

Innovation and Industrial Dynamics: Challenges for the next decade

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Innovation output in Spanish service firms: The impact of the 2008 economic crisis

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1. Justification

1. Why services firms?
 - (1) GVA EU-28 (2014): Services 67%; KIS 30,9%
 - (2) Employment EU-28 (2014): Services 64%; KIS 29,4%
2. Why knowledge intensive services (KIS) firms?
 - (1) Positive externalities
 - (2) Competitive and global nature
 - (3) Role in productivity growth
3. Why innovation output determinants?
 - (1) R&D -> Innovation output -> Productivity (CDM model)
4. 2008 Great Recession: Dramatic context change
 - (1) How did it impacted the determinants of innovation?

2. Main goals

1. To identify the main determinants of innovation for Spanish KIS firms
2. To compare them with determinants of innovation for Spanish services (non knowledge intensive) and manufacturing firms
3. To analyze the evolution of the main determinants of innovation for Spanish KIS firms through the period (2004 – 2012)

3. Theoretical framework

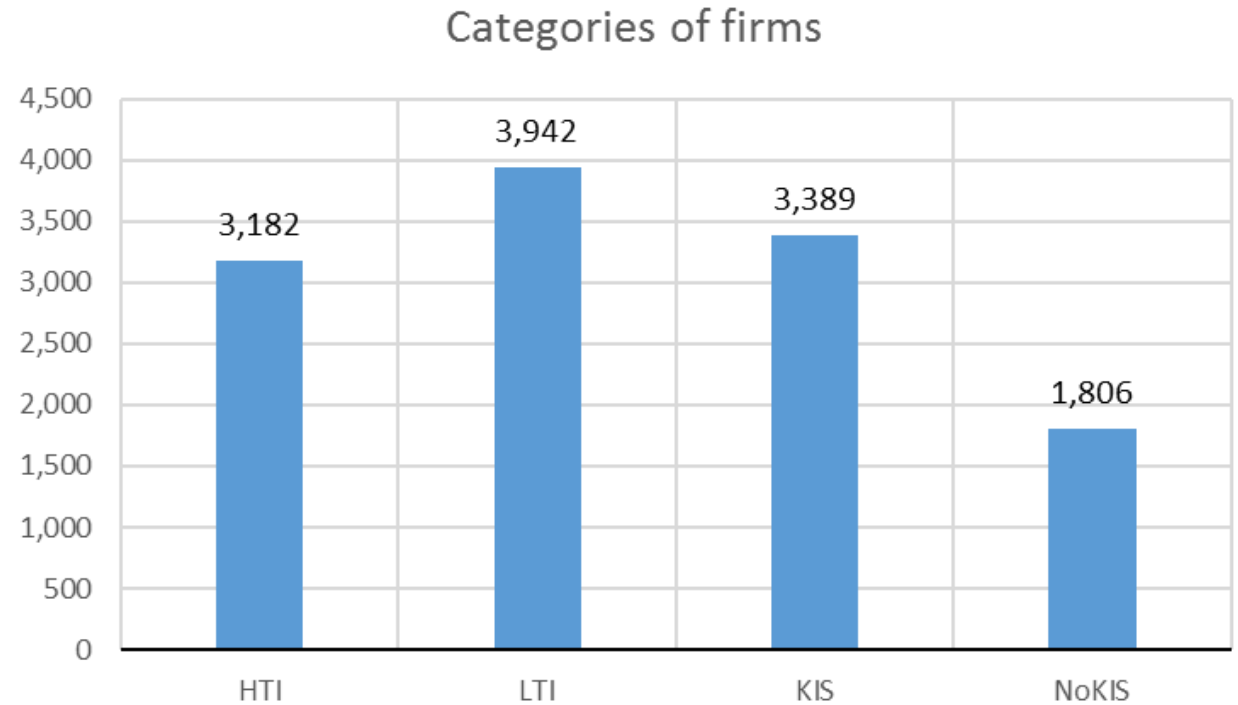
1. Innovation in services: Three approaches
 - (1) Technologist or assimilation approach
 - (2) Service-oriented or differentiation approach
 - (3) Integrative or synthesizing approach
2. A taxonomy of technological trajectories of service firms (Soete & Miozzo, 1989)
 - (1) Large scale physical networks: transport, wholesale trade (NoKIS)
 - (2) Informational networks: finance, insurance, communications (KIS)
 - (3) Specialized suppliers and science-based: software, specialized business serv. (KIS)
 - (4) Supplier dominated: repair, cleaning, catering, hotels, retail trade (NoKIS)
3. The literature about determinants
 - (1) Size and market structure
 - (2) Firm characteristics
 - (3) Sector characteristics

4. The data

1. The PITEC panel

- Based on the Spanish Innovation Survey (CIS questionnaire)
- Developed by INE & FECYT & COTEC annually from 2004
- 84,569 observations
- 11,236 firms
- From 2004 to 2012

2. Four categories



5. The model

1. CDM Model (Crépon, Duguet, & Mairesse, 1998)

EQ 1: R&D propensity

EQ 2: R&D intensity

EQ 3: The knowledge or innovation equation

EQ 4: The productivity equation

2. Innovation output indicators (g_i)

1. Product Innovation

2. Process Innovation

3. Organizational Innovation

4. Market innovation Share of sales of novelty products

5. New product/service to the firm

6. New product/service to the market

Innovation typologies

$$g_i = \gamma r_i + \delta W_i + \vartheta_i$$

3. Determinants of innovation outputs

1. r_i : R&D Intensity

2. W_i : Other determinants

1. Size Firm

2. Market Share

3. Group (D)

4. Cooperation (D)

5. Public Funds (D)

6. Export (D)

7. Human Capital

8. Research Employees

6. Methods (I)

6.1. Main determinants of innovation

The nature of PITEC (panel data):

- (1) 84,569 observations
- (2) 11,236 firms
- (3) From 2004 to 2012

The nature of dependent variables:

4 dichotomous dependent variables

- (1) Product innovation = 1 (the firm reports product innovation)
- (2) Process innovation = 1 (the firm reports process innovation)
- (3) Organizational innovation = 1 (the firm reports organizational innovation)
- (4) Market innovation = 1 (the firm reports marketing innovation)

2 continuous variables

- (1) New products to the firms
- (2) New products to the market

HTI, LTI, KIS, NoKIS

Xtlogit
(random effects:
time invariant
variables)

Xtreg
(fixed effects:
Hausman test)

6. Methods (II & III)

6.2. Main determinants of innovation for Spanish KIS firms

Post estimation Lincom command:

$$H_0: \beta_{i \text{ KIS}} = \beta_{i \text{ (HTI, LTI, NoKIS)}}$$

Where i = Size, cooperation, R&D intensity, public funds, export, human capital, and research employees

6.3. Evolution of main determinants of innovation for Spanish KIS firms (2004 – 2012)

Post estimation Lincom command:

$$H_0: \beta_{i \text{ 2004}} = \beta_{i \text{ (2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012)}}$$

Where i = Size, cooperation, R&D intensity, public funds, export, human capital, and research employees

7. Results (I)

7.1 Main determinants of innovation

	Product Innovation								Process Innovation							
	High Tech Industry		Medium and Low		Knowledge Intensive		No knowledge		High Tech Industry		Medium and Low		Knowledge Intensive		No knowledge	
	Coeff.	OR	Coeff.	OR	Coeff.	OR	Coeff.	OR	Coeff.	OR	Coeff.	OR	Coeff.	OR	Coeff.	OR
Size Firm	0.451*** (0.24)	1.570*** (0.194)	0.561*** (0.106)	1.752*** (0.185)	0.250*** (0.0753)	1.284*** (0.0966)	0.482*** (0.165)	1.619*** (0.269)	0.901*** (0.23)	2.462*** (0.303)	0.913*** (0.0979)	2.493*** (0.244)	0.837*** (0.0735)	2.309*** (0.170)	0.490*** (0.15)	1.633*** (0.247)
Market Share	0.311*** (0.0859)	1.364*** (0.117)	0.134* (0.0705)	1.144* (0.0806)	-0.0572 (0.0578)	0.944 (0.0546)	-0.558*** (0.27)	0.572*** (0.0729)	0.319*** (0.0856)	1.375*** (0.18)	0.0362 (0.0648)	1.037 (0.0672)	-0.0210 (0.0552)	0.979 (0.054)	-0.204* (0.117)	0.815* (0.0957)
Group = 1	-0.106 (0.0926)	0.900 (0.0833)	0.145* (0.0811)	1.156* (0.0938)	0.132* (0.0715)	1.141* (0.0885)	0.158 (0.139)	1.171 (0.163)	0.0417 (0.0878)	1.043 (0.0915)	0.0331 (0.0771)	1.034 (0.0797)	0.0929 (0.0742)	1.097 (0.0815)	0.404*** (0.23)	1.498*** (0.184)
Cooperation = 1	1.014*** (0.0718)	1.275*** (0.0836)	1.074*** (0.0622)	1.403*** (0.0799)	1.646*** (0.0616)	1.207*** (0.0770)	1.764*** (0.122)	1.898*** (0.247)	0.0839 (0.0602)	1.087 (0.0654)	0.443*** (0.0555)	1.557*** (0.0864)	0.238*** (0.0618)	1.269*** (0.0783)	0.564*** (0.22)	1.757*** (0.214)
Public Funds = 1	0.243*** (0.0656)	1.444*** (0.110)	0.338*** (0.0570)	1.393*** (0.0859)	0.188*** (0.0638)	1.423*** (0.0974)	0.641*** (0.130)	1.649*** (0.18)	0.244*** (0.0714)	1.276*** (0.0911)	0.263*** (0.0581)	1.301*** (0.0755)	0.0801 (0.0637)	1.083 (0.0690)	0.119 (0.0959)	1.126 (0.108)
Export = 1	0.367*** (0.0760)	2.755*** (0.198)	0.332*** (0.0617)	2.928*** (0.182)	0.353*** (0.0694)	5.189*** (0.316)	0.500*** (0.110)	5.833*** (0.709)	1.179*** (0.0655)	3.251*** (0.213)	1.475*** (0.0636)	4.371*** (0.278)	1.307*** (0.0578)	3.694*** (0.213)	2.315*** (0.26)	10.13*** (1.274)
Human Capital	0.00181 (0.0270)	1.002 (0.0270)	0.0619*** (0.0227)	1.064*** (0.0242)	0.106*** (0.0201)	1.111*** (0.0224)	0.209*** (0.0366)	1.232*** (0.0451)	-0.0355 (0.0256)	0.965 (0.0247)	0.0814*** (0.0213)	1.085*** (0.0231)	0.0165 (0.0193)	1.017 (0.0196)	0.0833*** (0.032)	1.087*** (0.0339)
R&D Intensity	0.390*** (0.0330)	1.477*** (0.0488)	0.454*** (0.0264)	1.575*** (0.0415)	0.486*** (0.0311)	1.625*** (0.0506)	0.636*** (0.0527)	1.889*** (0.0995)	0.282*** (0.0317)	1.325*** (0.0420)	0.406*** (0.0262)	1.500*** (0.0393)	0.419*** (0.0300)	1.520*** (0.0457)	0.747*** (0.0531)	2.112*** (0.12)
Research Employees	0.282*** (0.0471)	1.325*** (0.0624)	0.178*** (0.0446)	1.194*** (0.0533)	-0.0311 (0.0383)	0.969 (0.0371)	0.120 (0.0857)	1.128 (0.0967)	0.0204 (0.0444)	1.021 (0.0453)	-0.0689 (0.0438)	0.933 (0.0409)	-0.210*** (0.0367)	0.811*** (0.0297)	-0.490*** (0.0838)	0.613*** (0.0513)
Year = 2005	0.309*** (0.109)	1.362*** (0.148)	0.334*** (0.0887)	1.396*** (0.14)	0.114 (0.103)	1.121 (0.116)	0.170 (0.163)	1.186 (0.193)	0.308*** (0.101)	1.361*** (0.138)	0.345*** (0.0844)	1.413*** (0.119)	0.386*** (0.0980)	1.471*** (0.144)	0.519*** (0.139)	1.680*** (0.234)
Year = 2006	0.704*** (0.130)	2.023*** (0.264)	0.648*** (0.102)	1.911*** (0.195)	0.121 (0.111)	1.128 (0.125)	0.310* (0.178)	1.364* (0.242)	0.742*** (0.23)	2.099*** (0.259)	0.742*** (0.0964)	2.100*** (0.202)	0.475*** (0.106)	1.608*** (0.170)	0.657*** (0.149)	1.929*** (0.288)
Year = 2007	0.635*** (0.132)	1.887*** (0.249)	0.427*** (0.103)	1.533*** (0.158)	0.0675 (0.12)	1.070 (0.20)	0.211 (0.181)	1.235 (0.223)	0.447*** (0.125)	1.564*** (0.195)	0.478*** (0.0970)	1.613*** (0.156)	0.463*** (0.107)	1.588*** (0.170)	0.569*** (0.150)	1.767*** (0.265)
Year = 2008	0.623*** (0.117)	1.865*** (0.218)	0.407*** (0.0929)	1.502*** (0.140)	0.0641 (0.10)	1.066 (0.18)	0.160 (0.172)	1.174 (0.201)	0.484*** (0.108)	1.622*** (0.176)	0.505*** (0.0886)	1.657*** (0.147)	0.649*** (0.105)	1.914*** (0.201)	0.565*** (0.144)	1.759*** (0.254)
Year = 2009	0.883*** (0.122)	2.418*** (0.296)	0.654*** (0.0953)	1.924*** (0.183)	0.348*** (0.12)	1.416*** (0.158)	0.482*** (0.172)	1.620*** (0.278)	0.757*** (0.12)	2.132*** (0.240)	0.769*** (0.0906)	2.157*** (0.196)	0.898*** (0.107)	2.455*** (0.262)	0.850*** (0.146)	2.339*** (0.342)
Year = 2010	1.145*** (0.26)	3.143*** (0.396)	0.785*** (0.0977)	2.193*** (0.214)	0.440*** (0.113)	1.553*** (0.176)	0.650*** (0.173)	1.915*** (0.332)	0.894*** (0.115)	2.444*** (0.281)	0.896*** (0.0931)	2.450*** (0.228)	0.904*** (0.108)	2.469*** (0.266)	1.139*** (0.147)	3.123*** (0.458)
Year = 2011	-0.383*** (0.122)	0.682*** (0.0829)	-0.493*** (0.0993)	0.611*** (0.0607)	-0.583*** (0.115)	0.558*** (0.0641)	-0.0607 (0.178)	0.941 (0.168)	-0.348*** (0.114)	0.706*** (0.0806)	-0.537*** (0.0930)	0.585*** (0.0544)	0.101 (0.109)	1.106 (0.121)	0.429*** (0.149)	1.536*** (0.229)
Year = 2012	-0.870*** (0.25)	0.419*** (0.0522)	-0.886*** (0.103)	0.412*** (0.0425)	-1.050*** (0.117)	0.350*** (0.0411)	-0.482*** (0.185)	0.618*** (0.114)	-0.851*** (0.118)	0.427*** (0.0503)	-0.950*** (0.0967)	0.387*** (0.0374)	-0.373*** (0.111)	0.688*** (0.0766)	-0.0154 (0.154)	0.985 (0.151)
Constant	-0.653 (0.476)	0.521 (0.248)	-2.457*** (0.381)	0.0857*** (0.0326)	-2.647*** (0.323)	0.0709*** (0.0229)	-7.093*** (0.791)	0.000831*** (0.000657)	-1.470*** (0.473)	0.230*** (0.109)	-2.653*** (0.351)	0.0704*** (0.0248)	-3.323*** (0.311)	0.0360*** (0.0112)	-4.782*** (0.718)	0.00838*** (0.00603)
Insig2u	1.705*** (0.0520)	5.501*** (0.286)	1.822*** (0.0443)	6.182*** (0.274)	1.622*** (0.0477)	5.062*** (0.241)	1.965*** (0.0774)	7.134*** (0.552)	1.821*** (0.0490)	6.176*** (0.303)	1.606*** (0.0435)	4.981*** (0.217)	1.611*** (0.0466)	5.009*** (0.233)	1.959*** (0.0703)	7.089*** (0.498)
Observations	21,608		28,089		23,208		11,664		21,608		28,089		23,208		11,664	
Number of ident	3,182		3,942		3,389		1,806		3,182		3,942		3,389		1,806	
log likelihood	-8782		-12366		-10513		-3805		-10284		-13055		-11528		-4969	
Wald chi2 (18)	1944		2606		2425		996.5		1479		2670		1719		896	
Prob > chi2	0		0		0		0		0		0		0		0	
sigma u	2.345		2.486		2.250		2.671		2.485		2.232		2.238		2.663	
rho	0.626		0.653		0.606		0.684		0.652		0.602		0.604		0.683	
Likelihood-ratio test of rho=0	4285		6722		4922		2179		5720		5884		5494		2900	
Prob	0		0		0		0		0		0		0		0	

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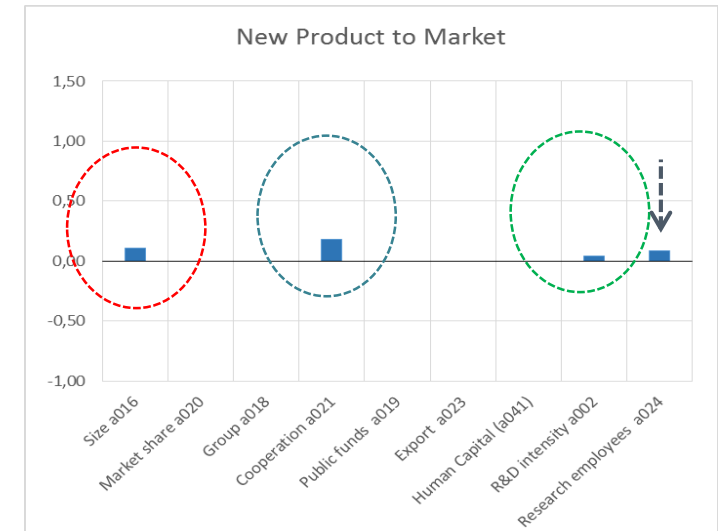
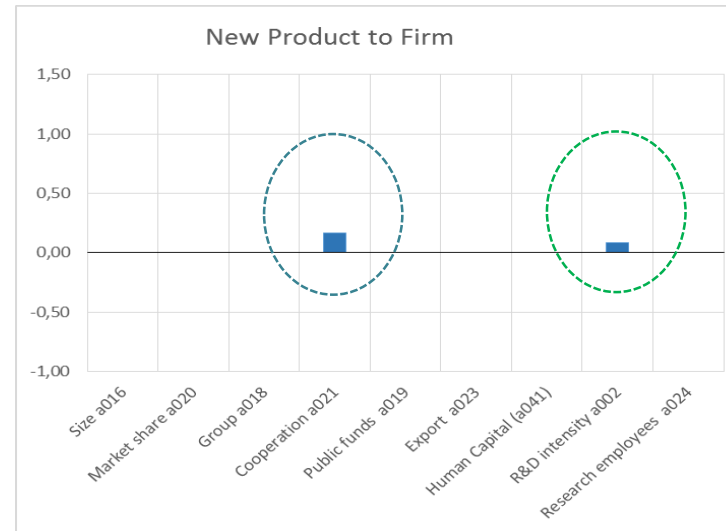
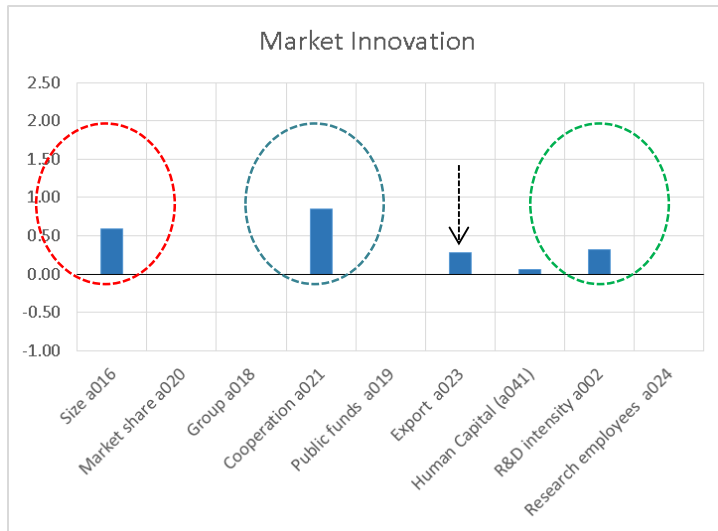
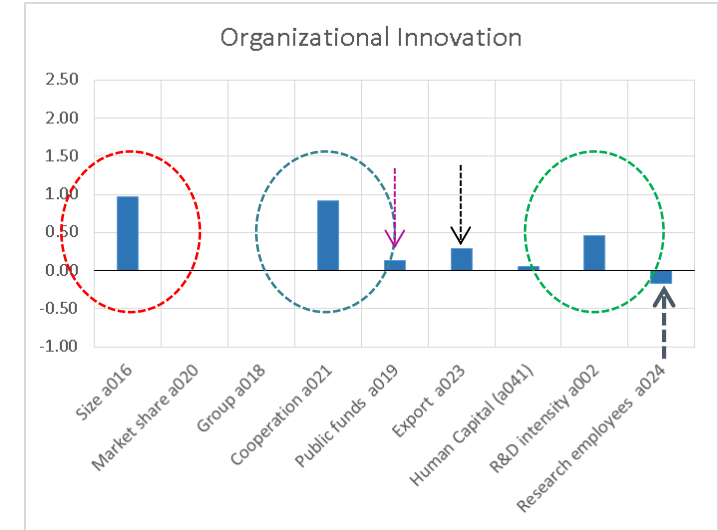
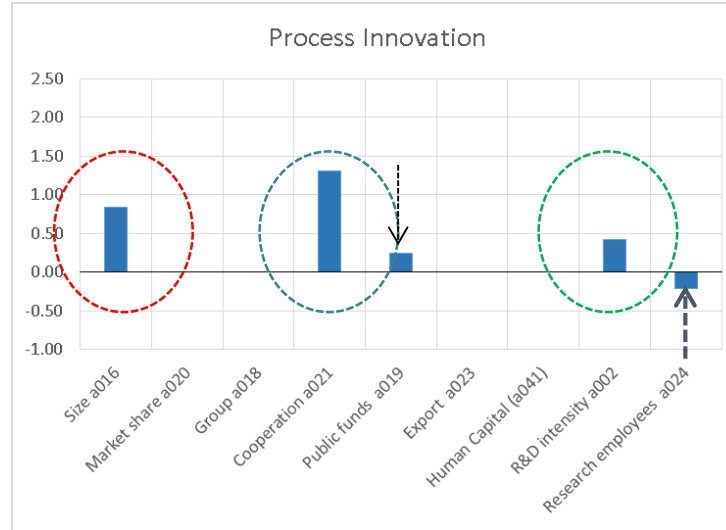
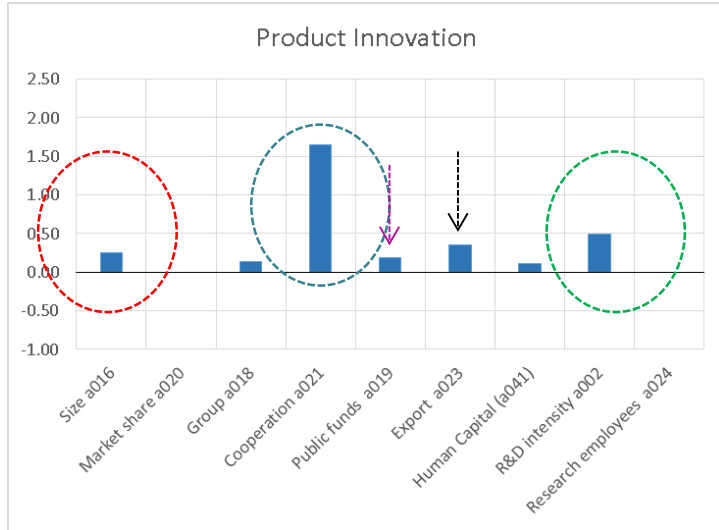
7. Results (I)

Size of the firm

Cooperation

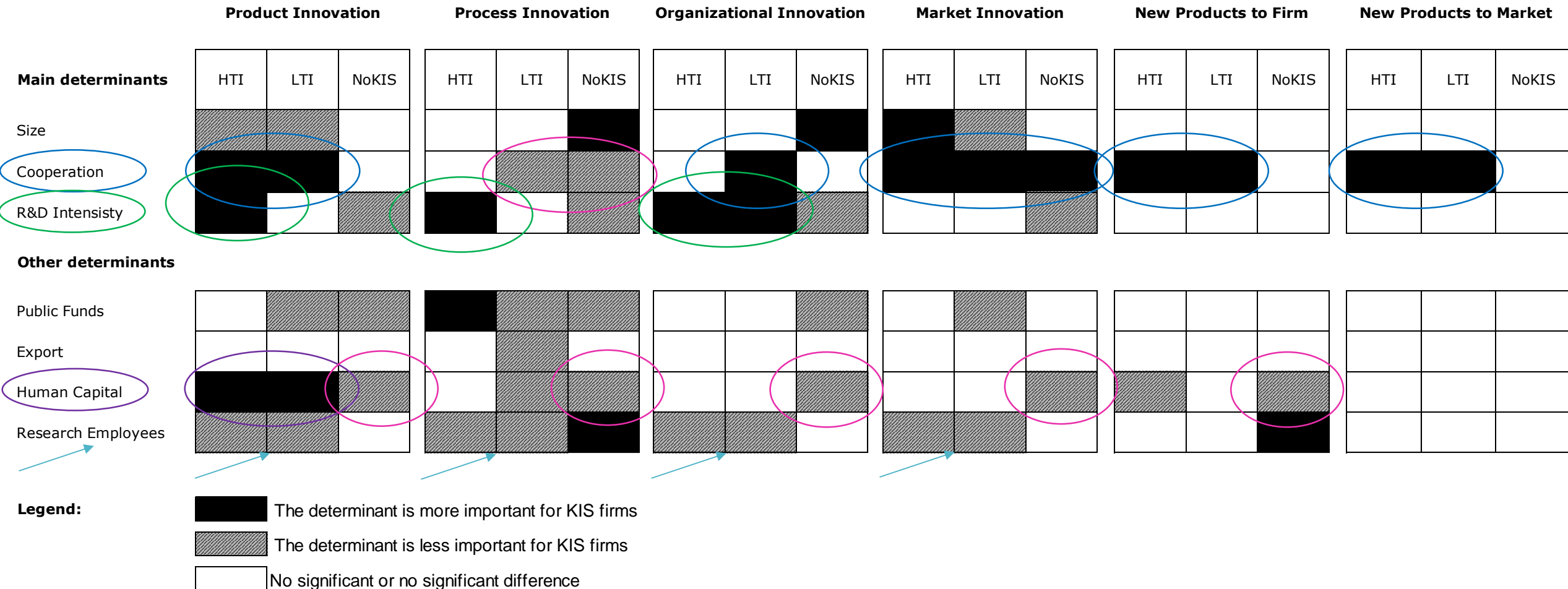
R&D intensity

7.1 Main determinants of innovation



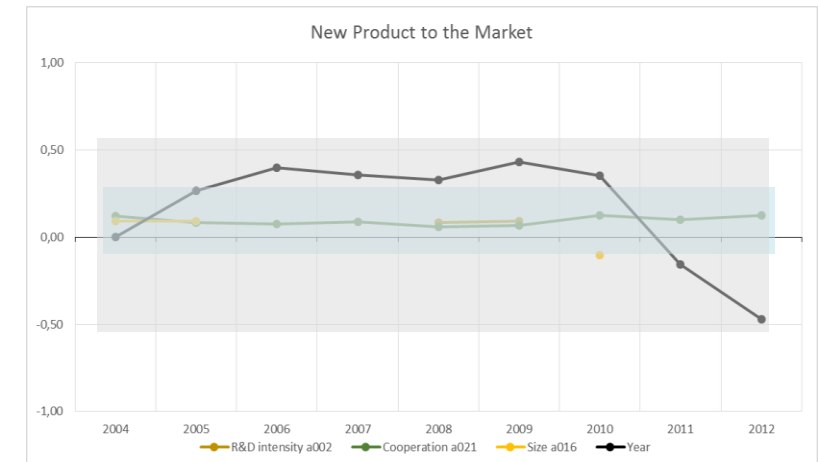
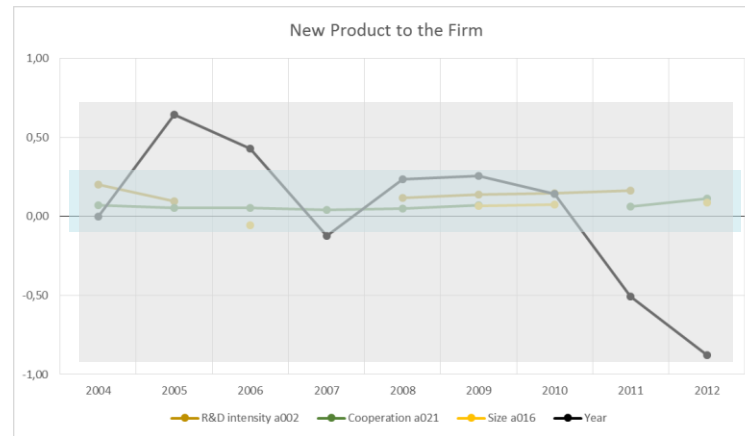
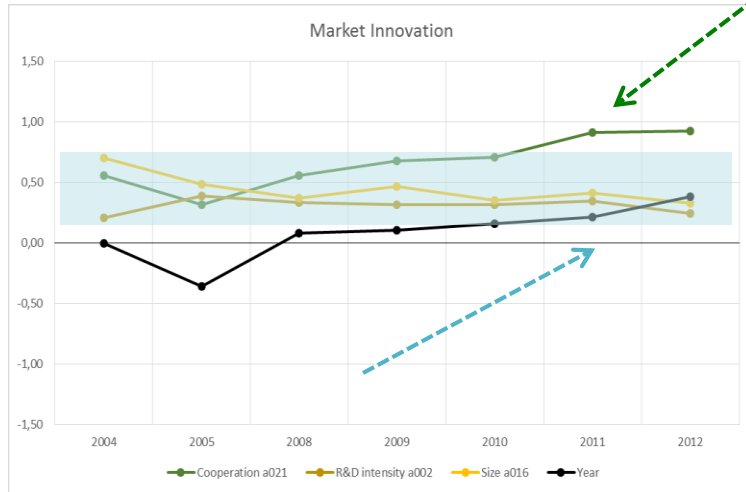
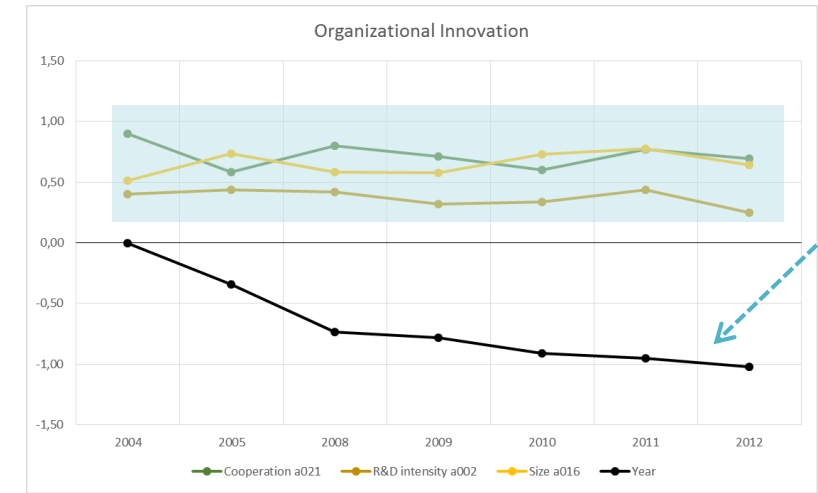
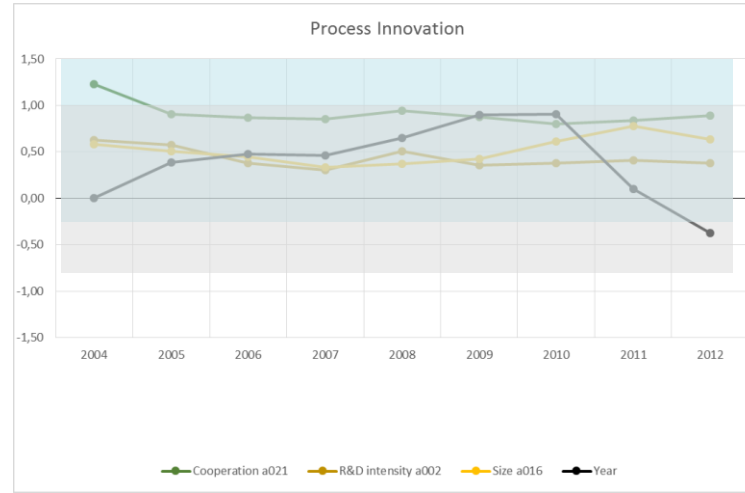
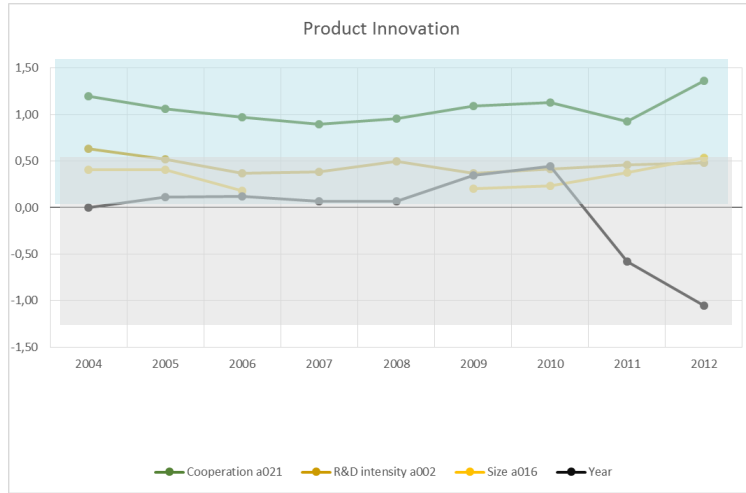
7. Results (II)

7.2 Main determinants of innovation for Spanish KIS firms



7. Results (III)

7.3 Evolution of main determinants of innovation of KIS firms (2004 – 2012)



8. Conclusions

1. Size of the firm, cooperation and R&D intensity are the most important determinants of innovation output, not only for KIS firms
2. Cooperation is the most important determinant in the case of KIS firms, and their influence is stronger than in manufacturing firms
3. R&D intensity, a main innovation input indicator, has a positive influence in all the innovation determinants for KIS firms
4. There are no significant differences in determinants between services and manufacturing firms
5. The influence of main determinants in innovation output keep constant over time from 2004 to 2012

9. Contributions and future research

1. Contributions

- Importance of cooperation as an innovation output determinant
- Signal similarities among services and manufacturing firms
- No significant impact of the financial crisis in the evolutions of innovation determinants

2. Future research

- Continue with CDM model: Equation 4 Productivity
- Deepen in the knowledge about cooperation partners: Who are they? What is the aim of the cooperation?
- To explore a territorial dimension: Andalusia, Madrid, Catalonia, etc.

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**Thanks for your
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