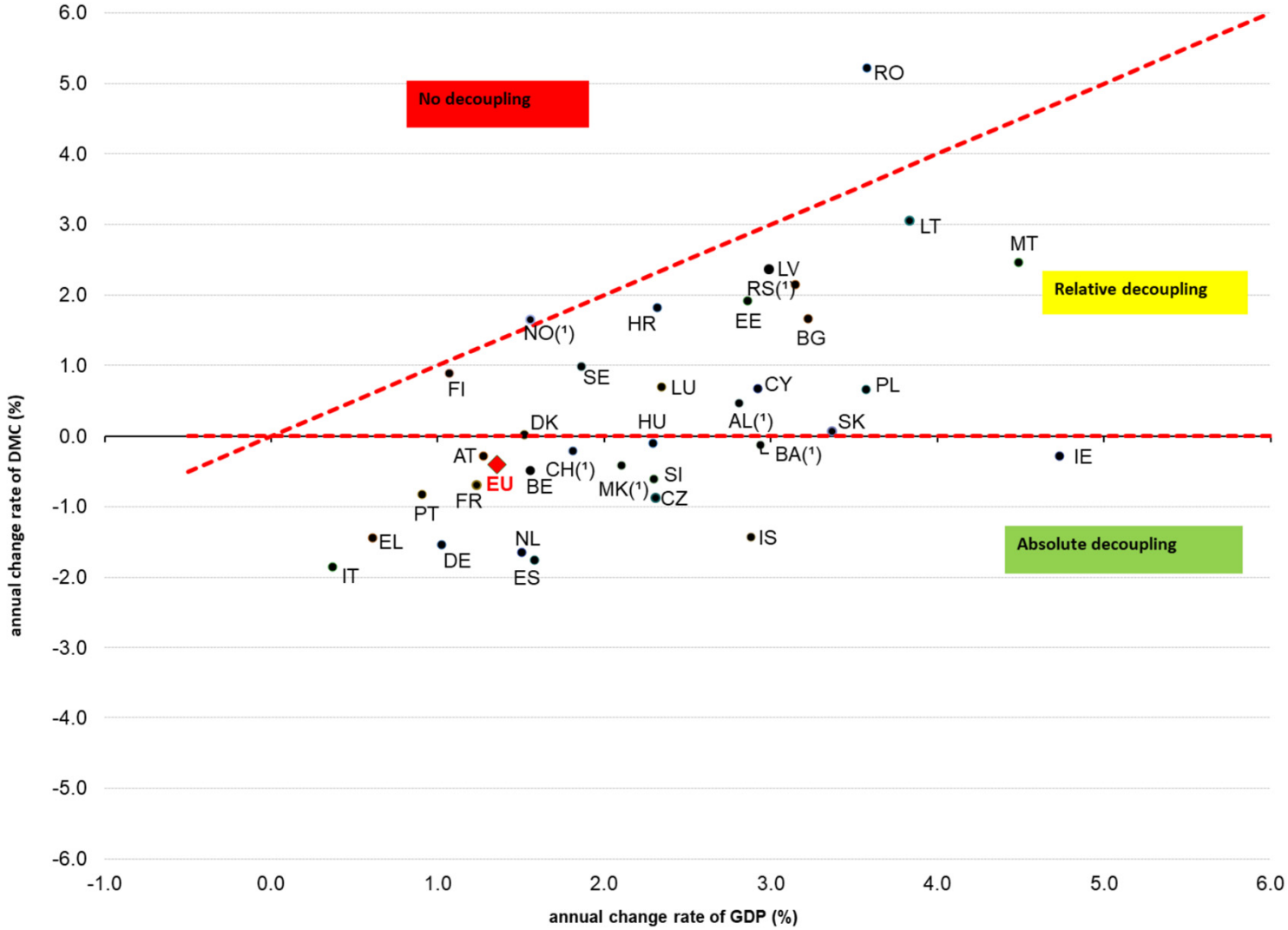
# Motivation

Annual rate of change in direct material consumption direct material consumption (DMC) and real gross domestic product (GDP in chain-linked volumes) in per cent for the years 2000 to 2024




Source: European Commission 2025

Note: GDP in chain-linked volumes, reference year 2015
(¹) deviating reference period
*Source:* Eurostat (online data codes: env_ac_mfa, nama_10_gdp)

eurostat



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# Possible solution

Under what conditions can SMEs contribute to this?

**(Technological and organisational) innovations:**

*Material consumption*

−

*Emissions*

−

*Use value*

+

Objective: absolute decoupling of GDP growht (as a proxy for prosperity) and environmental impact

(Is a further reduction in GDP growth necessary? See Jackson 2019 and the debates on de-growht and qualitative growth)

# Literature review

National innovation systems generate innovations, which in turn lead to further innovations, including eco-innovations (Dosi 1982, Dosi et al. 1995).

Studies that take into account global value chain integration, SMEs and eco-innovations find that value chain integration has a positive impact on eco-innovations (Meng et al. 2022, Suchek et al. 2024).

Two frequently discussed hypotheses:

1. The 'pollution haven' hypothesis: firms in highly regulated countries use global value chains to offload emissions (Copeland and Taylor 1994, Tobey 1990);
2. Environmental regulation promotes innovation and thus cleaner production (Porter and van den Linde 1995, Acemoglu et al. 2012).

Assessment:

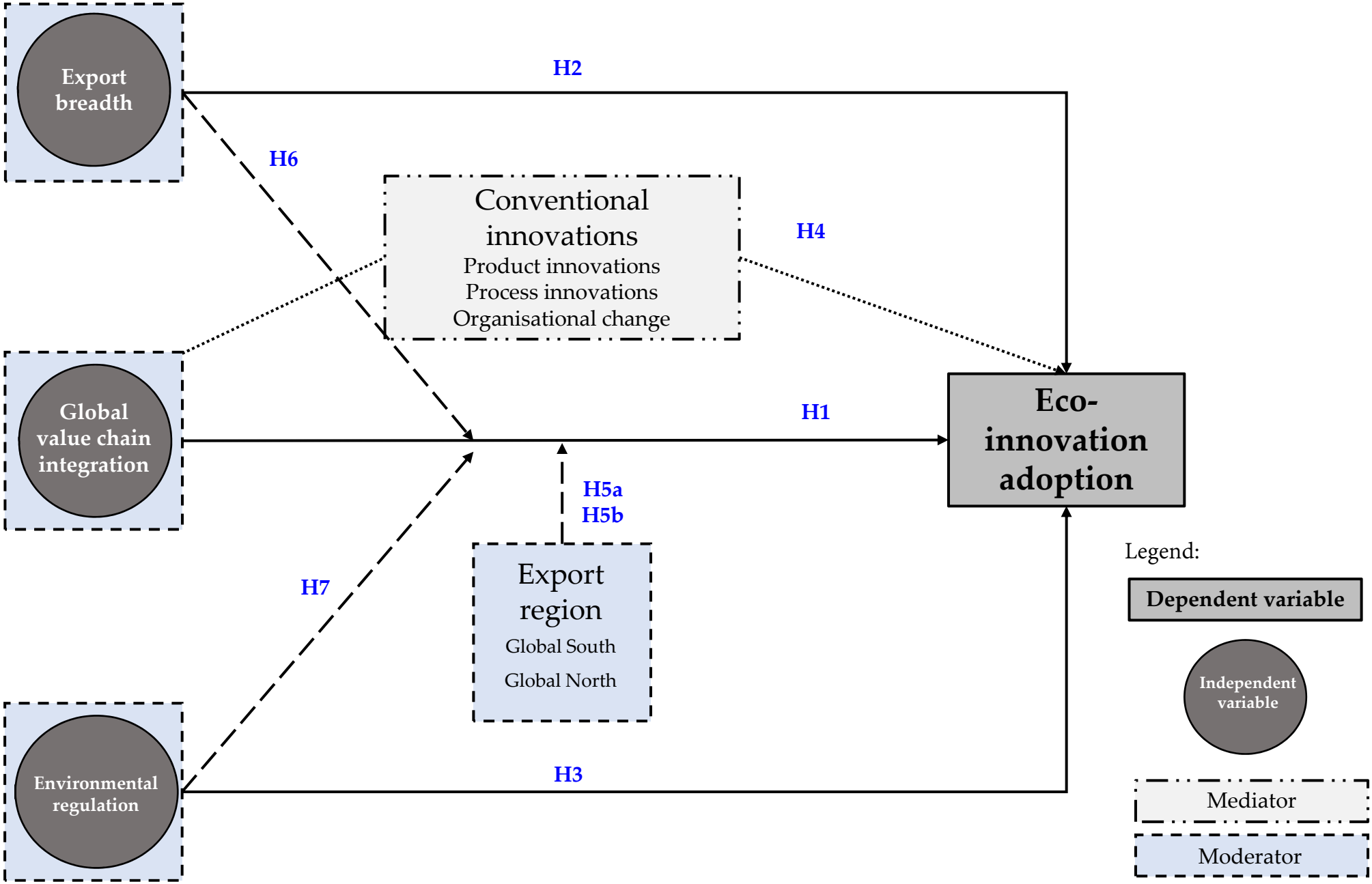
- Hypothesis 2 does not explicitly take value chains into account, so the hypotheses are not necessarily contradictory.
- Empirical evidence:
  - In favour of Porter/van den Linde: Martínez-Zarzoso et al. (2019), Hassan et al. (2024);
  - Mixed evidence for the 'pollution haven' hypothesis: Koźluk and Timiliotis (2016), Thomsen (2025).

# Scientific gaps

What explains the mixed evidence regarding the ‘pollution haven’ hypothesis, such as the hitherto unsystematic consideration of export destinations?

Does global value chain integration play a role in the effectiveness of environmental regulation?

# Theoretical framework



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# Hypotheses

H1: Integration into global value chains increases probability of eco-innovation adoption among EU SMEs.

H2: A high export breadth increases the extent of eco-innovation adoption among EU SMEs.

H3: Stricter environmental regulation leads to more eco-innovations.

H4: Conventional innovations mediate between value chain integration and eco-innovations (mediator): they lead to eco-innovations.

H5a: Exports to the Global North reinforce (moderate) the relationship between value chain integration and the adoption of eco-innovations.

H5b: Exports to the Global South reduce (moderate) the relationship between value chain integration and the adoption of eco-innovations.

H6: A high export breadth strengthens (moderates) the relationship between value chain integration and the adoption of eco-innovations.

# Data

Survey data:

- "**Flash Eurobarometer** 486: SMEs, Start-ups, Scale-ups and Entrepreneurship" (European Commission 2020);
- Survey of senior management at 16,365 SMEs on topics such as sustainability, digitalisation and innovation;
- Probability weighted sample of SMEs (by sector, size, age, etc.);
- Survey conducted in **spring 2020** (prior to the pandemic and the invasion-induced energy price crisis, the tariff increases imposed by the Trump II administration in 2025, and the energy price crisis caused by the US-Israel-Iran war in 2026);
- EU 27 plus 12 other non-EU countries (including the US, UK, Canada, Brazil, Türkiye and Japan);
- Focus subsequently on **6,378 EU SMEs** and their exports (across 7 regions) and supply chain relationships.

☞ Comparison between companies and countries at a given point in time

# Sample question

| | |
|---|---|
| Q11 | To which international markets, if any, did your enterprise export goods or services in 2019? |

(READ OUT - MULTIPLE ANSWERS POSSIBLE)

| | |
|---|---|
| None, your enterprise only operates in the UK | 1, |
| EU countries (INTERVIEWER, DO NOT READ OUT: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, UK) | 2, |
| Other European countries outside of the EU (incl. Russia) | 3, |
| North America (INTERVIEWER, DO NOT READ OUT: US and Canada) | 4, |
| Latin America and the Caribbean | 5, |
| China | 6, |
| Rest of Asia and the Pacific | 7, |
| Middle East and Africa | 8, |
| DK/NA | 9, |

# Method

Independent variable – implementation of eco-innovations – is binary (Yes/No)

→ **Logit model*** (Greene 2012)

$$\textbf{Prob}\,(\mathbf{Y}_i = \mathbf{1}\,|\mathbf{X}_i) = \frac{\exp(X_i'\boldsymbol{\beta})}{\mathbf{1} + \exp(X_i'\boldsymbol{\beta})} = \boldsymbol{\Lambda}(X_i'\boldsymbol{\beta})$$

We measure (average) marginal effects:

$$\textbf{Marginal Effect} = \textbf{Prob}\,[Y = 1\,|\bar{\mathbf{x}}_{(\mathbf{d})}, \boldsymbol{d} = \mathbf{1}] - \textbf{Prob}\,[Y = 1\,|\bar{\mathbf{x}}_{(\mathbf{d})}, \boldsymbol{d} = \mathbf{0}]$$

**Estimation equation**:

$$\mathbf{y} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\mathbf{x_1} + \boldsymbol{\beta_2}\mathbf{x_2} + \boldsymbol{\beta_{12}}\mathbf{x_1}\mathbf{x_2} + \boldsymbol{\delta}'\mathbf{X} + \boldsymbol{\varepsilon}$$

**Control variables**: firm size, age, turnover; management myopia; past innovations; lack of finance, demand, knowledge…

Test for **moderation effects**: for export breadth, global value chains and export breadth, regions (North/South).

Test for **mediation effects**: for conventional innovations (using cross partial derivatives and Karlson/Holm/Breen decomposition [Kohler et al. 2011, Hayes 2013, AI and Norton 2003])

**Model specification tests**: Link test (and more).

* Probit shows a poorer empirical fit, and multivariate analysis yields insignificant results.

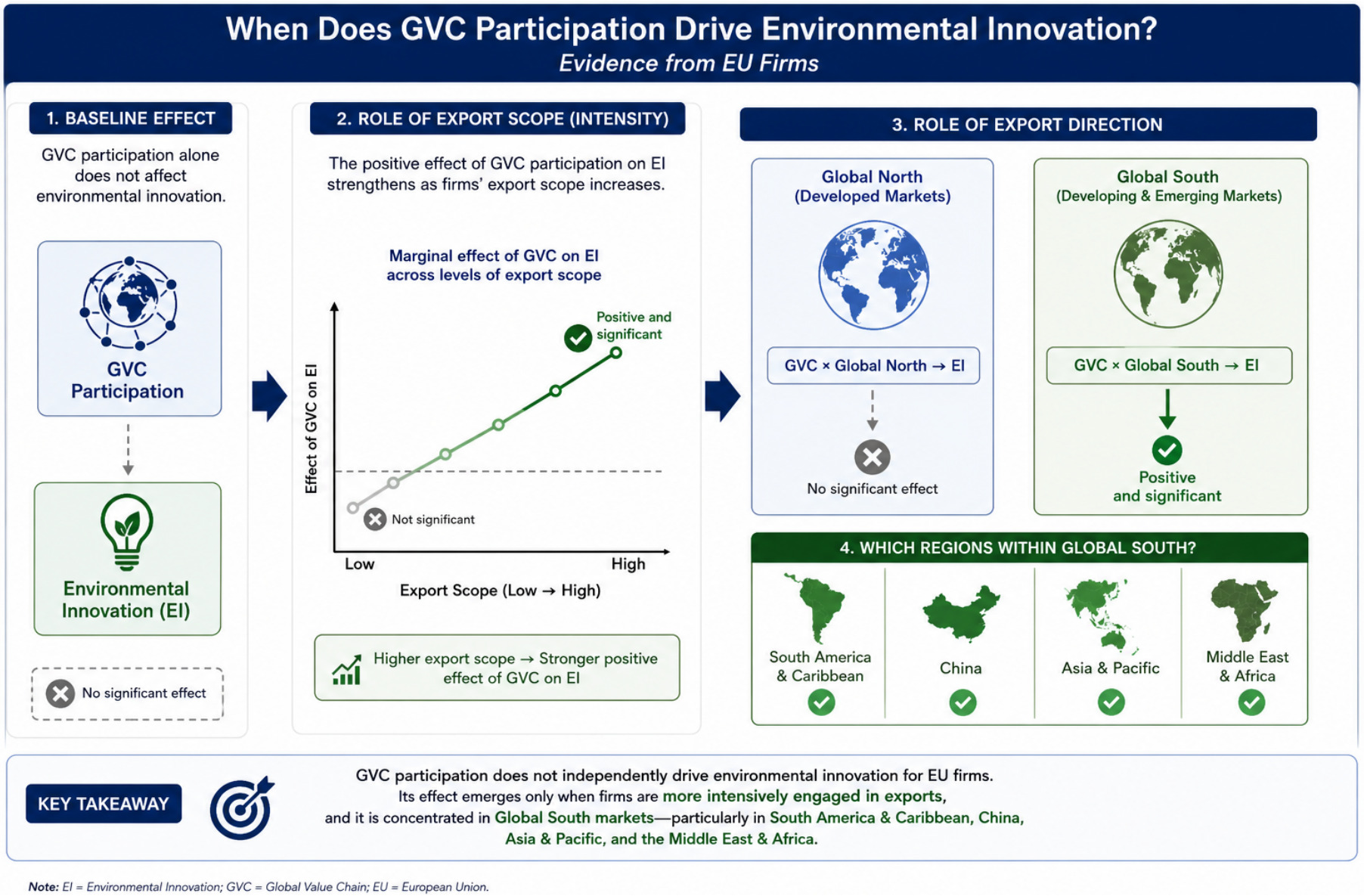
# Results I

| VARIABLES | (1) Marginal Effects EI | (2) Marginal Effects EI | (3) Marginal Effects EI |
|---|---|---|---|
| GVC | 0.0541** | 0.0515** | 0.0473** |
| | (0.0224) | (0.0237) | (0.0234) |
| Export_Any | | 0.0215* | |
| | | (0.0125) | |
| N_Export_scope | | | 0.0845*** |
| | | | (0.0217) |
| lnTurnover | 0.0000629 | 0.0000768 | 0.0000381 |
| | (0.000756) | (0.000749) | (0.000741) |
| lnFirmsize | 0.0138** | 0.0128** | 0.0118* |
| | (0.00592) | (0.00604) | (0.00611) |
| lnFirmage_yr | 0.0199*** | 0.0205*** | 0.0202*** |
| | (0.00488) | (0.00503) | (0.00501) |
| Manag_myopia | -0.0123 | -0.0120 | -0.0110 |
| | (0.0154) | (0.0154) | (0.0154) |
| Lack_demand | -0.00118 | -0.000682 | -0.000529 |
| | (0.00681) | (0.00689) | (0.00721) |
| Lack_knowledge | -0.0371 | -0.0369 | -0.0365 |
| | (0.0313) | (0.0314) | (0.0320) |
| Incompatability w/existing bus. model | -0.0996*** | -0.0985*** | -0.0979*** |
| | (0.0144) | (0.0143) | (0.0141) |
| Lack_profit | -0.0120 | -0.0117 | -0.0116 |
| | (0.0145) | (0.0148) | (0.0142) |
| Lack_skills | -0.00213 | -0.00233 | -0.000829 |
| | (0.0148) | (0.0149) | (0.0150) |
| Lack_clim_Finance | 0.0161 | 0.0163 | 0.0152 |
| | (0.0152) | (0.0153) | (0.0155) |
| PastInno | 0.168*** | 0.166*** | 0.164*** |
| | (0.0100) | (0.0103) | (0.00996) |

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Preliminary and outdated since yesterday …

# Results II




*Note:* *EI = Environmental Innovation; GVC = Global Value Chain; EU = European Union.*

# Interpretation

- SMEs that are part of a global value chain and primarily export to the Global South introduce more eco-innovations than companies that are not part of a global value chain and do not export to the Global South.
  - No evidence can be found for an impact of exports to the Global North on eco-innovations.
  - Possible explanations for the environmentally beneficial influence of the South: technology transfer, demand for sustainable products, or specialisation effects.
- Conventional innovations promote eco-innovations.
- The ‘pollution haven’ hypothesis is not supported by our data.
- The hypothesis that strict regulation has an environmentally beneficial effect is likewise not supported.

# Conclusion

## Answers to our research questions?

(Recall: 1. What explains the mixed evidence regarding the 'pollution haven' hypothesis, such as the hitherto unsystematic consideration of export destinations? 2. Does global value chain integration play a role in the effectiveness of environmental regulation?)

- 'Pollution haven' hypothesis: Consideration of export regions (North/South) shows the opposite for the Global South;
- A positive effect of environmental protection regulation on eco-innovations cannot be found;
- interaction effects of global value chains and export breadth can be found.

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# Appendix

**Table 1: Description of the variables**

| Variable | Description | Measurement |
|---|---|---|
| *Dependent variable* | | |
| EI | Q: During the past 12 months, has your enterprise introduced any of the following types of innovations?<br>An innovation with an environmental benefit, including innovations with an energy or resource efficiency benefit | 1 if Yes;<br>0 if No |
| *Independent variables* | | |
| GVC | Which of the following statements applies to your enterprise?<br>It is a part of a global value chain | 1 if mentioned;<br>0 otherwise |
| Export Any | To which international markets, if any, did your enterprise export goods or services in 2019? (See below)<br>If a firm exports to any of the regions listed below | 1 if exporting;<br>0 otherwise |
| Export Breadth/Scope *(also moderator)* | Count of export destinations<br>$= \frac{1}{7}\sum_{j=1}^{7} \text{Export Destination}_{fj}$ | 0 - 1 |
| *Moderators* | | |
| Export EU<br>Export Non-EU<br>Export NorthAmerica<br>Export SAmericaCaribbean<br>Export China<br>Export Asia andPacific | To which international markets, if any, did your enterprise export goods or services in 2019?<br>Other EU countries<br>Other European countries outside of the EU (incl. Russia)<br>North America<br>Latin America and the Caribbean<br>China<br>Rest of Asia and the Pacific<br>Middle East and Africa | 1 if mentioned;<br>0 otherwise |

| | | |
|---|---|---|
| Export MiddleEastAfrica<br><br>Export GlobalSouth<br><br><br><br>Export GlobalNorth | Other EU countries<br>Other European countries outside of the EU (incl. Russia)<br>North America<br><br>Latin America and the Caribbean<br>China<br>Rest of Asia and the Pacific<br>Middle East and Africa | 1 if mentioned any of these;<br>0 otherwise |
| *Control variables* | | |
| lnTO | What was the annual turnover of your enterprise in 2019? If you are not sure, please provide your best estimate. | Natural log |
| lnFirmsize | And how many employees, excluding the owners, did your enterprise have three years ago? If you are not sure, please provide your best estimate. | Natural log |
| lnFirmage | In what year was your enterprise first registered? If you are not sure, please provide your best estimate. | Year reported – 2020 = Age<br>Natural log |
| <br><br><br><br>Manag myopia<br>Lack demand<br>Lack knowledge<br><br><br>Incompatibility | Which of the following, if any, are currently preventing your enterprise from becoming sustainable, i.e. combining long-term success and profitability with a positive impact on society and the environment?<br>Lack of willingness among the management<br>Lack of consumer or customer demand<br>Lack of awareness about how to integrate sustainability into the enterprise's business model<br>It is not compatible with your current business model<br>It would not be profitable | 1 if mentioned;<br>0 otherwise |

| | | |
|---|---|---|
| Lack profit<br>Lack skills<br>Lack clim Finance | Lack of skills, including managerial skills<br>Lack of financial resources | |
| PastInno | During the past 12 months, has your enterprise introduced any of the following types of innovations?<br>A new or significantly improved product or service to the market<br>A new or significantly improved production process or method<br>A new organisation of management or a new business model<br>A new way of selling your goods or services<br>Any other type of innovation | 1 if mentioned product, process, organizational, market, or other innovation;<br>0 otherwise |
| Sector-specific effects<br>NACE A Classifications | Yes | 1 if mentioned;<br>0 otherwise |
| Country-specific effects | Yes | 1 if mentioned;<br>0 otherwise |

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| EInno | 10312 | .226 | .418 | 0 | 1 |
| GVC | 10312 | .09 | .286 | 0 | 1 |
| Export Any | 10312 | .341 | .474 | 0 | 1 |
| Export Scope/Breadth | 10312 | .675 | 1.31 | 0 | 7 |
| Export GlobalSouth | 10312 | .091 | .287 | 0 | 1 |
| Export GlobalNorth | 10312 | .335 | .472 | 0 | 1 |
| Export EU | 10312 | .319 | .466 | 0 | 1 |
| Export Non-EU | 10312 | .121 | .326 | 0 | 1 |
| Export NorthAmerica | 10312 | .057 | .232 | 0 | 1 |
| Export SAmericaCaribbean | 10312 | .035 | .185 | 0 | 1 |
| Export China | 10312 | .039 | .193 | 0 | 1 |
| Export Asia andPac | 10312 | .052 | .222 | 0 | 1 |
| Export MiddleEastAfrica | 10312 | .052 | .221 | 0 | 1 |
| Turnover | 10312 | 5221291 | 11,400,000 | 1 | 98,400,000 |
| Firmsize | 10312 | 24.65 | 40.252 | 1 | 249 |
| Firmage yr | 10312 | 23.659 | 20.645 | 1 | 170 |
| Manag myopia | 10312 | .077 | .267 | 0 | 1 |
| Lack demand | 10312 | .304 | .46 | 0 | 1 |
| Lack knowledge | 10312 | .227 | .419 | 0 | 1 |
| Incompatability | 10312 | .212 | .409 | 0 | 1 |
| Lack profit | 10312 | .15 | .357 | 0 | 1 |
| Lack skills | 10312 | .166 | .372 | 0 | 1 |
| Lack clim Finance | 10312 | .272 | .445 | 0 | 1 |
| PastInno | 10312 | .527 | .499 | 0 | 1 |

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| sector mining | 10312 | .003 | .054 | 0 | 1 |
| sector manufacturing | 10312 | .186 | .389 | 0 | 1 |
| sector energy | 10312 | .005 | .073 | 0 | 1 |
| sector water | 10312 | .009 | .096 | 0 | 1 |
| sector construction | 10312 | .103 | .303 | 0 | 1 |
| sector trade | 10312 | .279 | .449 | 0 | 1 |
| sector transport | 10312 | .059 | .236 | 0 | 1 |
| sector hospitality | 10312 | .058 | .233 | 0 | 1 |
| sector infocomm | 10312 | .039 | .193 | 0 | 1 |
| sector finance | 10312 | .022 | .148 | 0 | 1 |
| sector realestate | 10312 | .025 | .156 | 0 | 1 |
| sector STP | 10312 | .1 | .3 | 0 | 1 |
| sector admin | 10312 | .042 | .2 | 0 | 1 |
| sector education | 10312 | .022 | .146 | 0 | 1 |
| sector health | 10312 | .033 | .178 | 0 | 1 |
| sector arts | 10312 | .015 | .121 | 0 | 1 |
| France | 10312 | .043 | .202 | 0 | 1 |
| Belgium | 10312 | .042 | .201 | 0 | 1 |
| Netherlands | 10312 | .04 | .197 | 0 | 1 |
| Germany | 10312 | .041 | .199 | 0 | 1 |
| Italy | 10312 | .04 | .197 | 0 | 1 |
| Luxembourg | 10312 | .017 | .13 | 0 | 1 |
| Denmark | 10312 | .043 | .202 | 0 | 1 |
| Ireland | 10312 | .039 | .193 | 0 | 1 |
| Greece | 10312 | .042 | .201 | 0 | 1 |
| Spain | 10312 | .044 | .205 | 0 | 1 |
| Portugal | 10312 | .042 | .202 | 0 | 1 |
| Finland | 10312 | .044 | .204 | 0 | 1 |
| Sweden | 10312 | .042 | .2 | 0 | 1 |
| Austria | 10312 | .042 | .201 | 0 | 1 |
| Cyprus | 10312 | .016 | .125 | 0 | 1 |
| CzechRep | 10312 | .042 | .2 | 0 | 1 |
| Estonia | 10312 | .038 | .19 | 0 | 1 |
| Hungary | 10312 | .039 | .194 | 0 | 1 |
| Latvia | 10312 | .043 | .203 | 0 | 1 |
| Lithuania | 10312 | .043 | .203 | 0 | 1 |
| Malta | 10312 | .014 | .119 | 0 | 1 |
| Poland | 10312 | .042 | .201 | 0 | 1 |
| Slovakia | 10312 | .037 | .189 | 0 | 1 |
| Slovenia | 10312 | .044 | .204 | 0 | 1 |
| Bulgaria | 10312 | .039 | .193 | 0 | 1 |
| Romania | 10312 | .042 | .199 | 0 | 1 |

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) EInno | 1.000 | | | | | | | | | | | | | | | | | | | | | | | |
| (2) GVC | 0.118*** | 1.000 | | | | | | | | | | | | | | | | | | | | | | |
| (3) Export_Any | 0.081*** | 0.149*** | 1.000 | | | | | | | | | | | | | | | | | | | | | |
| (4) Export_scope | 0.105*** | 0.207*** | 0.716*** | 1.000 | | | | | | | | | | | | | | | | | | | | |
| (5) Export_GlobalS~h | 0.089*** | 0.166*** | 0.439*** | 0.797*** | 1.000 | | | | | | | | | | | | | | | | | | | |
| (6) Export_Developed | 0.080*** | 0.148*** | 0.987*** | 0.712*** | 0.400*** | 1.000 | | | | | | | | | | | | | | | | | | |
| (7) Export_EU | 0.081*** | 0.145*** | 0.951*** | 0.703*** | 0.392*** | 0.964*** | 1.000 | | | | | | | | | | | | | | | | | |
| (8) Export_Non_EU | 0.080*** | 0.166*** | 0.515*** | 0.749*** | 0.516*** | 0.522*** | 0.453*** | 1.000 | | | | | | | | | | | | | | | | |
| (9) Export_NorthAm~a | 0.070*** | 0.132*** | 0.342*** | 0.725*** | 0.563*** | 0.347*** | 0.324*** | 0.446*** | 1.000 | | | | | | | | | | | | | | | |
| (10) Export_SAmeri~n | 0.079*** | 0.124*** | 0.266*** | 0.670*** | 0.605*** | 0.255*** | 0.256*** | 0.387*** | 0.516*** | 1.000 | | | | | | | | | | | | | | |
| (11) Export_China | 0.068*** | 0.145*** | 0.279*** | 0.669*** | 0.635*** | 0.261*** | 0.262*** | 0.393*** | 0.519*** | 0.490*** | 1.000 | | | | | | | | | | | | | |
| (12) Export_Asia_ex~s | 0.063*** | 0.165*** | 0.326*** | 0.741*** | 0.742*** | 0.314*** | 0.310*** | 0.451*** | 0.564*** | 0.542*** | 0.537*** | 1.000 | | | | | | | | | | | | |
| (13) Export_Middle~a | 0.074*** | 0.145*** | 0.324*** | 0.691*** | 0.739*** | 0.298*** | 0.292*** | 0.419*** | 0.451*** | 0.511*** | 0.466*** | 0.551*** | 1.000 | | | | | | | | | | | |
| (14) Turnover | -0.052*** | -0.079*** | -0.061*** | -0.066*** | -0.060*** | -0.060*** | -0.058*** | -0.059*** | -0.040*** | -0.042*** | -0.039*** | -0.028*** | -0.041*** | 1.000 | | | | | | | | | | |
| (15) Firmsize | 0.115*** | 0.119*** | 0.155*** | 0.191*** | 0.147*** | 0.156*** | 0.160*** | 0.156*** | 0.120*** | 0.110*** | 0.119*** | 0.123*** | 0.117*** | -0.038*** | 1.000 | | | | | | | | | |
| (16) Firmage_yr | 0.068*** | 0.032*** | 0.009 | 0.072*** | 0.077*** | 0.010 | 0.017* | 0.067*** | 0.052*** | 0.051*** | 0.069*** | 0.073*** | 0.063*** | -0.034*** | 0.194*** | 1.000 | | | | | | | | |
| (17) Manag_myopia | -0.013 | 0.020** | -0.012 | 0.000 | 0.011 | -0.012 | -0.014 | -0.007 | 0.002 | -0.002 | 0.002 | 0.016* | 0.020** | -0.057*** | -0.003 | 0.015 | 1.000 | | | | | | | |
| (18) Lack_demand | 0.003 | 0.039*** | 0.011 | 0.008 | 0.013 | 0.012 | 0.012 | 0.016* | 0.002 | -0.011 | -0.009 | 0.006 | 0.005 | -0.061*** | -0.016* | 0.039*** | 0.120*** | 1.000 | | | | | | |
| (19) Lack_knowledge | 0.020** | 0.033*** | 0.010 | 0.012 | 0.017* | 0.010 | 0.012 | 0.012 | 0.009 | -0.003 | 0.002 | -0.001 | 0.022** | -0.067*** | 0.003 | 0.039*** | 0.197*** | 0.186*** | 1.000 | | | | | |
| (20) Incompatability | -0.070*** | -0.019* | -0.052*** | -0.041*** | -0.029*** | -0.054*** | -0.052*** | -0.038*** | -0.016 | -0.017* | -0.016 | -0.027*** | -0.007 | -0.033*** | -0.043*** | -0.001 | 0.124*** | 0.093*** | 0.107*** | 1.000 | | | | |
| (21) Lack_profit | 0.021** | 0.034*** | -0.012 | -0.012 | 0.003 | -0.013 | -0.015 | -0.010 | -0.016* | -0.020** | -0.001 | 0.001 | 0.008 | -0.072*** | 0.006 | 0.047*** | 0.160*** | 0.189*** | 0.144*** | 0.188*** | 1.000 | | | |
| (22) Lack_skills | 0.042*** | 0.050*** | 0.005 | 0.012 | 0.009 | 0.006 | 0.011 | 0.012 | 0.011 | -0.001 | -0.003 | 0.009 | 0.012 | -0.069*** | 0.024** | 0.041*** | 0.220*** | 0.152*** | 0.340*** | 0.056*** | 0.120*** | 1.000 | | |
| (23) Lack_clim_Fin~e | 0.024** | -0.003 | -0.031*** | -0.029*** | -0.019* | -0.028*** | -0.026*** | -0.031*** | -0.006 | -0.007 | -0.028*** | -0.022** | -0.014 | -0.023** | -0.020** | -0.039*** | 0.046*** | 0.087*** | 0.126*** | -0.006 | 0.116*** | 0.154*** | 1.000 | |
| (24) PastInno | 0.233*** | 0.121*** | 0.151*** | 0.158*** | 0.129*** | 0.151*** | 0.148*** | 0.132*** | 0.106*** | 0.086*** | 0.074*** | 0.090*** | 0.090*** | -0.081*** | 0.080*** | 0.013 | -0.003 | 0.034*** | 0.064*** | -0.040*** | 0.007 | 0.059*** | 0.054*** | 1.000 |

*** p<0.01, ** p<0.05, * p<0.1