Innovation drivers in agri-food system technological transition

Mercedes SANCHEZ
Public University of Navarra, Pampona (Spain)

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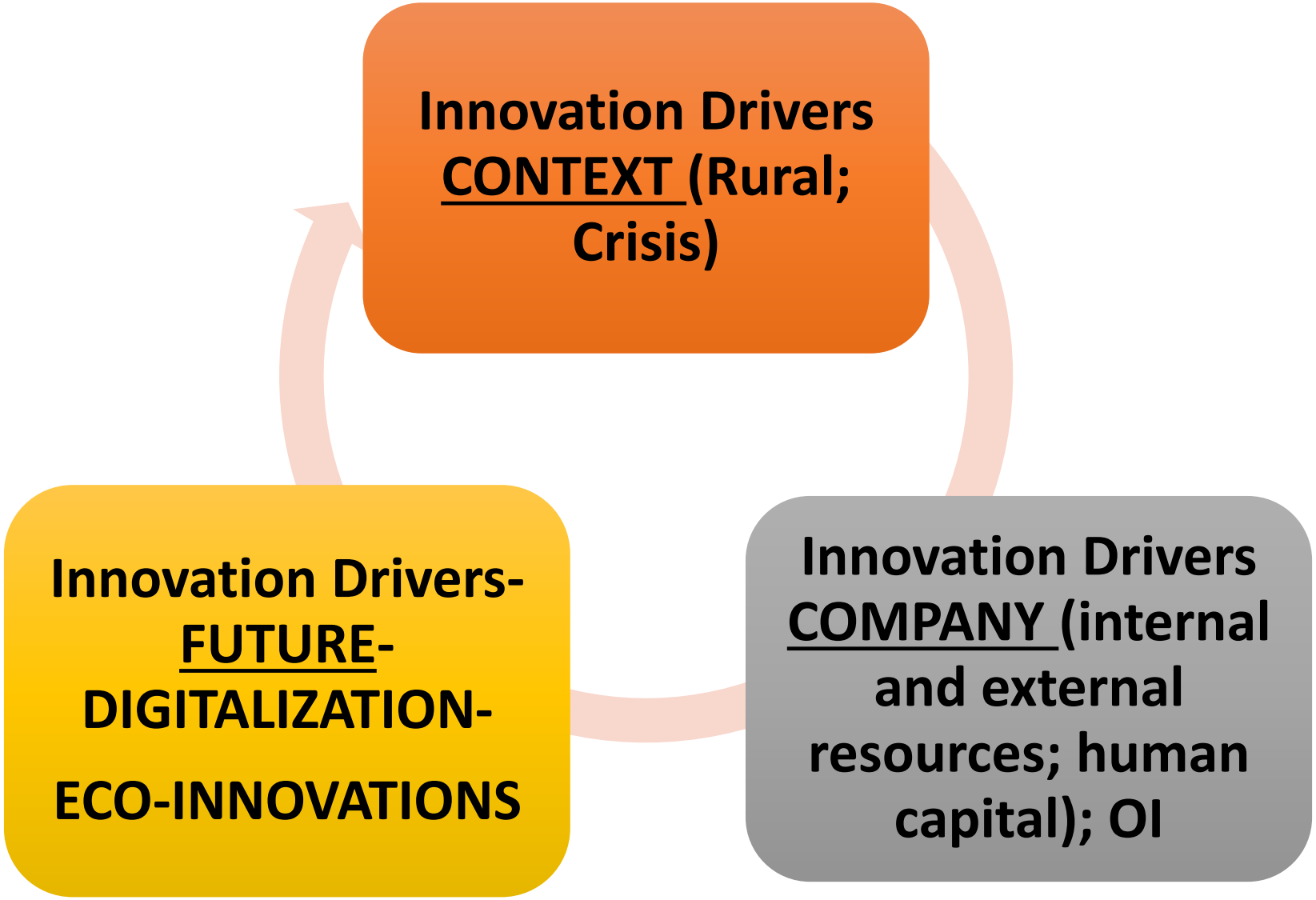
Overview


Innovation Drivers CONTEXT (Rural; Crisis)
Innovation Drivers COMPANY (internal and external resources; human capital); OI
Innovation Drivers- FUTURE- DIGITALIZATION- ECO-INNOVATIONS

What have we learned?

How could be the future (some considerations)?

What have we learned?.
Basic assumptions (Finco et al., 2018)

Innovation is a central drive of economic growth and productivity

The capacity to innovate is a strategic tool (global markets)

Agri food sector EU (economic output and Employment)

What is innovation?

new feeding systems, new types of packaging, new types of conservation, new additives, new consumer products ….

Horizon 2020 and new Common Agricultural Policy (CAP) emphasize the role of innovation.

European Innovation Partnership (EIP), Operational Groups (OGs) and different technological clusters

What have we learned?.
Basic assumptions (Finco et al., 2018)

More than 60% of firms develop or implement innovation

The innovation is <u>not a random</u> process

Firm Size, Turnover; participation in a network (Cluster or other options OI)

What have we learned?.
Drivers (Fortuin et al., 2007). *International Food and Agribusiness Management Review*

Customer centricity (Market orientation) (Batterink et al., 2006, García Martínez and Briz, 2000)

Teamwork and cooperation

Organizational communication (coordination and integration R&D, marketing activities and know how) Costa and Jongen (2006)

Open Innovation: absorb and utilize knowledge from outside the company (suppliers and buyers or even in some cases with competitors) (Chesbrough (2003)

Innovation Outputs types (Technological and Sales)

INCREMENTAL INNOVATION

RADICAL INNOVATION

01 **Product innovation**

Significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics" (OECD, 2018).

02 **Process innovation**

A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software" (OECD,2018).

03 **Organizational innovation**

A new organisational method in business practices, workplace organisation or external relations (OECD,2018)".

04 **Marketing innovation**

A new marketing method involving significant changes in product design and packaging, product placement, product promotion or pricing" (2018).

What have we learned?.
Drivers (Fearne et al., 2013). *Management Decision* and (García Álvarez-Coque et al., 2014), *New Medit*

Capacity of **rural and urban** spaces to promote innovation in the agro-food firms

2,000 firms based in the Valencia region, Spain.

Identify location of the firm. Local Labour Systems (LLS- OECD)

The location doesn't appear relevant concerning innovation

Primary sector less innovative, but Co-op businesses appear to be more innovative

What have we learned?.
Drivers (Fearne et al., 2013). *Management Decision*

How to measure innovation: R&D Intensity; Community Innovation Survey based on the Oslo manual for OECD countries

Low intensity of direct innovation both in the primary sector and the food industry in relation to other sectors

EU rural development policies in favour of promoting the economic diversification of rural areas (effectiviness)

What have we learned?.
Drivers (García Álvarez-Coque et al., 2015). *Agribusiness*

A database of over 2,700 agri-food businesses in the region of Valencia, Spain was used to test the influence of internal characteristics of the firm and of external characteristics linked to local systems on the willingness to participate in R&D activities promoted by knowledge supporting institutions

Results show that R&D activities are enhanced in medium and large firms, coops, experienced firms and better physical access to technological centers.

What have we learned?.
Drivers (Alarcón and Sánchez, 2013). *Journal of Agricultural Economics*

We examine the effects of* external and internal *expenditure on research and development on the business performance of industrial agri-food enterprises.
Filippaios *et al.,* (2009); Noronha *et al.,* (2006)

***The econometric analysis uses quantile regressions*. Survey of Business Strategies**

The positive effects of external R&D on business performance. Internal R&D was also revealed to be an important way of enhancing the productivity of SMEs.

The modernisation of the production process continues to be the main path to improve competitiveness

There is not a inverse relationship

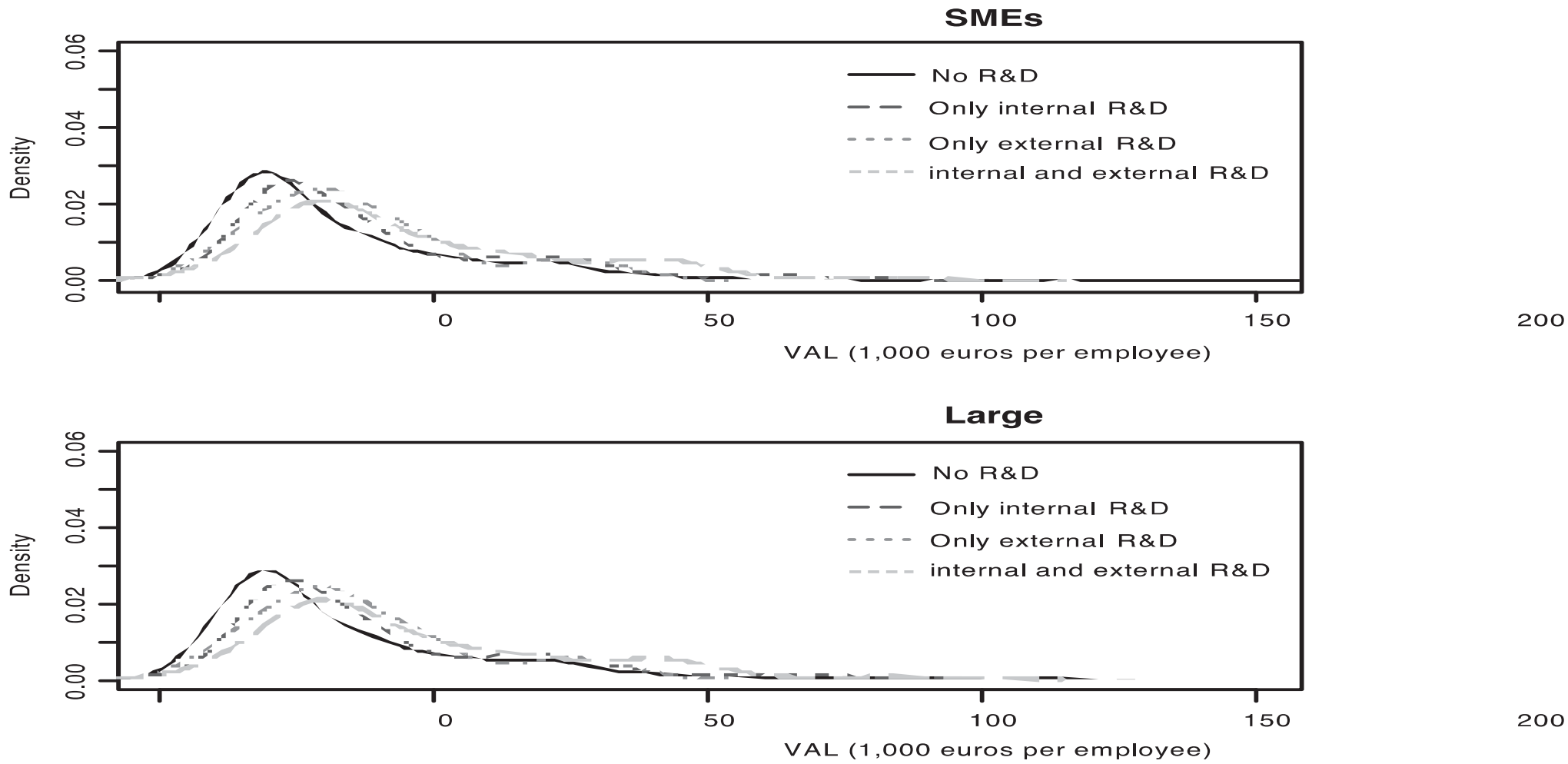
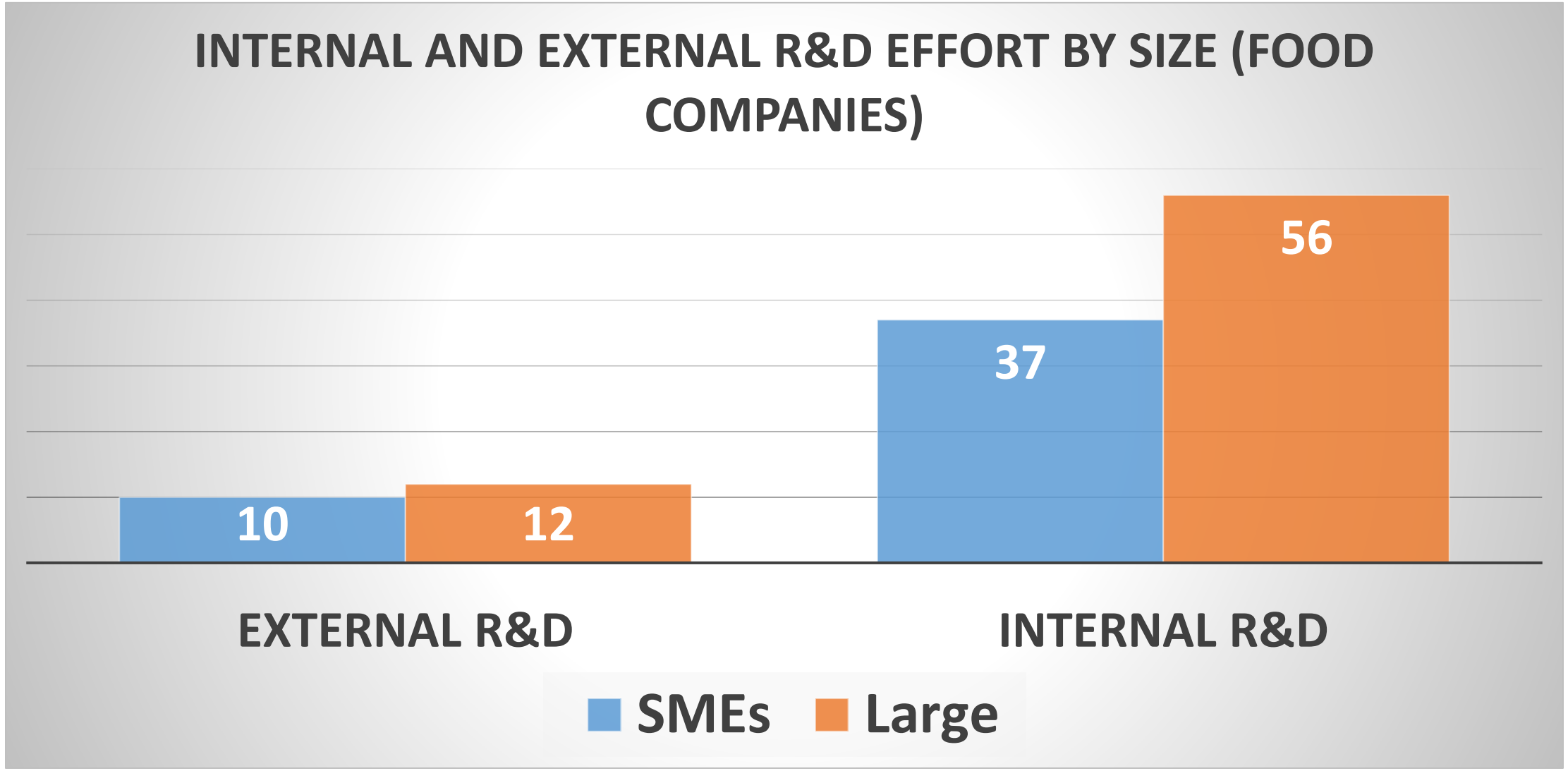


Figure 1. Kernel densities of *VAL* productivity ratios


INTERNAL AND EXTERNAL R&D EFFORT BY SIZE (FOOD COMPANIES)
10
12
37
56
EXTERNAL R&D
INTERNAL R&D
SMEs
Large

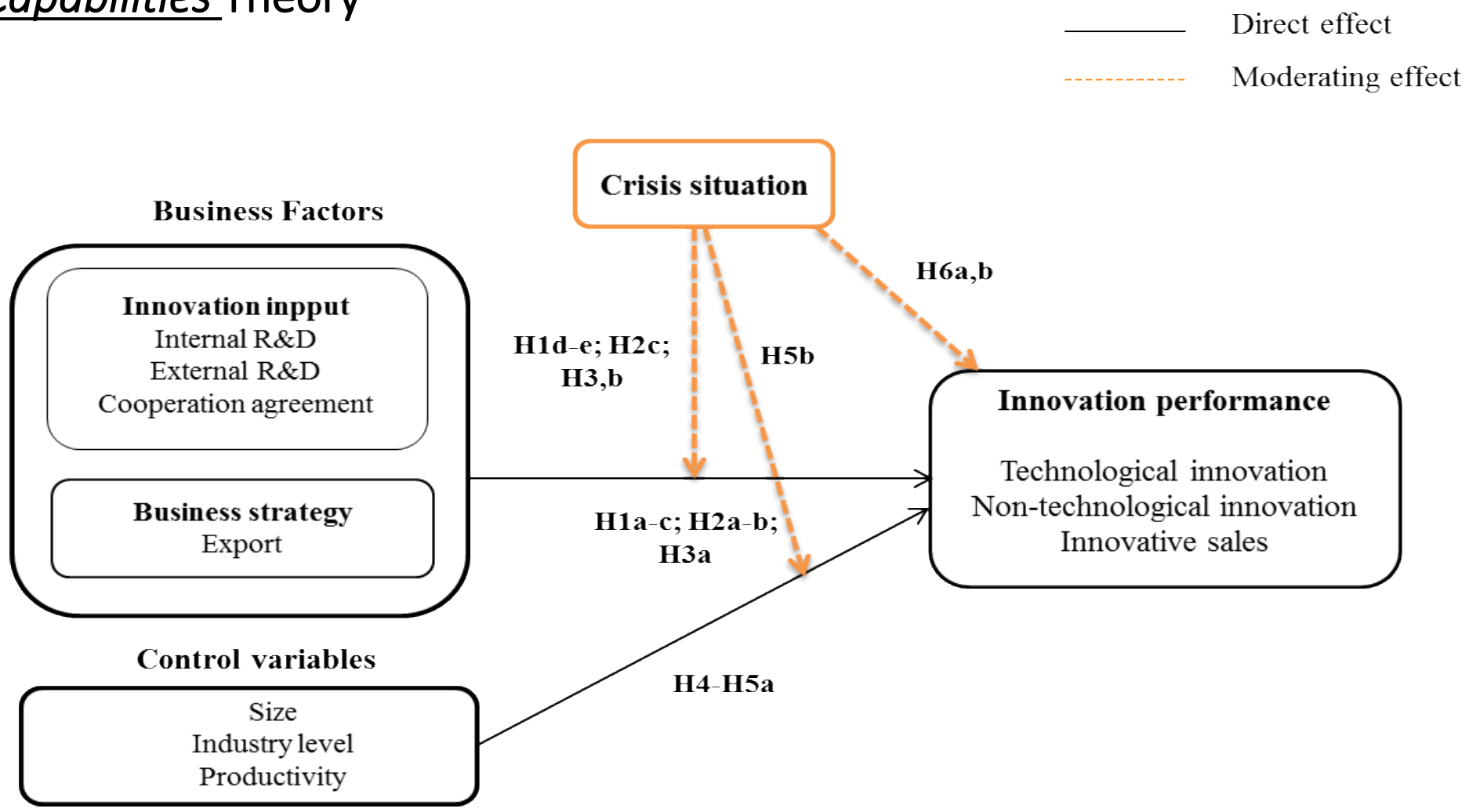
What have we learned?.
Drivers (Zouaghi and Sánchez, 2016). *Trends in Food Science and Technology*

Innovating in times of crisis is seen by many authors as an opportunity to growth, survive and succeed and as the attempt to maintain or develop competitiveness in today's global markets

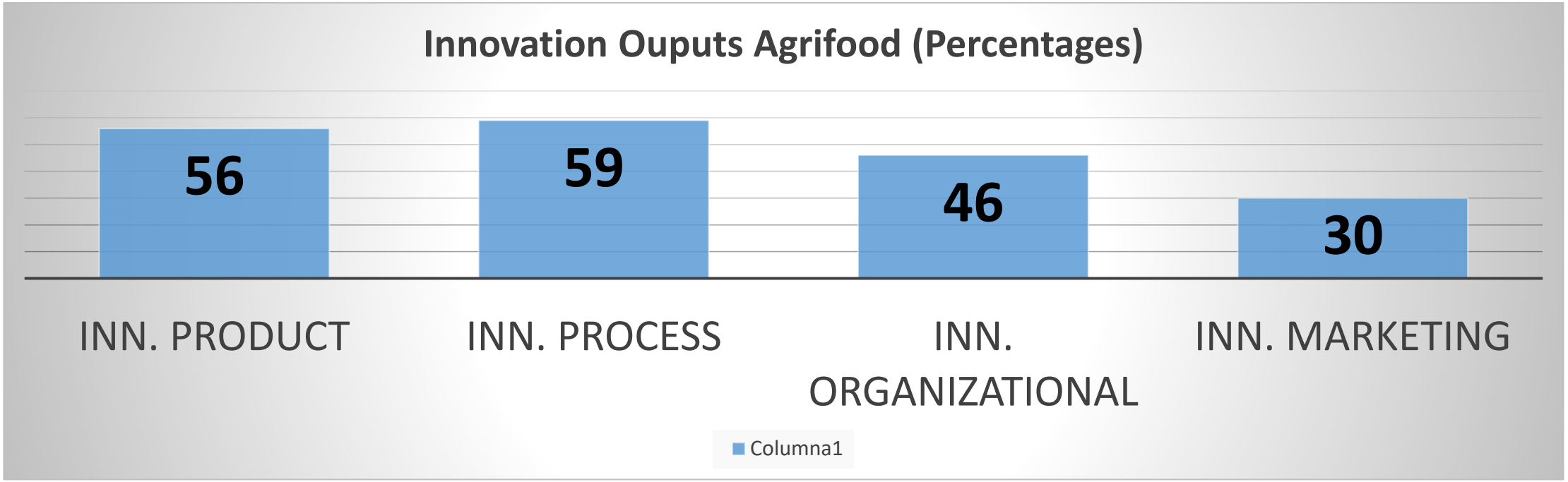
This study focuses on analyzing the overall effects of an economic crisis, both in terms of innovation inputs and innovation performance

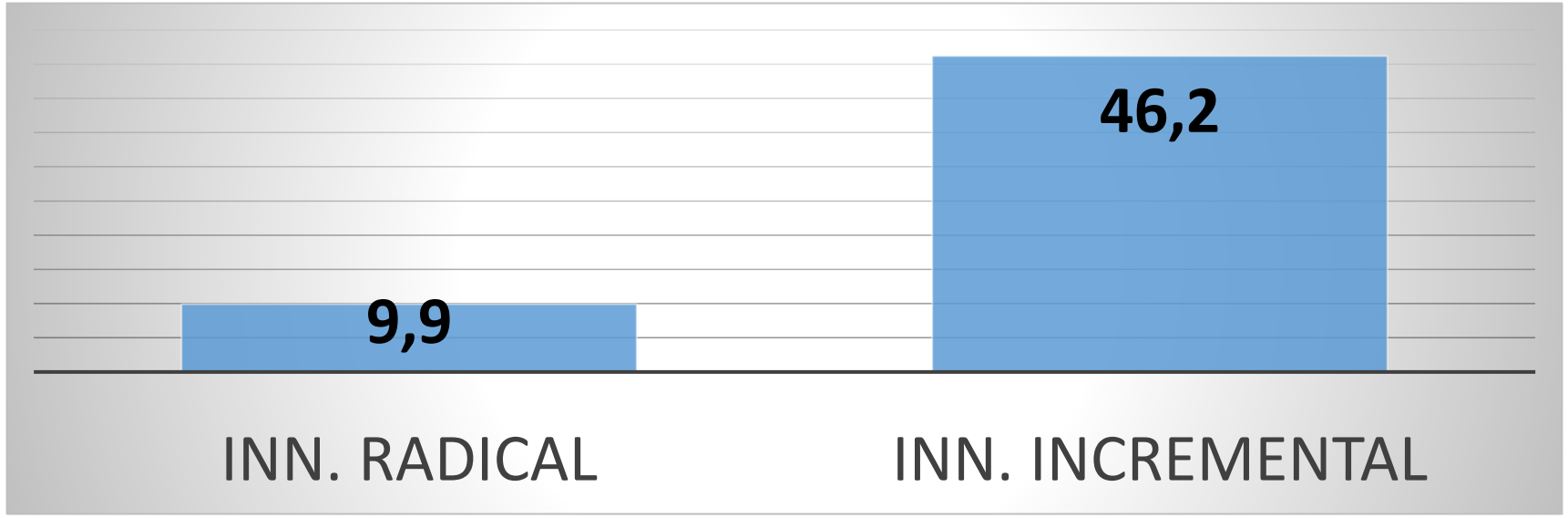
Food firms are mainly process-innovation oriented (Batterink et al., 2006) and both product and process innovation are to a large extent characterized by incremental rather than radical changes (Bayona et al., 2013; Fortuin & Omta, 2009; Hervas-Oliver et al., 2014).

Conceptual framework built on the basis of the *Resource-Based View (RBV)* and *Dynamic Capabilities* Theory



- The econometric models used are random effects logit model and random-effects Tobit models (CIS Database)


Innovation Ouputs Agrifood (Percentages)
56
59
46
30
INN. PRODUCT
INN. PROCESS
INN. ORGANIZATIONAL
INN. MARKETING
Columna1


9,9
46,2
INN. RADICAL
INN. INCREMENTAL

	Technological innovations				Non-technological innovations			
	Product innovation		Process innovation		Organizational innovation		Marketing innovation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Continuous_Internal R&D$_{t-1}$	2.598***	2.578***	1.290***	1.266***	1.241***	1.229***	1.377***	1.363***
	(0.057)	(0.057)	(0.052)	(0.052)	(0.053)	(0.053)	(0.059)	(0.059)
Occasional_Internal R&D$_{t-1}$	1.739***	1.733***	1.194***	1.174***	0.831***	0.810***	0.874***	0.856***
	(0.065)	(0.065)	(0.063)	(0.064)	(0.063)	(0.064)	(0.070)	(0.070)
External R&D_Nat$_{t-1}$	0.252***	0.250***	0.361***	0.352***	0.264***	0.259***	0.198***	0.198***
	(0.054)	(0.054)	(0.051)	(0.051)	(0.050)	(0.050)	(0.052)	(0.053)
External R&D_Inter$_{t-1}$	0.819***	0.829***	0.857***	0.864***	0.675***	0.674***	0.282	0.288
	(0.202)	(0.203)	(0.193)	(0.193)	(0.184)	(0.184)	(0.189)	(0.190)
COOP_Ind_NAT$_{t-1}$	0.541***	0.549***	0.568***	0.577***	0.438***	0.443***	0.262***	0.259***
	(0.062)	(0.062)	(0.059)	(0.059)	(0.058)	(0.058)	(0.062)	(0.062)
COOP_Instit_NAT$_{t-1}$	0.511***	0.495***	0.342***	0.328***	0.230***	0.223***	0.135**	0.138**
	(0.064)	(0.064)	(0.060)	(0.061)	(0.060)	(0.060)	(0.064)	(0.064)
COOP_Ind_INTER$_{t-1}$	0.426***	0.424***	0.288***	0.294***	0.297***	0.294***	0.186**	0.183**
	(0.092)	(0.093)	(0.086)	(0.087)	(0.082)	(0.082)	(0.083)	(0.083)
COOP_Instit_INTER$_{t-1}$	0.124	0.120	0.113	0.149	0.315**	0.317**	0.209*	0.199*
	(0.126)	(0.126)	(0.118)	(0.120)	(0.113)	(0.113)	(0.112)	(0.112)
SIZE$_{t-1}$	0.074***	0.067***	0.461***	0.458***	0.441***	0.445***	0.132***	0.132***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.021)	(0.021)
Export$_{t-1}$	0.463***	0.477***	-0.063	-0.047	0.057	0.067	0.273***	0.277***
	(0.049)	(0.050)	(0.046)	(0.046)	(0.048)	(0.048)	(0.052)	(0.052)
Productivity$_{t-1}$	0.139***	0.140***	0.156***	0.158***	0.065**	0.067**	0.077**	0.079**
	(0.026)	(0.026)	(0.025)	(0.025)	(0.026)	(0.026)	(0.030)	(0.030)
FOOD_SEC	-0.235*	-0.239*	0.664***	0.676***	0.019	0.013	1.010***	1.007***
	(0.123)	(0.124)	(0.116)	(0.117)	(0.124)	(0.124)	(0.137)	(0.137)
AGRI_SEC	-1.067***	-1.0715***	0.484*	0.508**	-0.821**	-0.829**	-0.733**	-0.769**
	(0.265)	(0.267)	(0.254)	(0.257)	(0.283)	(0.285)	(0.325)	(0.328)
D_2010-2012	-0.753***	-0.789***	-0.721***	-0.737***	-0.355***	-0.369***	-0.038	-0.061
	(0.032)	(0.036)	(0.030)	(0.033)	(0.030)	(0.033)	(0.032)	(0.037)
Interactions terms								

What have we learned?.
Drivers (Alarcón y Sánchez, 2016). *Food Policy*

This study examines the existence of an interrelationship between innovation decisions and exports for food and agricultural firms as such a relationship could be the source of competitive advantages.

We analysed 165 agricultural firms and 783 food companies operating in Spain (Europe) (2006-2011).

The results of the bivariate probit and matching models used indicate a bi- directional nature of these decisions in the case of food companies and a positive though not bidirectional one in the case of the agricultural firms.

Furthermore, a certain persistence is seen in the use of these decisions in both types of firms.

For food companies, capital intensity and size are also determinants of innovation and exports.

What have we learned?.
Drivers (García et al., 2017). *Technovation*

Research has demonstrated the value of external linkages to augment in-house R&D efforts.

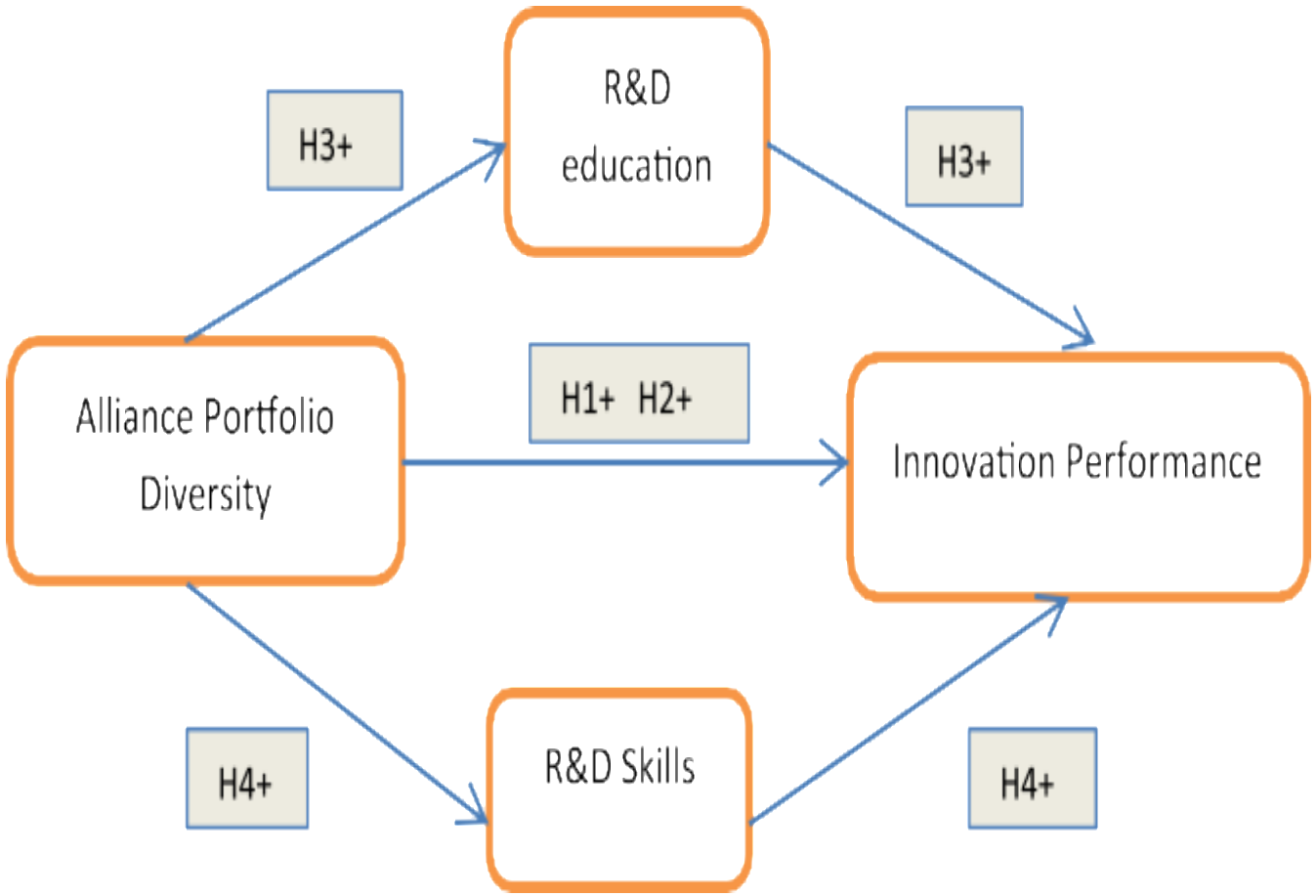
This paper examines the value of **Alliance Portfolio Diversity (APD)** and whether R&D human capital is the pathway through which alliance portfolio diversity influences **innovation novelty**.

We reason that the absorptive capacity of R&D human capital determines a firm's potential gains from highly diverse alliance portfolios. (Spanish Technological Innovation Panel 2005-2012)

What have we learned?.
Drivers (García et al., 2017). *Technovation*.

The results support the **curvilinear (inverted U-shaped)** association between **alliance portfolio diversity** and firm innovation performance reported in studies, suggesting that not only too little, but also **too much alliance portfolio** diversity **may be detrimental** to firm innovation performance.

Further, we find evidence that R&D human capital plays an important role in innovation novelty by partially mediating the relationship between alliance partner diversity and firm innovation performance


R&D
education
H3+
H3+
Alliance Portfolio
Diversity
H1+ H2+
Innovation Performance
H4+
R&D Skills
H4+

What have we learned?.
Drivers (García et al., 2017). *Technovation*

However, significant differences are found in the optimal level

of APD **depending on the industry's technological intensity (high vs low)** and the novelty of innovations (radical vs incremental).

Our findings indicate that high-tech industries, characterised by rapid technological changes, require a broader set of external partners to maximise radical innovation performance **than low- tech industries**.

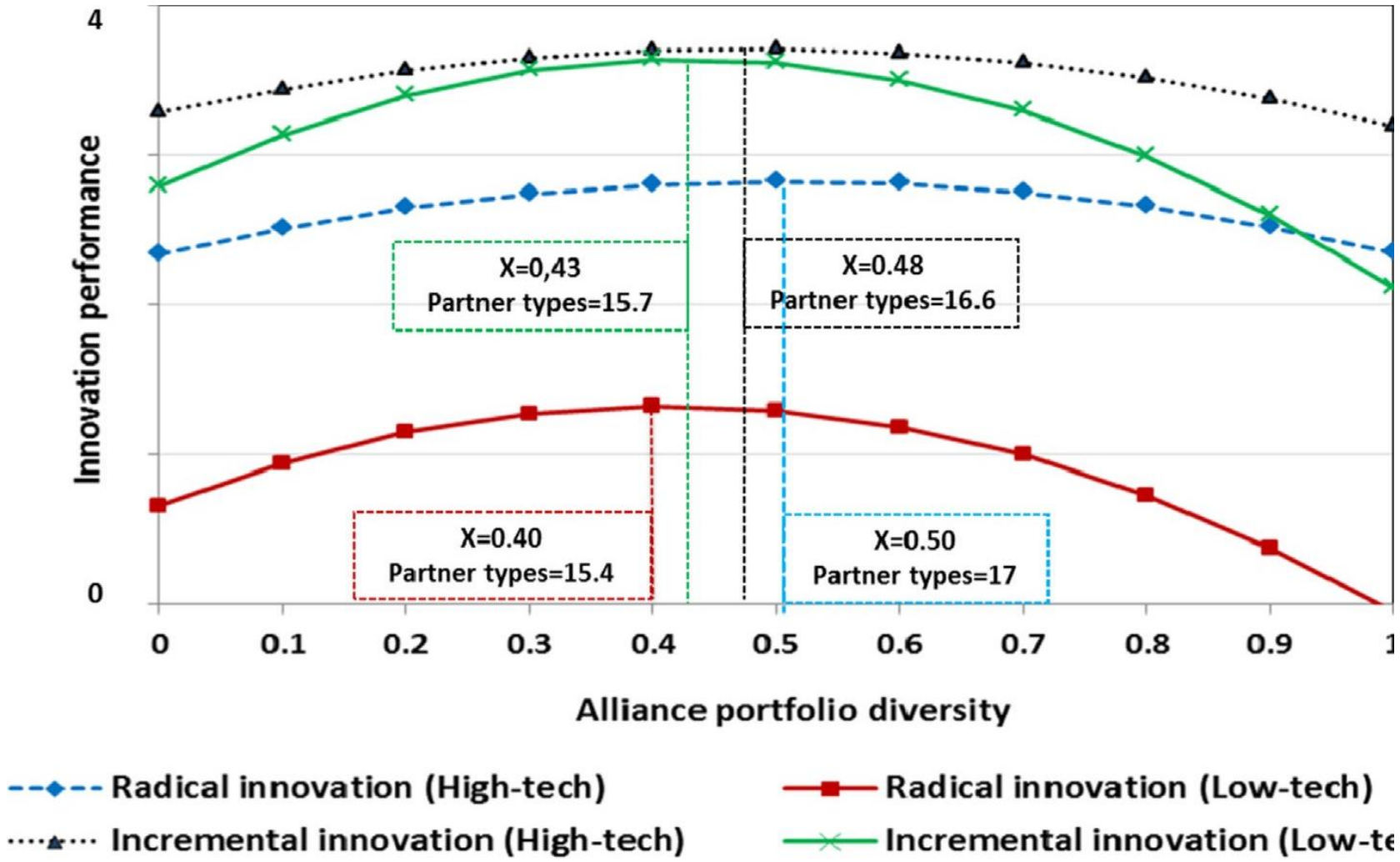


Fig. 2. Relationship between APD and firm innovation performance – Industry Differences.

What have we learned?.
Drivers (Bayona et al., 2017). *Management Decision*

The authors test and confirm the presence of the classical inverted U-shaped relationship between OI and firm innovative performance for **FnB** and non-FnB companies. However, the optimal number of external sources of knowledge used **is lesser for FnB** than the rest of the companies.

In this sense, our estimates highlighted the crucial role of **absorptive capacity** in order to increase innovation performance

- **Notes:** (a) Breadth and process innovation; (b) Depth and process innovations

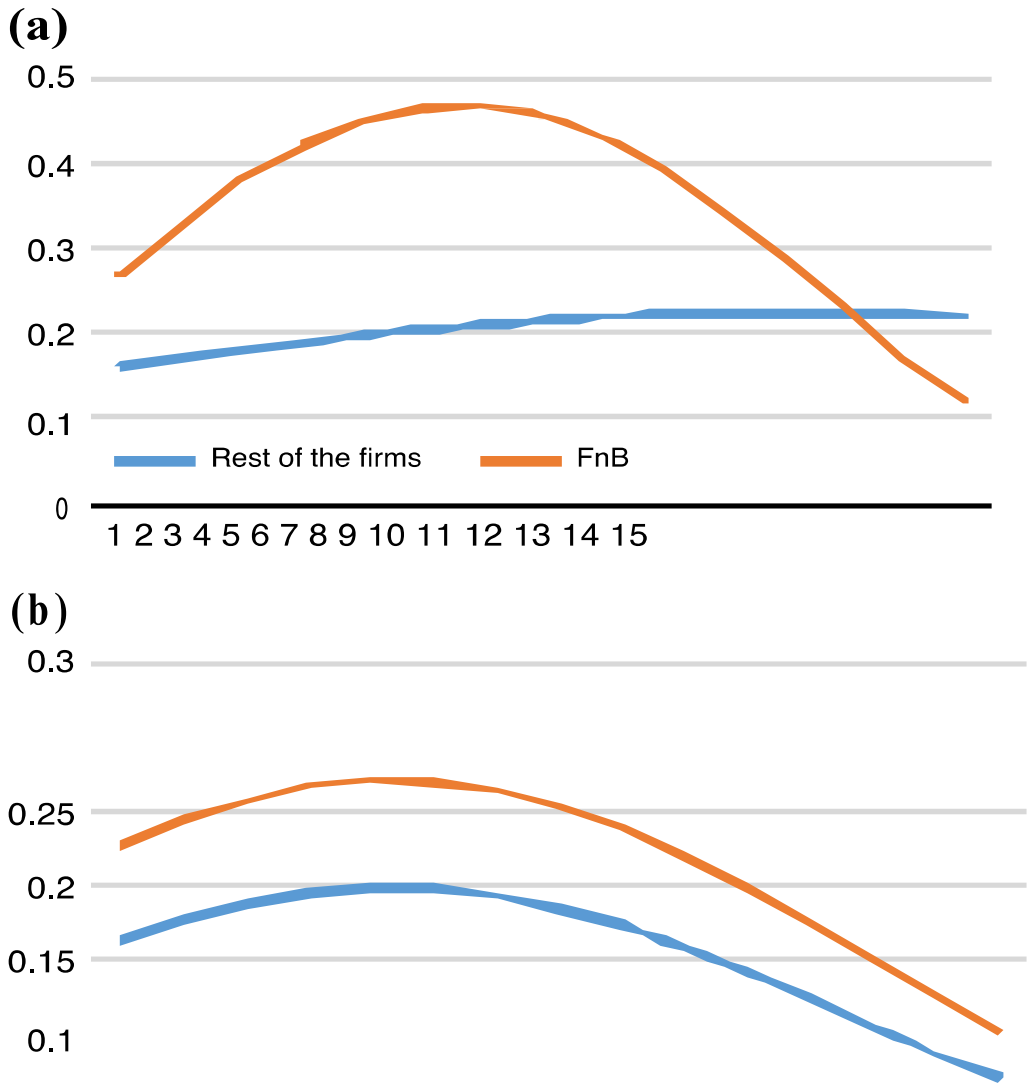
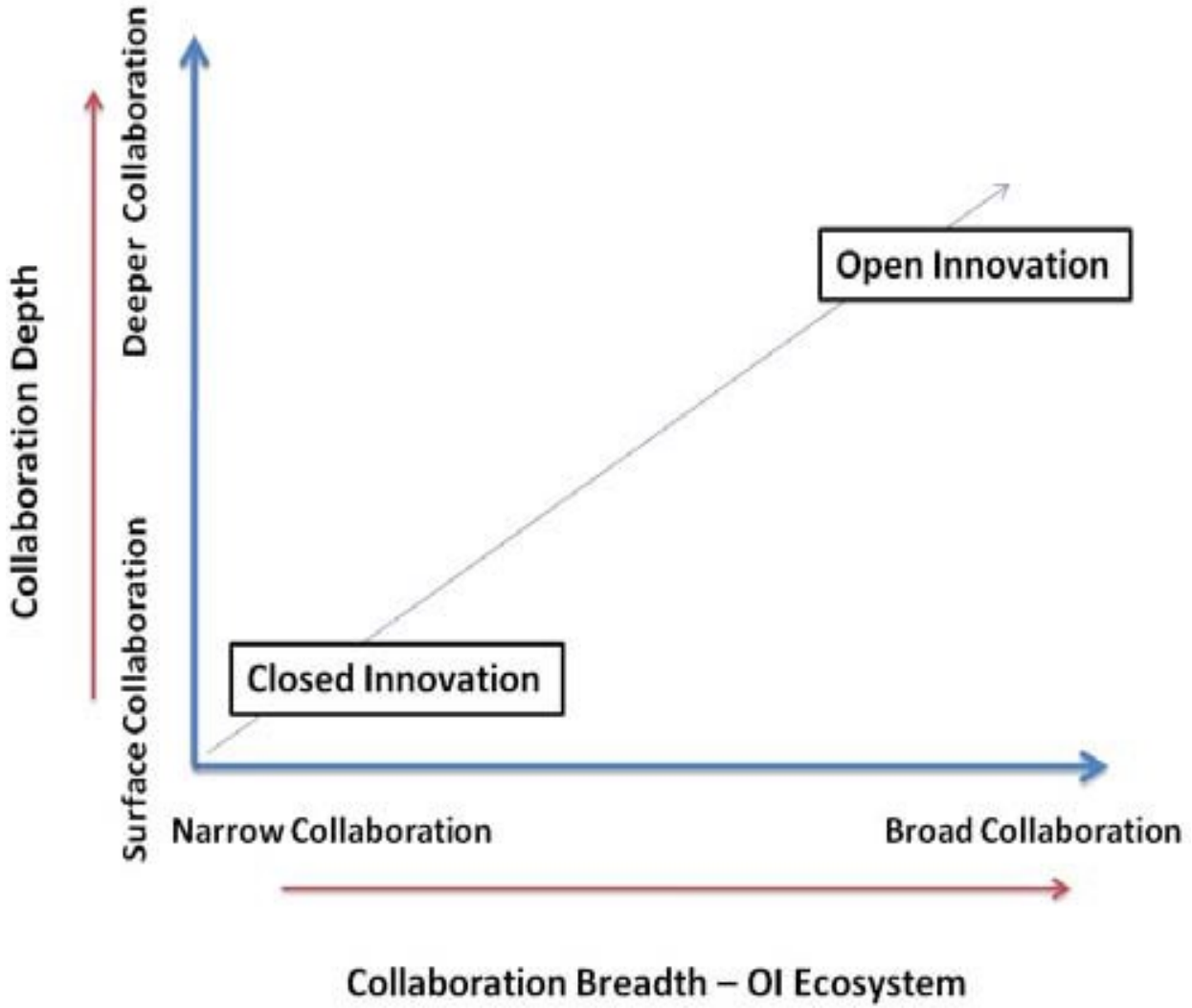


Figure 1 Openness of collaboration in innovation (see online version for colours)



What have we learned?.
Drivers (García et al.. 2014). *International Journal of Technology Management*

The study clusters food and drink companies in terms of **their degree of openness** measured across two dimensions, namely, collaboration **breadth** (broad to narrow collaboration ecosystem) and collaboration **depth** (deeper to surface collaboration).

Findings show that food and drink companies can be clustered into **three open innovation modes** in terms of their search strategy for external knowledge ranging from limited collaboration with traditional partners to a broad and deep openness approach with a wide spectrum of external sources..

What have we learned?.
Drivers (García et al., 2014). *International Journal of Technology Management*

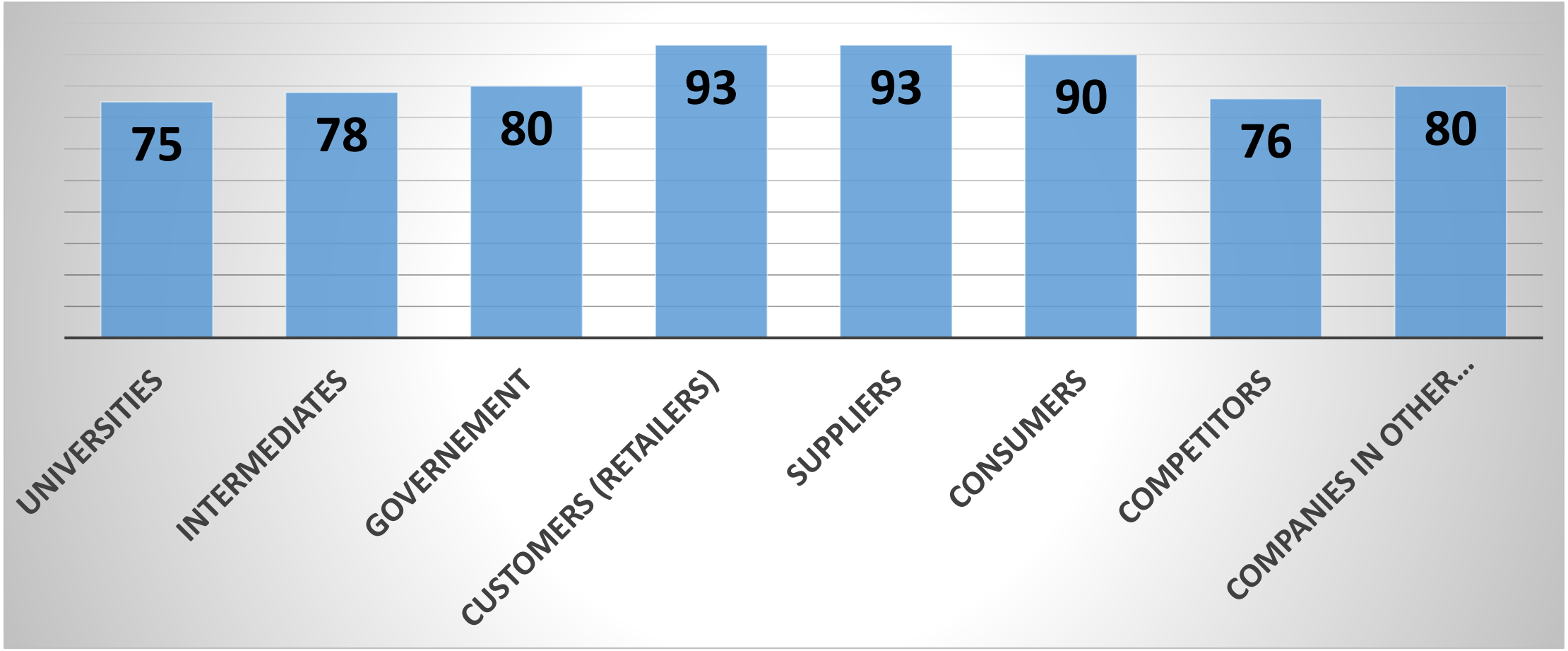
The data for the study was gathered through a large online survey sent to senior R&D and innovation managers of f&d companies in the UK, Spain and Italy.

F&D companies engaged in external collaboration in innovation' which amounts to 71% of the respondents (284 firms). Valid responses per country were 108 for the UK, 92 for Spain and 84 for Italy.

Technology pressures emerge as a key driver for greater openness.

However, it requires a dedicated architecture for collaboration to access and leverage external knowledge.

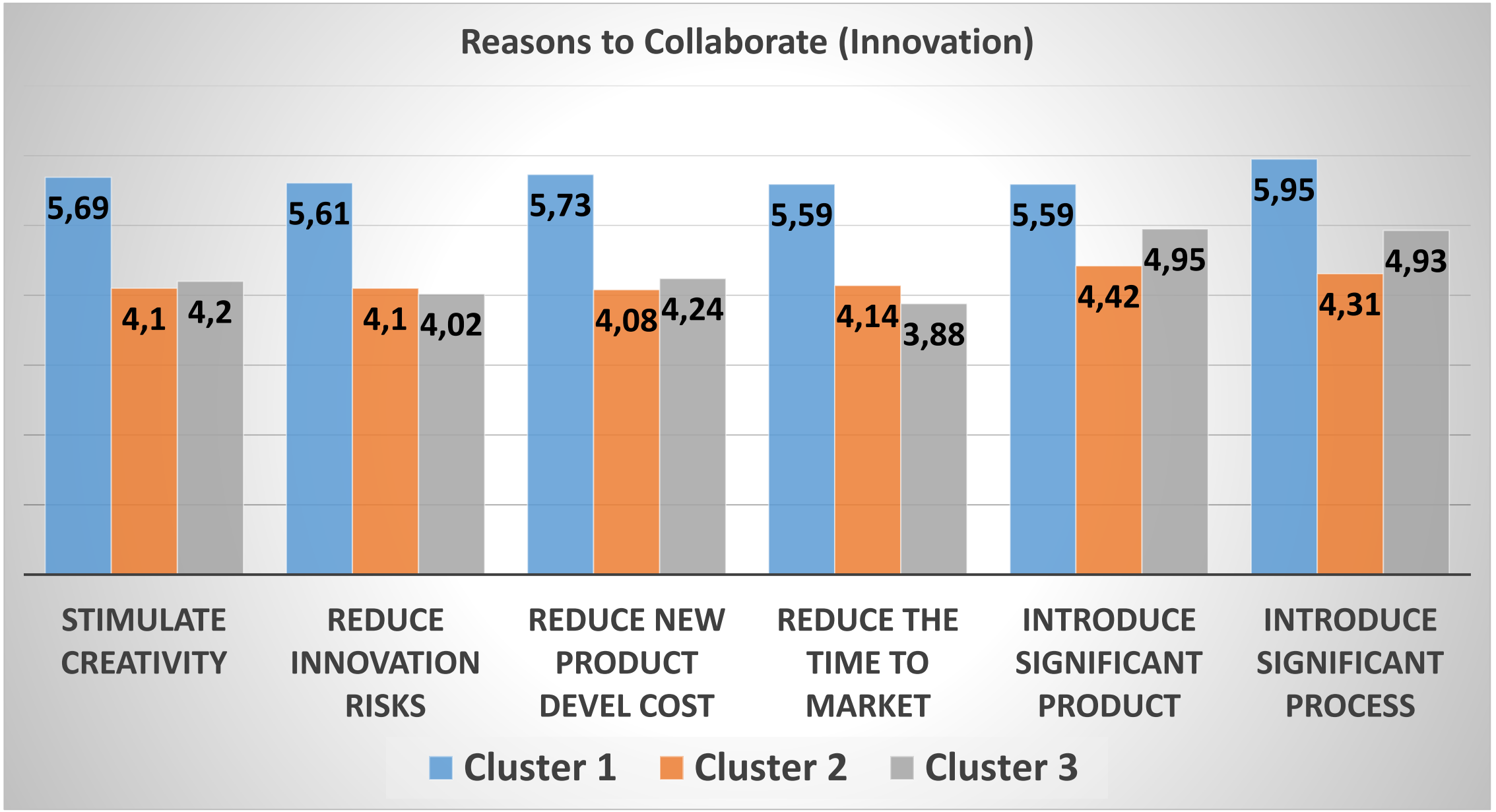
External sources of knowledge and technology in the f&d industry



Cluster 1. TRUE OPEN INNOVATION (45%)

Cluster 2. The SELECTIVE COLABORATOR (41%)

Cluster 3. The INCIPIENT COLABORATOR (14%)


Reasons to Collaborate (Innovation)
5,69
4,1
4,2
5,61
4,1
4,02
5,73
4,08
4,24
5,59
4,14
3,88
5,59
4,42
4,95
5,95
4,31
4,93
STIMULATE CREATIVITY
REDUCE INNOVATION RISKS
REDUCE NEW PRODUCT DEVEL COST
REDUCE THE TIME TO MARKET
INTRODUCE SIGNIFICANT PRODUCT
INTRODUCE SIGNIFICANT PROCESS
Cluster 1
Cluster 2
Cluster 3

The future (some additional considerations)

ECO-INNOVATIONS

For company who want

Change , innovate

Become more sustainable

More productivity

More profitability

Eco-innovation

Eco-innovation?

Concepts

Concept

Eco-innovation consists as an innovation which benefits the environment and contributes to environmental sustainability (Rennings,2000)

1

Concept

New or significantly improved product achieved in sustainable production taking into the account product lifecycle, that reduces the use of natural resources (including materials, energy, water, biomass and land) and decreases the release of harmful substances across the whole lifecycle.
(Eco-innovation observatory,2010)

2

Drivers of Environmental Innovation

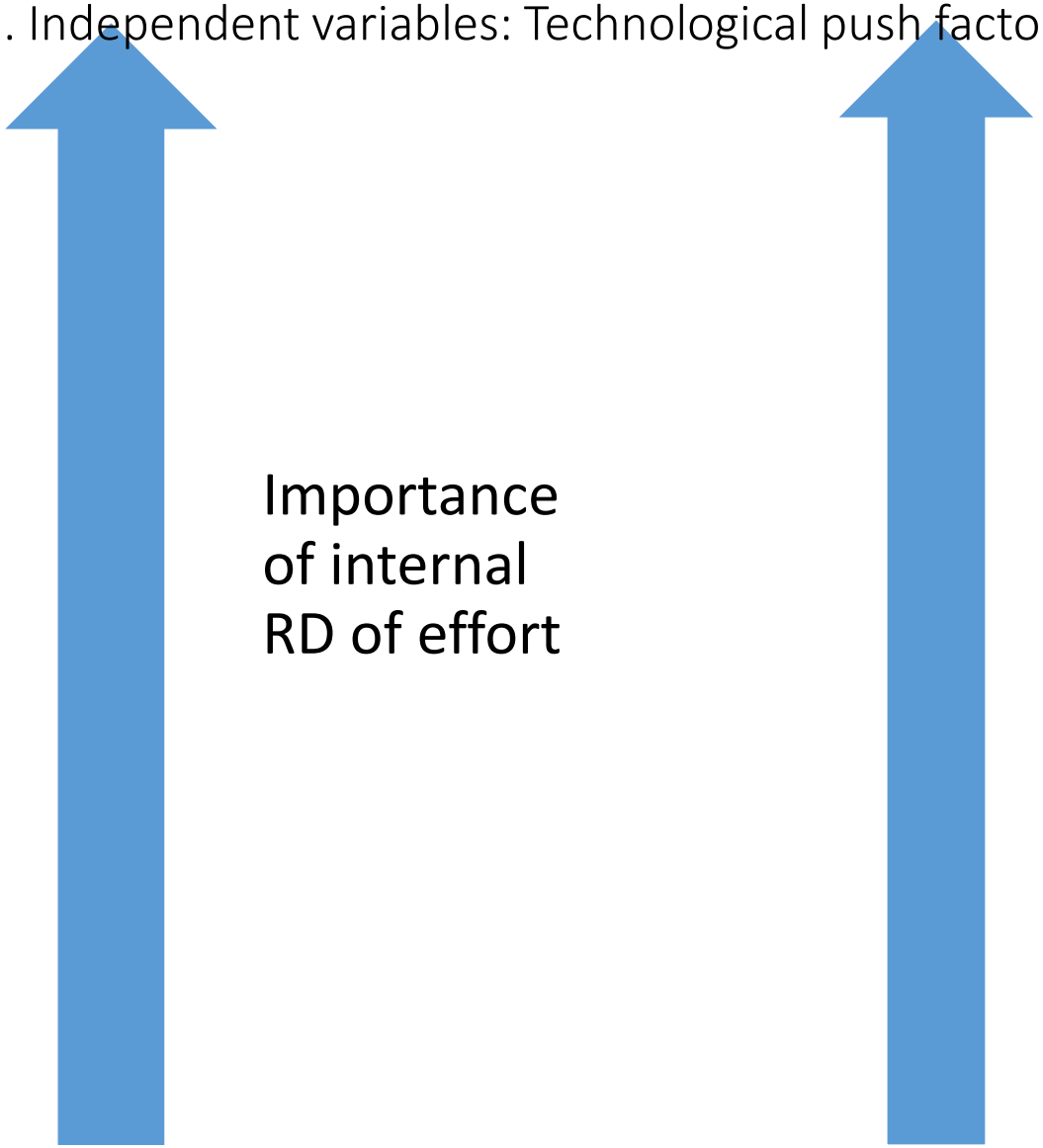
Factors

- **Supply side** — R&D activities , cost savings, corporate image and brand, firm size, relationships & networkings…
- **Demand side** — Customer demand , customer awareness, market share increase, competition
- **Regulation and policies** — Implementation of environmental policy, existence and anticipation of environmental regulation

Horbach, Rennings and Oltra (2007,2008)

The future (some additional considerations) ECO-INNOVATIONS. Khouloud and Sánchez, 2021

2. Independent variables: Technological push factors



Importance of internal RD of effort

Importance of internal information sources

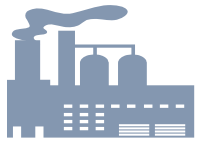
- Increasing awareness of the **cooperation** importance to implement eco-innovation

Technological push factors

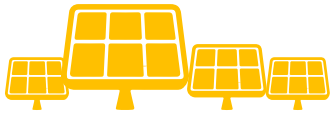
	All sectors	Agrifood sector	Dirty sector	Clean sector
External R&D	0,1139	0,0753	0,0220	O,0011
Internal R&D	0,4438	O,2998	O,4318	0,0569
R&D cooperation	0,0321	0,0535	0,1323	0,1877
Internal source of information	1,091	1,0855	1,166	0,271

Crucial role of the technology push factors

Crucial role of the technology push factors except the external R&D services



Crucial role of the technology push factors

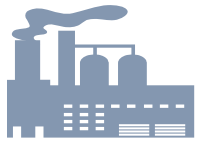
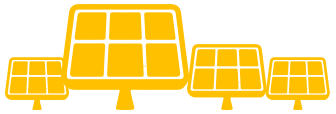


All of the variables indicating the technological push are significant

Market pull factors

	All sectors	Agrifood sector	Dirty sector	Clean sector
Increase market share	0,9376	1,0502	1,1532	0,6542
Penetration new markets	0,9565	0,9197	0,9108	0,497



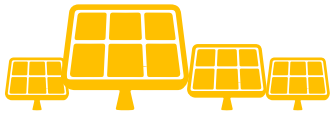



Eco-innovation introduction is highly driven by the market pull factors which prove the importance of commercial orientation of Spanish companies

Regulation influences

	All sectors	Agrifood sector	Dirty sector	Clean sector
Public subsidies	**0,1351**	0,21565	**0,1130**	**0,055**
Regulation	**0,6993**	**O,6774**	**O,6842**	**-0,1616**



- **Importance pertaining to the regulation dimension to employ eco-innovation by dirty and agri-food sector**
- **Almost the unique subsidies that have a significant effect on the introdcution of eco-innovation is National/Public subsidies**

- **Negative coefficient is shown for the clean industry → this category of firms do not need to fulfill regulation factor as its business activities have less damage on environment**

The future (some additional considerations)
DIGITALIZATION. Verhoef et al., (2021). *Journal of Business Research*

Digital Transformation altered consumer expectations and disrupting numerous markets

Three stages of digital transformation: digitization, digitalization, and digital transformation

Specific organizational structure and new metris to calibrate performance

New online retailers employ digital resources to increase the potential market (disruptive)

The future (some additional considerations)
DIGITAL TRANSFORMATION.
Cannas, et al., (2021), *Journal of Small Business Management*

The study of Digital Transformation through Dynamics Capabilities (firms capabilities) (Resource-based view (RBV))

DT is defined "as the use of new digital technologies (social media, mobile, analytics or embedded devices) to enable major business improvements (such as enhancing customer experience, streamlining operations or creating new business models)" (Fitzgerald et al., 2014,

DT has become a strategic imperative for leadership agendas (Fitzgerald et al., 2014; Hess et al., 2016; Singh & Hess, 2017)

179th EAAE SEMINAR

September 9th, 2021. Chania, Crete, Greece

Twitter as indicator of new trends in the digital transformation process of the agri-food sector

María Ancín, Emilio Pindado & Mercedes Sanchez

Public University of Navarre – Spain

upna

Universidad Pública de Navarra
Nafarroako Unibertsitate Publikoa

DATA COLLECTION: Twitter search (API)

“digitalization”
“digital transformation”
“big data”
“blockchain”
“artificial intelligence”
“AI”
“internet of things”
“IoT”
“machine learning”
“smart technologies”
“cloud computing”
“smart agriculture”
“agriculture 4.0”
“smart farming”
“digital agriculture”

+

“agri-food”
“agrifood”
“agriculture”

Tweets and metadata

DESCRIPTIVE ANALYSIS

Tweet metrics	User metrics
Tweet statics	User statics
Tweets over time	User activity
Hashtags	User visibility

CONTENT ANALYSIS

Word analysis	Hashtag analysis	Sentiment analysis
Term frequency	Frequency	Sentiment scores
Word combinations	Clustered document-level analysis	Emotion analysis
Clustered document-level analysis		

CONTENT ANALYSIS

Word analysis

in clustered documents **by country**

USA

Word	Freq	%
agriculture	2983	57,9
ai	1135	22,0
smart	1023	19,9
digital	891	17,3
market	628	12,2
climate	423	8,2
data	413	8,0
food	432	8,4
intelligence	431	8,4
artificial	413	8,0

Words (2)	Freq	%
smart agriculture	414	8,0
artificial intelligence	410	8,0
agriculture market	374	7,3
climate smart	295	5,7
intelligence ai	259	5,0
machine learning	200	3,9
digital agriculture	191	3,7
precision agriculture	119	2,3
big data	94	1,8
supply chain	94	1,8

India

Word	Freq	%
agriculture	1719	66,9
smart	596	23,2
digital	522	20,3
ai	489	19,0
farmers	324	12,6
india	286	11,1
technology	240	9,3
iot	211	8,2
farming	209	8,1
data	162	6,3

Words (2)	Freq	%
smart agriculture	164	6,4
digital agriculture	93	3,6
climate smart	84	3,3
agriculture sector	80	3,1
artificial intelligence	77	3,0
supply chain	70	2,7
next generation	65	2,5
smart farming	63	2,5
urban infrastructure	64	2,5
precision agriculture	58	2,3

UK

Word	Freq	%
agriculture	1253	63,9
digital	375	19,1
artificial	315	16,1
smart	338	17,2
intelligence	314	16,0
ai	202	10,3
iot	188	9,6
data	142	7,2
farming	179	9,1
management	158	8,1

Words (2)	Freq	%
artificial intelligence	310	15,81
smart agriculture	135	6,88
agriculture market	96	4,90
management cities	111	5,66
big data	60	3,06
climate smart	86	4,39
digital agriculture	73	3,72
smart management	64	3,26
data analytics	28	1,43
agriculture buildings	42	2,14

Nigeria

Word	Freq	%
agriculture	865	85,4
digital	485	47,9
smart	423	41,8
farmers	140	13,8
nigeria	103	10,2
village	112	11,1
navsa	100	9,9
climate	82	8,1
food	84	8,3
technology	81	8,0

Words (2)	Freq	%
smart agriculture	320	31,6
digital agriculture	230	22,7
adopted village	109	10,8
climate smart	70	6,9
agriculture navsa	61	6,0
gombe state	52	5,1
digital economy	53	5,2
agriculture book	39	3,8
empowerment programme	33	3,3
honourable minister	33	3,3

CONTENT ANALYSIS **Word analysis**

in clustered documents **by technology**

Big data

Words (2)	Freq	%
big data	357	55,69
data analytics	51	7,96
agriculture market	40	6,24
artificial intelligence	40	6,24
the future	33	5,15
future of	24	3,74
precision agriculture	23	3,59
agriculture industry	20	3,12
platform for	20	3,12
smart farming	18	2,81

Blockchain

Words (2)	Freq	%
supply chain	182	13,78
food supply	119	9,01
blockchain technology	89	6,74
global food	77	5,83
chain market	74	5,60
food security	73	5,53
digital agriculture	73	5,53
to track	68	5,15
blockchain chicken	67	5,07
agriculture giants	62	4,69

Artificial intelligence (AI)

Words (2)	Freq	%
artificial intelligence	916	22,21
agriculture market	324	7,85
can help	137	3,32
to improve	127	3,08
the future	123	2,98
machine learning	123	2,98
agriculture daily	116	2,81
future of	109	2,64
intelligence daily	108	2,62
the potential	106	2,57

Internet of things (IoT)

Words (2)	Freq	%
smart agriculture	88	7,35
precision agriculture	88	7,35
agriculture iot	63	5,26
smart farming	61	5,09
agriculture industry	50	4,17
real time	49	4,09
in 2021	45	3,76
iot technology	46	3,84
to improve	45	3,76
agriculture market	44	3,67

Machine learning

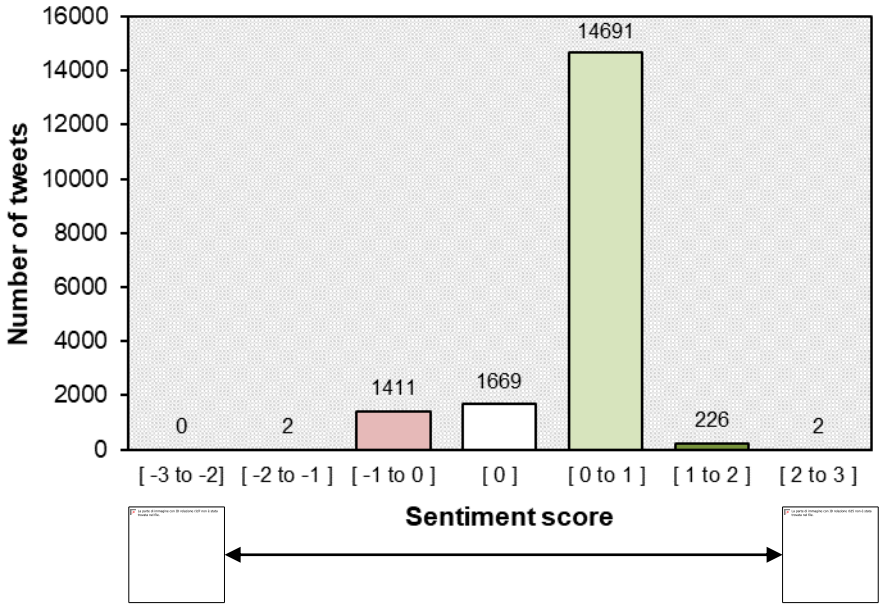
Words (2)	Freq	%
machine learning	343	42,71
artificial intelligence	129	16,06
help to	55	6,85
agriculture stimulates	53	6,60
fresh produce	53	6,60
growth infrastructure	53	6,60
internet machine	53	6,60
need help	53	6,60
stimulates growth	53	6,60
to improve	52	6,48

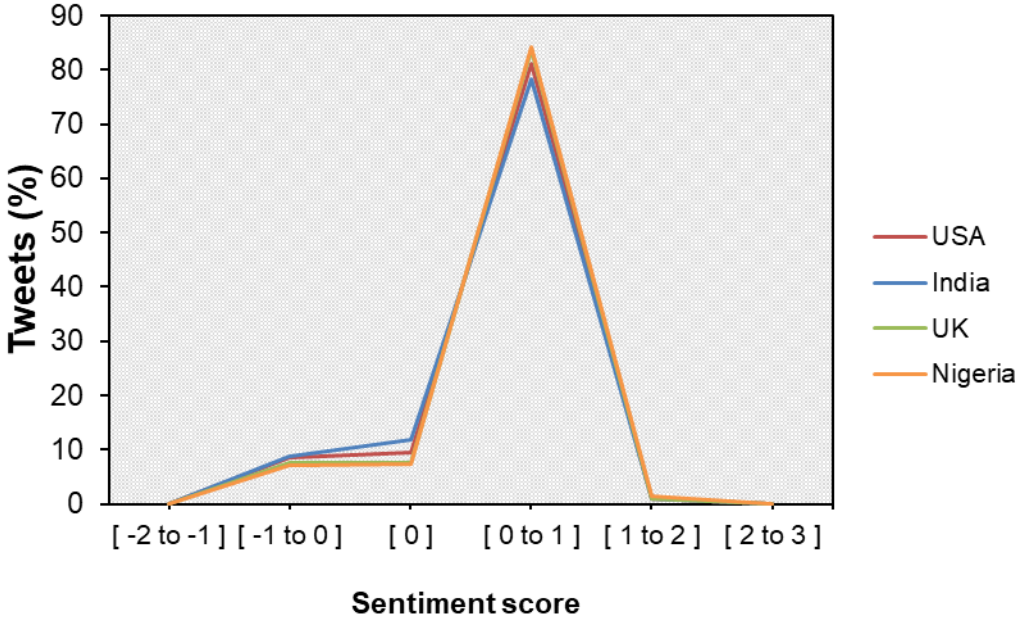
Cloud computing

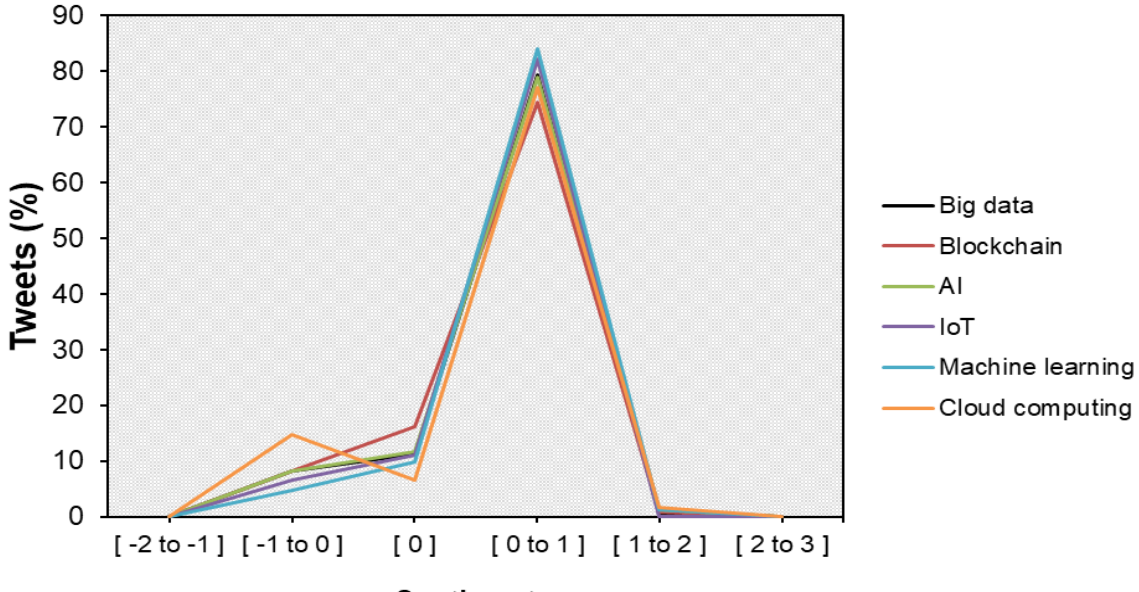
Words (2)	Freq	%
cloud computing	25	40,98
grand farm	7	11,48
trilogy networks	7	11,48
computing initiative	4	6,56
precision agriculture	4	6,56
rural cloud	4	6,56
smart farming	4	6,56
artificial intelligence	3	4,92
based computing	3	4,92
cloud based	3	4,92

CONTENT ANALYSIS

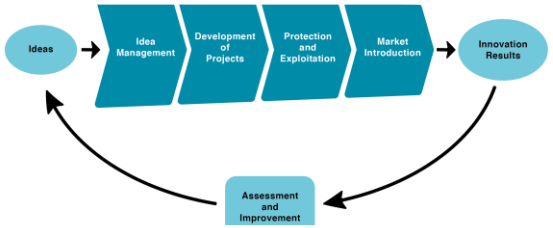
Sentiment analysis







At the end…some final conclusions…..



Process Innovation.
<u>Strategic</u> (not easy)

<u>Company</u> (size, sector) and <u>context</u> (crisis, eco, digital…)

<u>Agri and Food</u>

<u>Internal</u> (absorptive capacity) and <u>External</u> options

Human Resources

Types of innovation (technological, <u>incremental-radical)</u>

Databases, Countries (EU), Time, Econometrical models

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Thank you very much for your kind invitation

Grazie mille per avermi invitato al vostro Congresso

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