

ABSORPTIVE CAPACITY AND INNOVATION GENERATION OF PORTUGUESE FIRMS

REVISITING ZAHRA AND GEORGE'S MODEL

SEMINÁRIO DO GEE, MINISTÉRIO DA ECONOMIA
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Roadmap

The diagram features a horizontal bar at the top with a red segment on the left and a blue segment on the right. Below this, four white rounded rectangular boxes with red borders are stacked vertically, each containing a numbered step. Each box is positioned on a dark grey horizontal bar that is wider than the box itself, creating a sense of depth and progression.

1. Motivation and problem's design

2. Literature review and research hypotheses

3. Methodology

4. Results and discussion

Motivation
and
problem's design

Literature review
and
research hypotheses

Methodology

Results
and
discussion



The study of firms' absorptive capacity, revealed through a set of firm-level enablers that ease the process of assimilating external knowledge and their strategic cooperation relationships, has been neglected in a comparative framework contrasting manufacturing and service firms



it is important to understand how firms access new knowledge by establishing and successfully exploiting collaborations with other firms and institutions



As the firm is an open system, it is important to analyse internal firm-level factors that spur absorptive capacity, as well as the channels and liaison flows, in order to design a more efficient open innovation business model and to generate even more innovation

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Problem

AC

- Analysis of firm-level internal indicators that measure the firm's absorptive capacity (AC)

LF

- The role played by the firm's liaison factors (LF) and innovation strategies, considering external stakeholders

IG

- The outcome variable is used as proxy to assess the innovation generation (IG) (Tether, 2002; Quintana-Garcia & Benavides Velasco, 2004; and Rusko, 2011)

Portuguese
Firms

- Using a dataset of Portuguese (562) manufacturing firms and (571) service firms that participated in the European Community Innovation Survey (CIS), 2010

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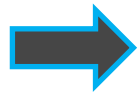
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discussion

Research objectives



**Generic
objective**

To identify a set of internal factors and liaison factors of the firm that affect firm-level absorptive capacity, in order to predict their impact on the firm's innovation generation



**Specific
objectives**

To analyze the relationships between:

(i) The potential absorptive capacity and the product innovation, by considering the influence of both firm's internal and liaison factors

(ii) The effective absorptive capacity and the product innovation

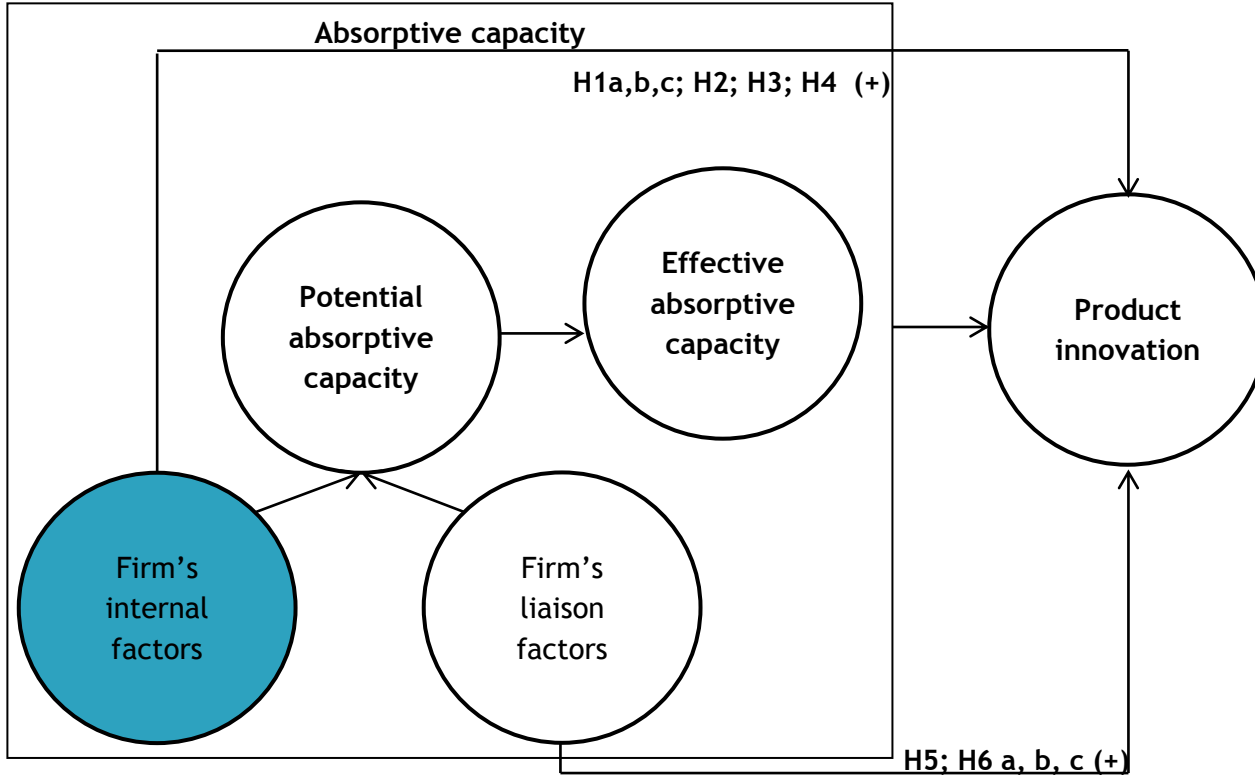
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*Conceptual model:
Firms' absorptive capacity and
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In order to successfully exploit business opportunities, firms must refine and extend existing technologies, by exploring, that is, learning or acquiring new external knowledge (Nelson & Winter, 1982; March, 1991; Nerkar & Roberts, 2004; Miller et al. 2007; and Heras, 2014)

H₁

The firm's acquisition of external sources of knowledge has a positive and significant effect on generating innovations

> H_{1a}

> H_{1b}

> H_{1c}

The ability to learn and absorb depends on the capacity for evaluating external knowledge (Van den Bosch et al., 1999; Zahra & George, 2002)

The greater the firm's absorptive capacity the greater its ability to fully capture the benefits resulting from flexibility in technology sourcing (Rothaermel & Alexandre, 2009)

The firm's external acquisition of R&D has a positive and significant effect on generating innovations

The firm's acquisition of other external knowledge has a positive and significant effect on generating innovations

The firm's acquisition of equipment, software and licenses has a positive and significant effect on generating innovations

Firms' absorptive capacity and innovation

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Having qualified human resources enhances the firm's capacity to absorb external sources of knowledge (Rothwell & Dodgson, 1991; Mangematin & Nesta, 1999; Vinding, 2004).

Formal education, work experience, organizational set-up and closer relationships with external and internal actors are important drivers of the firm's absorptive capacity (Vinding, 2000, 2004).

The same author argues that highly educated and technically qualified staff tend to be faster and more willing to assimilate and transform available external knowledge (Vinding, 2000).



H₂

The firm's employees having higher education has a positive and significant effect on generating innovations

Firms' absorptive capacity and innovation

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For developing absorptive capacity, employees' training in areas related to creativity and innovation may reveal an important effect on firms' absorptive capacity and on innovativeness (Malerba, 1992; Delaney & Huselid, 1996; Koch & McGrath, 1996)

The ability to learn and absorb depends on the capacity to value external knowledge (Zahra & George, 2002)

Learning is also positioned as a means of exploring new external knowledge. Thus, for the firm to be able to exploit successfully external sources of knowledge, employees must acquire skills and capacities for absorbing new knowledge (Nelson & Winter, 1982; March, 1991; Nerkar & Roberts, 2004; Miller et al., 2007; Heras, 2014)



H₃

Employees' training in areas related to innovation activities has a positive and significant effect on generating innovations

Firms' absorptive capacity and
innovation

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Gambardella (1992) states that firms with better in-house R&D programmes are more able and prepared to absorb external scientific information

Several scholars analyzed the impact of detecting process innovations and introducing them, on the firm's behavior in generating innovations, referring to architectural innovation and embracing R&D positioning (Zahra & George, 2002; Todorova & Durisin, 2007; Rothaermel & Alexandre, 2009; Kostopoulos et al., 2011)

The positive and significant impact of firms' investment in R&D activities performed inside the firm was also ratified by Stock et al. (2001), Cassiman & Veugelers (2006) and Li (2011)



H₄

The firm's internal R&D activities have a positive and significant effect on generating innovations

Firms' absorptive capacity and
innovation

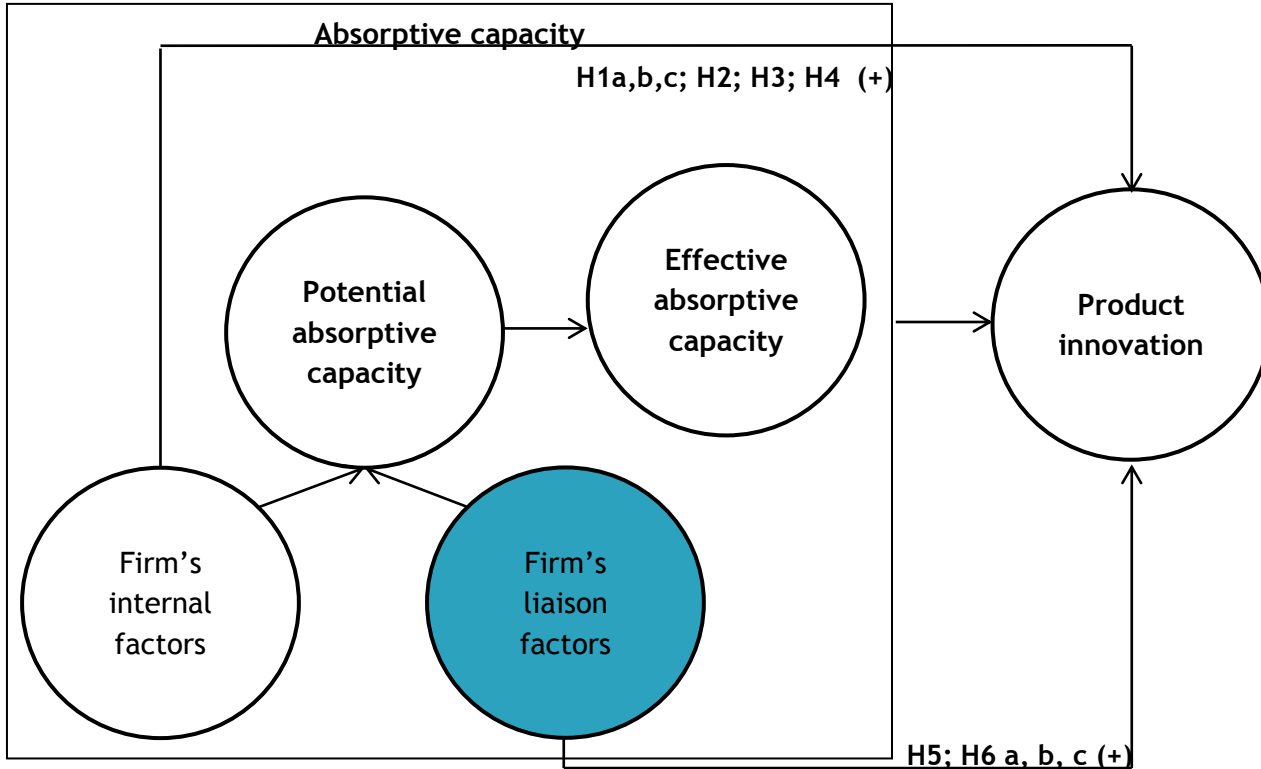
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Several authors point out that the main benefit derived from collaboration between competitors is the creation of completely new products (Tether, 2002; Quintana-Garcia & Benavides-Velasco, 2004)

Vega-Jurado et al. (2008) defend that it is easier for firms to absorb external knowledge from industry partners than from R&D stakeholders, as most firms have no structure or human resources highly skilled at assimilating and exploiting scientific knowledge of a less applicable nature

Zahra & George (2002)'s model addresses activation triggers, social integration mechanisms, and appropriability regimes acting as contingent/moderating factors of antecedents, components and outcomes of absorptive capacity. The present analysis is especially interested in the effect of social integration mechanisms, for reducing the gap between potential absorptive capacity and effective absorptive capacity.



H₅

The firm's cooperation liaisons with other firms have a positive and significant effect on generating innovations

Firms' cooperation liaisons and
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Brandenburger & Nalebuff (1996), Dussauge et al. (2000), Tether (2002) and Enkel et al. (2009) deal with the association between firms' innovative capacity and the cooperation and cooperation arrangements they enter to generate value added and to increase productivity

H₀

The firm's cooperation liaisons with other R&D stakeholders have a positive and significant effect on generating innovations

> H_{0a}

The firm's cooperation liaisons with consultants have a positive and significant effect on generating innovations

> H_{0b}

The firm's cooperation liaisons with universities have a positive and significant effect on generating innovations

> H_{0c}

The firm's cooperation liaisons with laboratories have a positive and significant effect on generating innovations

The network links between firms and the scientific community are important for generating firms' innovative performance (Jaffe, 1989; Cockburn & Henderson, 1998; Cohen et al., 2002; Kostopoulos et al., 2011; Li, 2011; Vasudeva & Anand, 2011), especially, studying the impact of cooperation links between universities, research centres and firms

Firms' cooperation liaisons and
innovation strategies

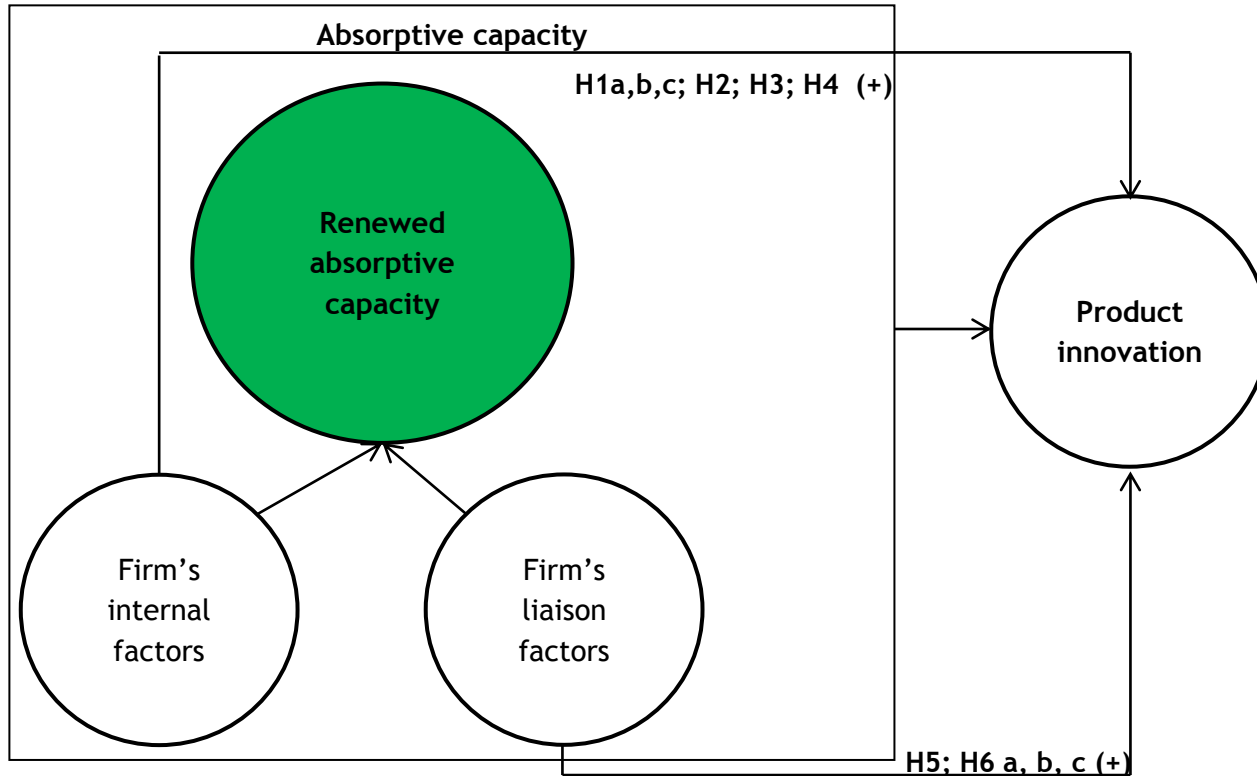
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Type of approach

Secondary data

Population

Sampling procedure

Sample's dimension

Fieldwork

Data analysis and estimation

Software

Quantitative approach

CIS 2010

Firms located in Portugal

Non probabilistic convenience sample

562 manufacturing firms and 571 service firms

From september 2014 until december 2014

Descriptive statistics and logistic regression

STATA 13.0



Technical details of the research

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Prod_innov	Coefficient	Std. Err.	z	P>z
Nace	-0.009	0.006	0.991	0.118
Size	0.152	0.109	1.164	0.164
External_acquisition_r&d	0.411**	0.185	1.509	0.026
Acquisition other external knowledge	0.528***	0.182	1.695	0.004
Acquisition equipment, software, licenses	0.013	0.245	1.013	0.959
Employees' graduated	0.322	0.253	1.379	0.203
Training in innovation	-0.304	0.322	0.738	0.345
Internal r&d	0.353**	0.166	1.423	0.034
Cooperation competing firms	0.627**	0.292	1.872	0.032
Cooperation consultants	0.508***	0.184	1.662	0.006
Cooperation universities	0.259	0.181	1.296	0.152
Cooperation laboratories	-0.239	0.227	0.788	0.293
Sector services	1.039***	0.310	2.826	0.001

N = 1133; Dependent variable: Product innovation. *P < .10. **P < .05. ***P < .01.

Logit analysis: All firms
Dependent variable - generation of product
innovation

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Prod_innov	Coefficient	Std. Err.	z	P>z
Nace	0.001	0.006	1.001	0.902
Size	-0.100	0.152	0.905	0.511
External_acquisition_r&d	0.029	0.270	1.030	0.914
Acquisition other external knowledge	0.576**	0.244	1.780	0.018
Acquisition equipment, software, licenses	0.197	0.289	1.217	0.496
Employees' graduated	0.215	0.509	1.240	0.673
Training in innovation	-2.081***	0.785	0.125	0.008
Internal r&d	0.062	0.239	1.064	0.795
Cooperation_competing firms	1.939***	0.715	6.948	0.007
Cooperation_consultants	0.101	0.203	1.106	0.620
Cooperation_universities	-0.349	0.217	0.705	0.108
Cooperation_laboratories	0.174	0.281	1.190	0.536
Sector	0.001	0.006	1.001	0.902

N = 562; Dependent variable: Product innovation. *P < .10. **P < .05. ***P < .01.

Logit analysis: Manufacturing firms
Dependent variable - generation of product
innovation

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Prod_innov	Coefficient	Std. Err.	z	P>z
Nace	-0.075***	0.026	0.928	0.005
Size	0.392**	0.179	1.480	0.029
External_acquisition_r&d	0.707**	0.302	2.029	0.019
Acquisition other external knowledge	0.532	0.319	1.702	0.096
Acquisition equipment, software, licenses	-0.462	0.515	0.630	0.369
Employees' graduated	0.135	0.446	1.144	0.763
Training in innovation	0.269	0.560	1.308	0.631
Internal r&d	0.602**	0.258	1.826	0.020
Cooperation_competing firms	0.611	.0.590	1.842	0.301
Cooperation_consultants	1.630***	0.514	5.103	0.002
Cooperation_universities	1.557***	0.474	4.747	0.001
Cooperation_laboratories	0.022	0.478	1.023	0.963
Sector	-0.075***	0.026	0.928	0.005

N = 571; Dependent variable: Product innovation. *P < .10. **P < .05. ***P < .01.

Logit analysis: Service firms
Dependent variable - generation of product
innovation

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H₁

The firm's acquisition of external sources of knowledge has a positive and significant effect on generating innovations

H1a: the
external
acquisition of
R&D



H1b: the
acquisition of
other external
knowledge



Being consistent with prior studies, such as those by Nelson & Winter (1982), March (1991), Lundvall & Johnson (1994), Van den Bosch et al. (1999), Johnson et al. (2002), Zahra & George (2002), Nerkar & Roberts (2004), Vinding (2004), Miller et al. (2007), Rothaermel & Alexandre (2009) and Heras (2014)

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H₄

The firm's internal R&D activities have a positive and significant effect on generating innovations



**H₄: the
firms'
internal R&D**



This is also consistent with previous studies (Cohen & Levinthal, 1989; Gambardella, 1992; Cassiman & Veugelers, 2006; Li, 2011)

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H5

The firm's cooperation liaisons with other firms have a positive and significant effect on generating innovations



H5: the
cooperation
relationships with
competing firms



In line with prior research, namely, Lundvall (1988), Jaffe (1989), Freeman (1991, 1994), Sako (1994), Shaw (1994), Brandenburger & Nalebuff (1996), Coombs et al. (1996), Dussauge et al. (2000), Cohen et al. (2002), Garraffo (2002), Tether (2002), Quintana-Garcia & Benavides-Velasco (2004), Vega-Jurado et al. (2008) and Rusko (2011)

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H₆

The firm's cooperation liaisons with other R&D stakeholders have a positive and significant effect on generating innovations



H_{6a}: The liaisons with consultants



This finding is consistent with the previous works of Jaffe (1989), Cockburn & Henderson (1998), Cohen et al. (2002), Kostopoulos *et al.* (2011), Li (2011) and Vasudeva & Anand (2011)



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H₁

The firm's acquisition of external sources of knowledge has a positive and significant effect on generating innovations



H1b: the
acquisition of
other external
knowledge



This finding is in line with previous results obtained by Nelson & Winter (1982), March (1991), Lundvall & Johnson (1994), Van den Bosch et al. (1999), Johnson et al. (2002), Zahra & George (2002), Nerkar & Roberts (2004), Vinding (2004), Miller et al. (2007), Rothaermel & Alexandre (2009) and Heras (2014)

Internal factors and RAC:
Manufacturing firms

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H3

Employees' training in areas related to innovation activities has a positive and significant effect on generating innovations



H3: the
firms'
internal R&D



Thus, we do not support Hypothesis 3 for manufacturing firms, these results are contradicting previous studies



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H₆

The firm's cooperation liaisons with other R&D stakeholders have a positive and significant effect on generating innovations



H6a: *The liaisons with consultants*



This finding is consistent with the previous work of Jaffe (1989), Cockburn & Henderson (1998), Cohen et al. (2002), Kostopoulos et al. (2011), Li (2011) and Vasudeva & Anand (2011)

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H₁

The firm's acquisition of external sources of knowledge has a positive and significant effect on generating innovations



H1a: the
external
acquisition of
R&D



H1b: the
acquisition of
other external
knowledge



Being consistent with prior studies, such as those by Nelson & Winter (1982), March (1991), Lundvall & Johnson (1994), Van den Bosch et al. (1999), Johnson et al. (2002), Zahra & George (2002), Nerkar & Roberts (2004), Vinding (2004), Miller et al. (2007), Rothaermel & Alexandre (2009) and Heras (2014)

Internal factors and RAC:
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H₄

The firm's internal R&D activities have a positive and significant effect on generating innovations



**H₄: the
firms'
internal R&D**



This is also consistent with previous studies, such as Cohen & Levinthal (1989), Gambardella (1992), Cassiman & Veugelers (2006) and Li (2011)

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H₆

The firm's cooperation liaisons with other R&D stakeholders have a positive and significant effect on generating innovations



H6a: *The liaisons with consultants*



H6b: *The liaisons with universities*



This finding is consistent with the previous work of Jaffe (1989), Cockburn & Henderson (1998), Cohen et al. (2002), Kostopoulos et al. (2011), Li (2011) and Vasudeva & Anand (2011). Nevertheless, it shows that Portuguese service firms are more likely to establish links with R&D stakeholders than manufacturing firms

Liaison factors and RAC:
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Internal factors

Literature	Research hypothesis	Dependent variable: Innovation generation			
		All firms		Manufacturing firms	Service firms
		ES	SO		
Nelson & Winter, 1982; March, 1991; Lundvall & Johnson, 1994; Van den Bosch et al., 1999; Johnson et al. 2002; Zahra & George, 2002; Nerkar & Roberts, 2004; Vinding, 2004; Miller et al., 2007; Rothaermel & Alexandre, 2009; Heras, 2014.	H1a	(+)	0.411**	0.029	0.707**
	H1b	(+)	0.528***	0.576**	0.532*
	H1c	(+)	0.013	0.197	-0.462
Cohen & Levinthal, 1989, 1990, 1994; Rothwell & Dodgson, 1991; Mangematin & Nesta, 1999; Narula, 2004; Vinding, 2000, 2004; Giuliani & Bell, 2005; Fosfuri & Tribó, 2008; Vega-Jurado et al., 2008.	H2	(+)	0.322	0.215	0.135
Nelson & Winter, 1982; March, 1991; Delaney & Huselid, 1996; Koch & McGrath, 1996; Nerkar & Roberts, 2004; Miller et al., 2007; Heras, 2014.	H3	(+)	-0.304	-2.081***	0.269
	H4	(+)	0.353**	0.062	0.602**
Cohen & Levinthal, 1989; Gambardella, 1992; Cassiman & Veugelers, 2006; Li, 2011					

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Liaison factors

Literature	Research hypothesis	Dependent variable: Innovation generation			
		All firms		Manufacturing firms	Service firms
		ES	SO		
Lundvall, 1988; Jaffe, 1989; Freeman, 1991, 1994; Sako, 1994; Shaw, 1994; Brandenburger & Nalebuff, 1996; Coombs et al., 1996; Dussauge et al., 2000; Cohen et al., 2002; Garraffo, 2002; Tether, 2002; Quintana-Garcia & Benavides-Velasco, 2004; Vega-Jurado et al., 2008; Rusko, 2011.	H5	(+)	0.627**	1.939***	0.611
Jaffe, 1989; Cockburn & Henderson, 1998; Cohen et al., 2002; Kostopoulos et al., 2011; Li, 2011; Vasudeva and Anand, 2011.	H6a	(+)	0.508***	0.101	1.630***
	H6b	(+)	0.259	-0.349	1.557***
	H6c	(+)	-0.239	0.174	0.022
Number of observations			1133	562	571
Wald			363.850***	187.846***	175.901***
Chi ²			89.053***	27.693***	145.341***

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Summing up

Internal factors of absorptive capacity

For manufacturing firms, the acquisition of external R&D has a positive and significant association with innovation generation; training in innovation areas has a negative and significant effect on the innovation generation

For service firms, acquisition of external R&D activities and internal R&D capacities show a positive and significant association with innovation generation

Absorptive
Capacity

Knowledge assimilation,
Spillovers
&
Exploitation

Renewed
Absorptive
Capacity

Liaison factors of absorptive capacity

For manufacturing firms, establishing cooperation liaisons with other competing firms has a positive and significant effect on the innovation generation

For service firms, the cooperation links with consultants and universities have a positive and significant effect on the innovation generation

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IMPLICATIONS

R&D managers must be aware of the set of determinants that drive the firm's absorptive capacity, so that they can prepare and tune them to fully exploit external knowledge and promote the innovation generation

Public policies should be directed towards consolidating firms' absorptive capacity and fostering cooperation dynamics among firms, competing firms and the scientific community, securing formal channels and mechanisms for developing joint innovation



GUIDELINES FOR FUTURE RESEARCH

To explore the factors motivating firms to behave alternatively, in terms of R&D business models, based on customising their open innovation business model

To model firms' open innovation strategy and their absorptive capacity pathway, by analyzing diverse liaison strategies to absorb external knowledge and establish technology transfer activities, such as cross-licensing, out-licensing or in-licensing strategies, and competitive/technological surveillance or forecasting projects



Many thanks for your attention

Q&A

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