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# WHAT FIRMS DON'T KNOW CAN HURT THEM: OVERCOMING A LACK OF INFORMATION ON TECHNOLOGY [*]

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ABSTRACT: The availability of information on technology is a key factor in the innovation process. Firms that lack such information thereby face a major barrier to innovation. Yet little is known about the types of companies that lack this information. This paper examines what characterises firms that lack information on technology and analyses how innovative companies can overcome this gap in their knowledge. Empirical analysis was conducted with the Panel of Technological Innovation (PITEC), based on the information from the Spanish version of the Community Innovation Survey (CIS). The analysis leads to three principal conclusions. First, a large number of firms perceive the lack of information on technology as a barrier to innovation. Second, there are notable sector differences in the way firms perceive this barrier: High-tech firms perceive lower levels of this barrier. Third, not all sources of information on technology are equally effective at overcoming this barrier. The most useful sources are consultants, commercial laboratories and private R&D institutes.

Keywords: Information on technology, barriers to innovation, sources of information, overcoming obstacles

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## 1. INTRODUCTION

Numerous analyses in the field of innovation economics have examined the drivers and firm characteristics that explain firms' R&D behaviour and innovation performance (Cohen, 2010). Another stream of literature has focused on the obstacles or barriers that may prevent or hamper firms' innovation activities (Mohnen et al., 2008; D'Este et al., 2012; Blanchard et al., 2012). Broadly speaking, such analyses can be divided into two groups. The first group consists of studies that have examined the factors that explain the varying importance of firms' perceptions of barriers to innovation (Baldwin and Lin, 2002; Galia and Legros, 2004; Iammarino et al., 2009). The second group consists of studies that have examined the effect of these barriers on innovation propensity and innovation intensity (Canepa and Stoneman, 2008; Savignac, 2008; Mancusi and Vezzulli, 2010). Most studies in this second group have focused on the effect of financial barriers. These financial barriers are important, but empirical analyses (Mohnen et al., 2008; Segarra et al., 2008; Holzl and Janger, 2012; Blanchard et al., 2012; Pellegrino and Savona, 2013) have shown that other barriers to innovation are also important. Yet these barriers have received less attention from scholars. Notably, few studies have analysed a lack of technological information as a barrier to innovation.

The Community Innovation Survey, the preeminent source of data for analysing barriers to innovation, covers four groups of barriers: (i) cost factors (i.e. lack of internal funds, lack of external funds and excessive innovation costs); (ii) knowledge factors (i.e. lack of qualified personnel, lack of information on technology, lack of information on markets and difficulty in finding cooperation partners for innovation); (iii) market factors (i.e. market dominated by established enterprises and uncertain demand for innovative goods and services); and (iv) other factors (i.e. no need for innovation because of lack of demand and the existence of prior innovations). Although the CIS gathers separate data for each specific barrier, most analyses have considered these barriers jointly, grouping them into one of these four categories (Segarra et al., 2013) or just one variable (Blanchard et al., 2012). The aforementioned analytical approaches highlight the importance of examining each obstacle separately to improve our understanding of innovation and provide innovation policy recommendations.

Accordingly, in this research, the lack of technological information is studied as a specific, separate barrier to innovation. Information on available technologies can

improve companies' innovation activity for three reasons. First, it reduces the risk of innovation projects. Second, it enables early introduction of innovations. Third, it may offer a springboard for the exploitation of new business opportunities. For these reasons, access to information on available technologies is a key issue in innovation processes and a pillar of technology policies, as exemplified by policies that provide firms with access to technology centres. However, we still have a poor grasp of what type of firms face this barrier and what characteristics help firms overcome this barrier. To the best of our knowledge, the literature fails to explore how the lack of information on technology hinders innovation activities.

This paper has two goals: to examine the characteristics of the firms that lack information and to analyse how innovative firms overcome this lack of information. Given the scarcity of studies on this topic, this paper contributes to filling the gap on how companies can overcome barriers to innovation. We examined general characteristics of the firm and characteristics that relate to R&D and innovation strategies, including the use of different sources of information. In doing so, we determined the characteristics that positively affect a firm's ability to overcome this constraint, which may hamper the firm's innovation activities.

Data for the empirical analysis were gathered from the Spanish Technological Innovation Panel (PITEC) for the period 2004 to 2011. This database, which is built from the Spanish version of the Community Innovation Survey (CIS), provides rich data on innovation performance and firm characteristics.

The rest of the paper proceeds as follows: Section 2 presents a review of the literature on business activity, innovation and the lack of information on technology. Section 3 discusses the features of the dataset and provides descriptive data on this obstacle. Section 4 describes the econometric strategy, defines the variables and presents the results of the estimates. Section 5 concludes and highlights the principal policy implications.

## 2. BACKGROUND

### 2.1. Business activity, innovation and information on technology

Access to information on available technologies is relevant to firms for three reasons. First, it reduces the risk of innovation projects. It is also a general requirement for any firm's production activity. Accordingly, the lack of information on technology is a major barrier to the effective use of resources and capabilities (Fawcett et al., 2008; Van Donk, 2008) and the supply chain network (Katunzi, 2011). Second, access to technological information sources presents an opportunity to accelerate innovations, share costs, improve market access and achieve economies of scale and scope (Ahuja, 2000; Hagedoorn, 2002; López, 2008). Third, the availability of technological information can boost firm performance (Baldwin and Lin, 2002; McEvily and Chakravarthy, 2002; Mansury and Love, 2007) and provides a platform for the exploitation of new business opportunities.

The relationship between accessing information on technology and innovating can be addressed from two perspectives: (i) by analysing potential complementarities between different information sources and (ii) by examining the existence of alternative information channels.

Under the first perspective, internal and external sources of knowledge and information are considered to complement one another. Some firms are prone to resisting technological information that originated outside the company. These firms suffer from the 'not-invented-here' syndrome (Katz and Allen, 1982; Laursen and Salter, 2006). In reality, however, organising the processes of exploration, maintenance and exploitation of knowledge and information occurs both inside and beyond the firm's borders (Zollo and Winter, 2002; Cassiman and Veugelers, 2006). In fact, it could be claimed that the role of combining internal and external information and knowledge is essential in the innovation process (Lichtenthaler, 2007). Thus, in the innovation process, internal activities related to information on technology may be synergistic with access to external information from connections with other firms, consultants, agreements with universities and research institutes (Arora and Gambardella 1990; Cassiman and Veugelers, 2002; Hagedoorn and van Kranenburg, 2003). Firms must effectively manage the information they collect from outside their borders to maximise the positive effects of this information on innovation performance. External knowledge is more effective when firms have the right internal capabilities. Firm should strengthen their absorptive capacity (Zahra and George, 2002) because a high absorptive capacity helps firms access and exploit knowledge that is generated elsewhere (Negassi, 2004).

Under the second perspective, the existence of different channels to access to information on technology is considered. Different external sources can affect different types of innovation (Inauen and Schenker-Wicki, 2011). Firms that use information from universities or research institutes are more likely to have higher R&D intensity than companies that use information from suppliers. Information from suppliers is often linked to process innovations (Rouvinen, 2002), whereas information from customers, universities and research institutes tends to be more relevant to firms that focus on product innovation (Suh and Kim, 2012). The effect of other information sources is ambiguous. Firms can also obtain information from competitors and open sources (conferences, professional meetings, magazines, etc.). This information could replace in-house R&D. But such information could also have indirect effects that lead to new technological opportunities, enhancing the benefits of performing in-house R&D.

### 2.2 Firm characteristics and lack of information

Innovation is a complex process that often requires different types of knowledge and information (Johnson, 2002). Thus, barriers to innovation that relate to the lack of information on technology may be highly specific to each firm. We therefore considered the following variables, which capture key features of the firm: size, age, business group membership, sector and exporter status.

First, because of their size, SMEs are generally thought to experience greater barriers to innovation because they face additional difficulties in accessing the necessary resources to innovate (Reinstaller et al., 2010). Barriers linked to financial resources and problems associated with costs are often highlighted as barriers to innovation for smaller companies (Savignac, 2008; Iammarino et al, 2009; Alessandrini, et al., 2010). In this study, we explore the possible relationship between access to technological information and size.

Second, the literature is inconclusive regarding the relationship between age and access to information on technology. In a recent study of Spanish manufacturing and service firms, Pellegrino (2017) found no significant association between a firm's age and perception of different kinds of knowledge-related barriers that may hamper innovation.

Third, barriers to information may be internal or external to the firm, but accessing knowledge and information sources within the company is likely to be simpler than

accessing knowledge outside the firm. Firms that belong to a business group enjoy advantages of scale that lone companies of the same size do not. As well as financial resources, knowledge and information can be shared among firms that belong to the same corporate group (Reinstaller et al., 2010).

Fourth, along with regulatory barriers, barriers related to access to knowledge are relevant in all sectors. Manufacturing firms are most likely to perceive the lack of information on technology as a factor that hinders innovation activities (Reinstaller, 2010). High-tech firms report lower knowledge- and information-related barriers. Arguably, high R&D intensity negatively affects the firm's perception of how important a lack of information on technology actually is. In other words, the cumulative nature of knowledge seems to be negatively associated with a lack of information on technology.

Finally, internationalised companies (i.e. exporters) report the existence of greater barriers due to a lack of knowledge and technology information. This perception may reflect these companies' awareness of such shortcomings because of broader, more international competition (Reinstaller, 2010).

## 3. DATA AND DESCRIPTIVE STATISTICS

We took our empirical data from the Spanish Technological Innovation Panel (PITEC) for the period 2004 to 2011. This database provides firm-level data. It is compiled jointly by the Spanish National Statistics Institute (INE), the Spanish Foundation for Science and Technology (FECYT) and the COTEC Foundation. The PITEC collects data under the Oslo Manual Guidelines (1997). The database is built using the Spanish version of the Community Innovation Survey (CIS). An important feature that distinguishes PITEC from most European CIS-type datasets is its longitudinal nature, which enables exploitation of the advantages of panel data for econometric analyses.

The PITEC dataset provides rich data on innovation engagement and performance and firm characteristics. For descriptive statistics, see Tables A.2 and A.3 in the appendix. Together with the general firm information, PITEC also provides a set of innovation variables. PITEC provides self-report assessment of factors that constrain innovation

activities or influence the decision to innovate. For the items on barriers to innovation in the Spanish version of the CIS, see Table A.4 in the appendix.

We focused on manufacturing firms. From the initial sample for 2004 to 2011 (100,016 observations) we discarded all firms in other sectors. Consistent with previous studies (D'Este et al., 2012; García-Quevedo et al., 2017; Pellegrino and Savona, 2017), we selected a relevant sample by excluding observations that referred to 'non-innovation oriented firms', defined as firms that did not introduce any type of innovation and did not encounter any barriers to innovation during the three-year period considered in the survey. We inferred that these firms were not interested in innovation. After excluding all firms with missing values for pertinent variables and firms with observations for just one year, we obtained a sample consisting of 26,734 observations.

The descriptive analysis corresponding to the four knowledge-related barriers to innovation covered by the PITEC database shows that a high proportion of firms consider the lack of information on technology a constraint for their innovation activities (Table 1). Although 19.3% had not experienced this obstacle, 31% and 8% considered it of medium or high importance, respectively. The lack of information on technology was the second most important knowledge-related obstacle, after the lack of qualified personnel.

Insert Table 1 here.

Firms perceived this obstacle as important throughout the period of analysis. The percentage of firms that perceived the lack of information on technology as highly important ranged from 6.7% to 8.8%. Similarly, the percentage of firms that considered the lack of information on technology as moderately important ranged from 29.0% to 32.4% (Table 2).

Despite this consistent perception of the obstacle's importance, the transition matrix (Table 3) shows that a substantial percentage of firms changed their perceptions. More than 12% of firms that perceived this obstacle as moderately or highly important overcame it, and in the next period, they reported that they did not experience it as a barrier. Conversely, nearly 12% of firms that considered that this factor was not a constraint for their innovation activities reported it as moderately or highly important in the next period.

Insert Tables 2 and 3 here.

## 4. EMPIRICAL ANALYSIS AND RESULTS

### 4.1. Econometric method

The goals of the empirical analyses were to examine the firm-level factors that influence the perception of lack of information on technology and to study the factors that help firms overcome this barrier. For a detailed description of the variables, see Table A.1 in the appendix.

For the first analysis, we used the same definition of the dependent variable as that used in previous studies (Hölzl and Janger, 2014; Pellegrino and Savona, 2017). Using data from the survey, we constructed a dummy that took the value 1 when the firm reported high or medium importance of the lack of information on technology, and 0 otherwise. We used the following model:

$$LACK\_INFO_{it} = \beta_0 + \beta_1 F_{it} + \mu_i + e_{it} \quad (1)$$

where LACK_INFO is the lack of information on technology (defined above) and F refers to characteristics of the firms regarding their perceptions of barriers to innovation—in this case, the lack of information on technology. We include size, age, whether the firm belongs to a group and the firm's sector according to technological focus. To examine possible nonlinearities, we included quadratic terms for size and age. We also considered whether the firm exports and whether the firm has invested in innovation activities. Because of the nature of the dependent variable, we used a random effects probit model with panel data. In the estimates, we considered time-invariant and unobservable specific firm characteristics and time effects to control for cyclical change.

In the second analysis, our main contribution, we focused on the factors that may make firms more likely to overcome the lack of information on technology. We analysed innovative firms because only firms that have innovated can provide information on their R&D and innovation strategies and their information sources. Therefore, the CIS survey only provides information on these issues for firms that had introduced product

or process innovations or that had innovation activities that were ongoing or were abandoned during the reference period.

To calculate the estimates, we split the period 2004 to 2011 into two sub-periods: 2004 to 2007 and 2008 to 2011. We were thus able to analyse which factors explained how firms that faced barriers in the first period overcame these barriers in the second period. Although firms answered the question regarding barriers faced over a three-year period, our longitudinal data provided annual values for this variable. We used the year-data dummies of the first analysis and calculated the average value of these dummies for each of the two four-year periods. This variable ranged from 0 to 1, with five possible values: 0, 0.25, 0.5, 0.75 or 1.

We constructed the dependent variable 'overcome lack of information' as a dummy that took the value 1 when the average value of the lack of information dummy was between 0.75 and 1 in the first period (2004–2007) and between 0 and 0.25 in the second period (2008–2011). Otherwise, the dummy took the value 0, indicating firms that maintained the same perception of the barrier throughout the period and firms that considered that the importance of this barrier had increased. To check the robustness of our results, we considered an alternative definition of this variable. For values of the dummy equal to 1, the definition was the same as the definition that was stated earlier. For values equal to 0, however, we considered only firms that had not changed their status regarding answers to the 'lack of information' item in both periods. The model was given by:

$$OVERC_{it} = \beta_0 + \beta_1 F_{it} + \beta_2 S_{it} + \beta_3 I_{it} + \mu_i + e_{it} \qquad (2)$$

where OVERC is defined above. For the independent variables, we considered three groups of factors. As in the first econometric analysis, in the first group of variables (firm-specific characteristics), we included size, age, exporter status and business group membership. We also included industry dummies to control for sector heterogeneity. The second group of variables corresponded to R&D and innovation strategies. First, we considered internal R&D activities. We distinguished between applied and basic research, which may require different skills and human capital and may have varying influences on overcoming the lack of information on technology. Second, we considered different ways of accessing external knowledge and technology that can be used to overcome the lack of information on technology. We included acquisition of

technology embodied in new machinery and equipment, acquisition of R&D services, and cooperation with other firms and institutes. We also controlled whether the firm had obtained public support to finance R&D activities. Finally, the third group of variables corresponded to the sources of information that the firms used for their technological activities. We exploited the detailed information that PITEC provides, and we distinguished between different sources of information that help firms overcome a lack of information on technology. Specifically, we included four market sources (i. customers, ii. competitors, iii. suppliers, and iv. consultants, commercial laboratories and private R&D institutes) and one institutional source (universities and public research institutes). As in the first equation, we used a random effects probit model to perform the estimations. We also included time effects to control for cyclical change.

### 4.2. Results and discussion

The estimates regarding the determinants of the perception that the lack of information on technology acts as a barrier to innovation show that certain characteristics—age, exporter status and innovation status—were not significant. These variables did not seem to relate to the perception that the lack of information on technology has a negative influence on innovation.

Insert Table 4 here.

In contrast, group membership, size and sector mattered. Belonging to a business group affected the firm's perception of the lack of information on technology. According to certain scholars (Reinstaller et al., 2010), firms that belong to the same business group can cooperate on matters of technological information and knowledge similarly to the way they cooperate in other areas such as financial resource issues. Unlike similar-sized lone firms, firms within a business group can achieve economies of scale. Our results show that firms that belong to a group are more likely not to perceive the lack of information on technology as an obstacle to innovate.

Our analysis also yielded an interesting finding regarding size. It is generally accepted that small and medium-sized enterprises face additional hurdles to achieve sufficient resources to innovate. The literature (Iammarino et al., 2009; Alessandrini et al., 2010) tends to emphasise SMEs' restrictions in terms of costs and access to financial resources. Our estimates included the quadratic term for firm size to examine possible

nonlinearities. The results reveal an inverted-U relationship, suggesting that the firm's perception of the lack of information on technology as an obstacle increases with size up to a certain point.

The estimates also reveal significant differences by sector. While firms that belong to a low- or a low-medium-technology industry are more likely to perceive the obstacle of a lack of information on technology, the opposite is true of firms in high-technology sectors. Notably, a lack of information on technology is negatively related to the cumulative nature of knowledge. In other words, high investment in R&D reduces the perception of the importance of the lack of information on technology. Because of differences across sectors, we performed separate estimates for the three principal macro sector categories, as per the OECD classification of industries according to their technological content. These categories are low- and low-medium-technology, medium- and medium-high-technology and high-technology industries. The results for each sector were similar to the overall results that were reported earlier. Only slight differences emerged in the variable that controlled for group membership. This variable was only significant for the medium and medium-high technology industries.

The results of the estimates regarding factors that help firms overcome the obstacle of a lack of information on technology show that some firm-specific characteristics matter. While age and exporter status were non-significant, an increase in size helps overcome this obstacle. Greater size is helpful until a certain point, as reflected by the negative sign of the variable for the quadratic size term. This finding is consistent with the results for the perception of the lack of information on technology.

Insert Table 5 here.

The principal results correspond to the way the other two groups of variables (i.e. R&D and innovation strategies and the use of different information sources) relate to overcoming the lack of information on technology.

With respect to the first group of variables, the estimates show that firms with internal R&D that invested in basic as well as applied research had more difficulties to overcome a lack of information as a barrier to innovate. Although all companies used sources of information on technology, use of this information was more intensive among the most innovative companies (Coad et al., 2014). Our findings suggest that

firms that devote more resources to research need more information on new technological advances and may have trouble overcoming a lack of such information.

Regarding the variables related to the use of external sources of information for innovation activities, the results show that not all types of sources of information play the same role in overcoming a lack of information on technology. We analysed three sources of technological information: (i) universities and public research centres; (ii) customers and suppliers; and (iii) consultants, commercial laboratories and private R&D institutes. The results for each of these sources are as follows:

Firms that considered universities and public research centres important sources of information do not overcome the obstacle to innovation posed by the lack of information on technology easier than the rest of firms. In relation to this finding, the following two points must be considered. First, universities are centres of basic research whose results require proof of concept (prototypes, tests, etc.) before the technology can be applied. There is also cognitive distance (lack of codified common knowledge) and institutional distance (different terms, languages and incentives) between universities and companies. Second, companies that are most likely to use universities and public research centres as sources of information are highly innovative. As noted in the previous estimate, these firms encountered specific problems to overcome the lack of information on technology as an obstacle to innovation.

The estimate also considered firms that sourced information from customers and suppliers. According to some studies (Faems, 2005), the connection with value chain partners (clients and suppliers) provides a solid basis for the gradual development of existing products and services. The results of our investigation showed a positive relationship between two market information sources (i.e. customers and suppliers) and overcoming the lack of information on technology. Nevertheless, the results of the robustness check estimate failed to confirm this finding.

Finally, firms that sourced information from consultants, commercial laboratories and private R&D institutes found it easier to overcome a lack of information on technology. Information-related barriers may also refer to the institutional environment where business activities are conducted. The presence of technology transfer institutes and the availability of a high level of human capital in firms can reduce barriers that relate to

knowledge and technological information. For instance, knowledge-intensive business services (KIBS) in technology and know-how address the fact that certain firms are unable to generate this type of knowledge and information in house (García-Quevedo and Mas-Verdú, 2008; Doloreux, and Shearmur, 2013).

## 5. CONCLUSIONS

Firms' innovation potential is conditioned by the availability of different resources: financial, human, technological and market information and so forth. To a varying degree, all organisations face barriers to obtaining the resources they need to complete innovation projects. Most studies of barriers to innovation have focused on financial barriers. Studies that have examined knowledge-related barriers have done so in aggregate form without distinguishing between these barriers. This study focused on a specific barrier: the lack of information on technology.

Access to information on technology is a key factor in innovation processes and is a key consideration when designing technology policy. Despite its importance, our knowledge about the type of firms that face this obstacle is scarce. To fill this gap, we performed two analyses. First, we analysed the characteristics of firms that lack information. Second, we studied the way innovative firms can overcome this obstacle.

The results yield four conclusions. First, a significant number of firms perceived a lack of information on technology (nearly 40% considered it moderately or highly important). The perception of this barrier persisted over time. However, the longitudinal analysis implies that some firms overcame this barrier during the study period. More than 12% of companies that initially perceived the lack of information on technology an obstacle of medium or high importance considered it a minor barrier in the following period.

Second, sectors differ significantly regarding firms' perceptions of barriers. Low-medium technology industries are particularly constrained, whereas high-tech industries face this obstacle to a lesser degree. The cumulative nature of knowledge seems to be negatively related to the perception of the lack of information on technology. Firms that

operate in sectors with high R&D investment perceive the lack of information on technology as less important.

Third, firms that are more oriented to internal R&D struggle to overcome a lack of information. This conclusion implies that R&D-intensive companies require more information on technology but also suggests that, if such a barrier exists, it may be more difficult to overcome.

Fourth, firms that use consultants, commercial laboratories and private R&D institutes as a source of information for technological innovation activities find it easier to overcome a lack of information on technology. This finding does not hold when the sources of information are universities and public research centres.

Based on the conclusions of this research, some policy implications are derived. Firstly, public policies aimed at providing information on technology should focus especially on certain sectors (low and medium technology industries) which, in line with the results obtained, are particularly affected by this barrier. Second, and in order to overcome the barriers of information on technology, it would be useful to design actions from the supply side and from the demand side. From the supply side, reinforcing and expanding the role of private R & D institutes, commercial laboratories, and consultants who have proven to be especially effective in this field. From the demand side, facilitating and encouraging the access of firms to the technological information supplied by these agents through the use of ad hoc instruments (for example through innovation vouchers).

REFERENCES


Ahuja, G. 2000. The Duality of Collaboration: Inducements and Opportunities in the Formation of Interfirm Linkages. *Strategic Management Journal*, 21, 317-343.

Alessandrini, P., Presbitero, A. F. and Zazzaro, A. (2010). Bank Size or Distance: What Hampers Innovation Adoption by SMEs? *Journal of Economic Geography*, 10(6), 845-881

Arora, A., and Gambardella, A. 1990. Complementarity and external linkages: the strategies of the large firms in biotechnology. *Journal of Industrial Economics*, 38, 361-379.

Baldwin J. and Lin Z., 2002. Impediments to advanced technology adoption for Canadian manufacturers, *Research Policy*, 31, pp. 1-18.

Cassiman, B., and Veugelers, R. (2006). In search of complementarity in innovation strategy: internal R&D and external knowledge acquisition. *Management Science*, *52*(1), 68–82.

Cassiman, B., and Veugelers, R. 2002. R&D cooperation and spillovers: Some empirical evidence from Belgium. *American Economic Review*, 92(4), 1169-1184.

Coad, A. and Reid, A. (2012). *The Role of Technology and Technology-Based Firms for Economic Growth.* Technopolis Brighton.

Coad, A.; Marc Cowling, M.; Nightingale, P; Pellegrino, G.; Savona, M. Siepel, M (2014) *Innovative Firms and Growth*. UK Innovation Survey

Couerduroy, R, Murray, G, Cowling, M, Licht, G (2012). Adolescent Firm Survival and Internationalisation. *International Small Business Journal*, 30 (5). August. 472-492.

Criscuolo Haskel J.E. and Slaughter, M.J., (2010) Global engagement and the innovation activities of firms. *International Journal of Industrial Organization* 28(2), pp. 191-202

D'Este P., Iammarino S., Savona M. and von Tunzelmann N. (2012), What Hampers Innovation? Revealed Barriers versus Deterring Barriers, *Research Policy*, 41, 482–488.

D'Este, P., Iammarino, S., Savona, M. and von Tunzelmann, N., 2009. Revealed versus Deterring Barriers to Innovation Evidence from the 4th Community Innovation Survey (CIS4), DIUS Working Paper 09 -09, Department for Innovation, University and Skills.

Den Hertog, P. (2000). Knowledge-intensive business services as co-producers of innovation. *International Journal of Innovation Management*, 4(4), 491–528

Doloreux, D., and Shearmur, R. (2013). Innovation strategies: Are knowledge-intensive business services just another source of information? *Industry and innovation*, *20*(8), 719-738.

Duysters, G., Lokshin, B., (2011). Determinants of Alliance Portfolio Complexity and Its Effect on Innovative Performance of Companies. *Journal of Production innovation Management*. 28, 570–585

Faems, D., B. Van Looy, and K. Debackere, 2005. Interorganizational Collaboration and Innovation: Toward a Portfolio Approach. *Journal of Product Innovation Management.* 22(3): 238-250.

Fawcett, S. E., Magnan, G and McCarter, M. (2008) Benefits, barriers, and bridges to effective supply chain management. *Supply Chain Management: An International Journal* 13, no. 1. 35-48.

Galia, F. and Legros, D. 2004. Complementarities between obstacles to innovation: evidence from France. *Research Policy*, 33, 1185-1199.

García-Quevedo, J., and Mas-Verdú, F. (2008). Does only size matter in the use of knowledge intensive services? *Small Business Economics*, *31*(2), 137-146.

García-Quevedo, J., Pellegrino, G., and Savona, M. (2017). Reviving demand-pull perspectives: The effect of demand uncertainty and stagnancy on R&D strategy. *Cambridge Journal of Economics*, 41, 1087-1122.

Hadjimanolis, A. 1999. Barriers to innovation for SMEs in a small less developed country (Cyprus). *Technovation*, 19, 561-570.

Hagedoorn J.; van Kranenburg H. 2003. Growth patterns in R&D partnerships: an exploratory statistical study. *International Journal of Industrial Organization*, 21(4), 517-531.
Hagedoorn, J. 2002. Inter-firm R&D partnership: an overview of major trends and patterns since 1960. *Research Policy*, 31, 477-492.

Hölzl, W. and Janger, J. 2014: "Distance to the frontier and the perception of innovation barriers across European countries", *Research Policy*, 73(4): 707-725.

Hottenrott H. and Peters B. (2011), Innovative Capability and Financing Constraints for Innovation: More Money, More Innovation? *Review of Economics and Statistics*, 94, 1126–1142.

Hutton, W. and Nightingale P (2011), *The Discouraged Economy*. Work Foundation London

Iammarino S., Sanna-Randaccio F., Savona M. (2009), The perception of obstacles to innovation in foreign multinationals and domestic firms in Italy. *Revue d'Economie Industrielle*, 125, 75–104.

Inauen, M. and A. Schenker-Wicki, 2011. The Impact of Outside-in Open Innovation on Innovation Performance. *European Journal of Innovation Management*. 14(4): 496-520.

Johnson B., Lorenz E., Lundvall B-A., 2002, Why all this fuss about codified and tacit knowledge?, *Industrial and Corporate Change*, vol.11, n°2

Katz, R.,and Allen, T.J. (1982). Investigating the Not Invented Here (NIH) syndrome: A look atthe performance, tenure, and communication patterns of 50 R&D Project Groups. *R&D Management*, 12 (1), 7-20.

Keupp M. and Gassmann O. (2013), Resource constraints as triggers of radical innovation: longitudinal evidence from the manufacturing sector, *Research Policy*, 42, 1457 – 1468.

Klevorick A, Levin R, Nelson R, Winter S. (1995). On the Sources and Significance of Interindustry Differences in Technological Opportunities. *Research Policy* 24(2): 185-205.

Kogut, B., Zander, U., (1992). Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. *Organizational Science*. 3, 383–397.

Laursen, K., and Salter, A. (2006). Open for Innovation: The Role of Openness in Explaining Innovation Performance among U.K. Manufacturing Firms. *Strategic Management Journal*, 27,131–150.

Leiponen, A., and Helfat, C.E. (2010). Innovation objectives, knowledge sources, and the benefits of breadth. *Strategic Management Journal,* 31, 224–236.

Levin RC, Cohen WM, Mowery DC. 1985. R&D Appropriability, Opportunity, and Market Structure: New Evidence on Some Schumpeterian Hypotheses. *The American Economic Review* 75(2): 20-24.

Lichtenthaler, U. (2007). The drivers of technology licensing: an industry comparison. *California Management Review*, *49*(4), 67–89.

Lin, X., and Germain, R. (2004). Antecedents to Customer Involvement in Product Development: Comparing US and Chinese Firms. *European Management Journal*, 22(2), 244-255.

López, A. 2008. Determinants of R&D cooperation: Evidence from Spanish manufacturing firms. *International Journal of Industrial Organization*, 26:113–136

Madrid-Guijarro, A., Garcia, D. and van Auken, H. (2009) Barriers to Innovation among Spanish Manufacturing SMEs. *Journal of Small Business Management*, 47(4), 465-488.

Mancusi, M. and Vezzulli A. (2010), R&D, Innovation, and Liquidity Constraints, *Research Policy*, 31, 1–18.

Mansury, M.A. and Love, J.H. (2007). Innovation, productivity and growth in US business services: A firm level analysis. *Technovation*, 1, 52-62.

Marin, G., Marzucchi, A. and Zoboli, R. (2014). SMEs and Barriers to Eco-Innovation in EU: A Diverse Palette of Greens, Working Paper Nº 2014-04, Ingenio, Valencia, Spain.

McEvily S. and Chakravarthy B. (2002), The persistence of knowledge-based advantage: an empirical test for product performance and technological knowledge, *Strategic Management Journal*, 23(4), 285–305.

Negassi, S. (2004). R&D co-operation and innovation: a microeconometric study on French firms. *Research Policy*, 33, 365–384.

Pellegrino G., (2017). Barriers to innovation in young and mature firms. *Journal of Evolutionary Economics*, forthcoming

Pellegrino, G., and Savona, M. (2017). No money, no honey? Financial versus knowledge and demand constraints on innovation. *Research Policy* 46, 510–521.

Reinstaller A. Hölzl, W., Janger J., Stadler, I., Unterlass F., Daimer S., Stehnken, T. (2010). *Barriers to internationalisation and growth of EU's innovative companies*. PRO INNO Europe: INNO-Grips II report, Brussels: European Commission, DG Enterprise and Industry.

Rouvinen P. (2002). Characteristics of product and process innovators: some evidence from the Finnish innovation survey. *Applied Economics Letters* 9(9): 575-580.

Savignac F. (2008), Impact of financial constraints on innovation: what can be learned from a direct measure? *Economics of Innovation and New Technology*, 17 (6), 553–569.

Siepel, J., Cowling, M., and Coad, A. (2012). *Long run growth and survival of UK high tech firms.* London: NESTA

Suh, Y. and M.-S. Kim, 2012. Effects of Sme Collaboration on R&D in the Service Sector in Open Innovation. *Innovation: Management, Policy & Practice*. 14(3): 349-362

van Donk, P D (2008) Challenges in relating supply chain management and information and communication technology: an introduction." *International Journal of Operations & Production Management 28,* no. 4 308-312.

Zahra, S. A., and George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, *27*(2), 185-203.

Zollo, M., and Winter, S. G. (2002). Deliberate learning and evaluation of dynamic capabilities. *Organization Science, 13*(3), 339-351.

**Table 1. Percentage of firms for which knowledge-related barriers to innovation were 'not experienced' or of low, medium or high importance**

| | Not experienced | Low | Medium | High |
|---|---|---|---|---|
| Lack of qualified personnel | 19.60 | 36 | 33 | 11.40 |
| Lack of information on technology | 19.30 | 41.40 | 31.32 | 8 |
| Lack of information on market | 20.40 | 41.90 | 29.20 | 8.50 |
| Difficulties in finding partners for innovation | 35.90 | 30.2 | 23.50 | 10.50 |

**Table 2. Percentage of firms for which lack of information on technology was 'not experienced' or of low, medium or high importance**

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | Total |
|---|---|---|---|---|---|---|---|---|
| Not experienced | 20.97 | 19.53 | 19.29 | 18.44 | 18.65 | 19 | 19.17 | 19.28 |
| Low | 40.01 | 39.96 | 39.7 | 40.68 | 41.88 | 43.77 | 45.14 | 41.40 |
| Medium | 31.16 | 32.31 | 32.45 | 32.33 | 30.68 | 30.4 | 28.96 | 31.32 |
| High | 7.86 | 8.19 | 8.56 | 8.55 | 8.78 | 6.83 | 6.73 | 8 |
| Number | 3,562 | 4,469 | 4,262 | 4,034 | 3,849 | 3,585 | 2,973 | 26,734 |

**Table 3. Transition probabilities for different perceptions of the obstacle 'lack of information on technology'**

| | | Status at t | | | |
|---|---|---|---|---|---|
| | | Not experienced | Low | Medium | High |
| Status at t – 1 | Not experienced | 69.46 | 18.62 | 9.57 | 2.35 |
| | Low | 8.62 | 76.26 | 12.85 | 2.27 |
| | Medium | 6.27 | 18.73 | 69.49 | 5.5 |
| | High | 6.01 | 11.51 | 23.53 | 58.95 |
| | Total | 19.30 | 41.40 | 31.32 | 8 |

**Table 4. Determinants of perception of lack of information on technology—random effects probit estimations (total sample and macro sector categories)**

| | (1) Total | (2) Low-/low-med-tech | (3) Med-high-tech | (4) High-tech |
|---|---|---|---|---|
| Exporter dummy t-1 | -0.018 | -0.018 | 0.004 | -0.066 |
| | (0.045) | (0.055) | (0.087) | (0.176) |
| Industrial group t-1 | -0.094** | 0.033 | -0.284*** | -0.228 |
| | (0.045) | (0.057) | (0.080) | (0.174) |
| Innovation expenditure dummy t-1 | 0.058 | 0.067 | 0.020 | 0.307 |
| | (0.036) | (0.042) | (0.071) | (0.204) |
| ln(Age) | -0.128 | -0.092 | -0.121 | -0.649 |
| | (0.195) | (0.241) | (0.380) | (0.743) |
| ln(Age) sq. | 0.021 | 0.027 | 0.005 | 0.097 |
| | (0.032) | (0.040) | (0.062) | (0.127) |
| ln(Size) t-1 | 0.477*** | 0.374*** | 0.576*** | 0.572* |
| | (0.091) | (0.120) | (0.165) | (0.312) |
| ln(Size) sq. t-1 | -0.067*** | -0.056*** | -0.079*** | -0.066* |
| | (0.010) | (0.014) | (0.018) | (0.035) |
| Low-med-tech. | 0.125* | | | |
| | (0.065) | | | |
| Med-high-tech. | -0.062 | | | |
| | (0.063) | | | |
| High-tech. | -0.367*** | | | |
| | (0.107) | | | |
| Year dummies | Yes | Yes | Yes | Yes |
| Sector dummies | No | Yes | Yes | Yes |
| Number of observations | 26,734 | 15,862 | 8,890 | 1,982 |
| Log likelihood | -13,731.42 | -8,298.58 | -4,483.83 | -910.75 |
| Sigma | 1.502*** | 1.482*** | 1.503*** | 1.594** |
| | (0.030) | (0.038) | (0.052) | (0.123) |
| Rho | 0.693*** | 0.687*** | 0.693*** | 0.718** |
| LR test for Rho | 7,842.892 | 4,561.016 | 2,613.168 | 586.880 |

Notes: ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. All coefficients are marginal effects evaluated at the means of the other regressors. Standard errors (in brackets) are obtained by the delta method. Dependent variable: Lack of information on technology. Dummy (medium and high importance) (see definition in Table A1).

**Table 5. Overcoming lack of information on technology—random effects probit estimates main estimation and robustness check (total sample)**

| | (1) | (2) |
|---|---|---|
| Applied research(int.) | -0.169* | -0.348* |
| | (0.098) | (0.185) |
| Basic research (int.) | -0.825* | -1.719* |
| | (0.471) | (0.873) |
| Cooperation | -0.003 | -0.004 |
| | (0.006) | (0.012) |
| Exporter dummy | -0.008 | -0.020 |
| | (0.009) | (0.017) |
| External R&D | -0.313 | -0.432 |
| | (0.202) | (0.385) |
| Industrial group | -0.008 | -0.026** |
| | (0.007) | (0.013) |
| Info (clients) | 0.012* | 0.001 |
| | (0.007) | (0.013) |
| Info (competitors) | -0.002 | 0.011 |
| | (0.006) | (0.012) |
| Info (laborat.) | 0.019*** | 0.035*** |
| | (0.006) | (0.012) |
| Info (suppliers) | 0.013** | 0.016 |
| | (0.006) | (0.012) |
| Info (univers./publ.) | -0.011 | -0.019 |
| | (0.007) | (0.013) |
| ln(Age) | -0.033 | -0.037 |
| | (0.028) | (0.051) |
| ln(Age) sq. | 0.005 | 0.004 |
| | (0.005) | (0.008) |
| ln(Size) | 0.066*** | 0.127*** |
| | (0.016) | (0.029) |
| ln(Size) sq. | -0.007*** | -0.014*** |
| | (0.002) | (0.003) |
| Subsidy dummy | 0.010* | 0.022* |
| | (0.006) | (0.012) |
| Technology acquisition | -0.060 | -0.147 |
| | (0.117) | (0.227) |
| Year dummies | Yes | Yes |
| Sector dummies | Yes | Yes |
| Number of observations | 8,205 | 4,335 |
| Log likelihood | -2,210.53 | -1,764.15 |

Notes: ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. All coefficients are marginal effects evaluated at the means of the other regressors. Standard errors (in brackets) are obtained by the delta method. Dependent variable: Lack of information on technology (overcome) (see definition in Table A1 and Section 4).

**Table A1. variables: acronyms and definitions**

| Variable name | Variable description |
|---|---|
| Lack of information dummy (med/high) | Dummy = 1 if the firm reports lack of information on technology as barrier to innovation of high or medium importance; 0 otherwise |
| Lack of information (overcome) | Dummy = 1 if the average value of the variable 'lack of information on technology' for firm *i* ranges from 0.75 to 1 for the period 2004 to 2007 and ranges from 0 to 0.25 for the period 2008 to 2011; 0 otherwise |
| Applied research (internal) | Total expenditure on applied internal research divided by turnover |
| Basic research (internal) | Total firm expenditure on basic internal research divided by turnover |
| Cooperation | Dummy = 1 if the firm takes part in cooperative innovative activities |
| Exporter dummy | Dummy = 1 if the firm has traded in an international market over the three-year period; 0 otherwise |
| External R&D | Total expenditures on external R&D divided by turnover |
| Industrial group | Dummy = 1 if the firm belongs to an industrial group |
| Info (clients) | Dummy = 1 if the firm reports information for innovation activities from clients is of high or medium importance |
| Info (competitors) | Dummy = 1 if the firm reports information for innovation activities from competitors is of high or medium importance |
| Info (laboratories) | Dummy = 1 if the firm reports information for innovation activities from laboratories, consultancies and private research centres is of high or medium importance |
| Info (suppliers) | Dummy = 1 if the firm reports information for innovation activities from suppliers is of high or medium importance |
| Info (universities/ public research institutes) | Dummy = 1 if the firm reports information for innovation activities from universities and/or public research centres is of high or medium importance |
| Innovation expenditure dummy | Dummy = 1 if the firm has invested in at least 1 of the 7 categories of innovation activity included in the questionnaire |
| ln(Age) | Natural logarithm of firm age (years elapsed since firms was founded) |
| ln(Age) squared | Squared value of natural logarithm of firm's age (years elapsed since firms was founded) |
| ln(Size) | Natural logarithm of total number of employees in firm |
| ln(Size) squared | Squared value of natural logarithm of employees in firm |
| Subsidy dummy | Dummy = 1 if the firm has received public support for innovation; 0 otherwise |
| Technology acquisition | Total expenditure on technological acquisitions (machinery and equipment) divided by turnover |

**Table A2. Descriptive statistics (mean, standard deviation, median, minimum and maximum) for all firms**

| | Mean | SD | Median | Min | Max |
|---|---|---|---|---|---|
| Tech. info (medium-high) | 0.393 | 0.488 | 0 | 0 | 1 |
| Exporter dummy t-1 | 0.827 | 0.378 | 1 | 0 | 1 |
| Industrial group t-1 | 0.378 | 0.485 | 0 | 0 | 1 |
| ln(Age) | 3.204 | 0.630 | 3.219 | 0 | 5.088 |
| ln(Age) sq. | 10.661 | 3.933 | 10.36 | 0 | 25.883 |
| ln(Size) t-1 | 4.162 | 1.286 | 4.025 | 0.6931 | 9.253 |
| ln(Size) sq. t-1 | 18.978 | 11.604 | 16.232 | 0.4805 | 85.616 |
| Innovation expenditure dummy t-1 | 0.865 | 0.341 | 1 | 0 | 1 |
| Med-low-tech. | 0.273 | 0.446 | 0 | 0 | 1 |
| Med-hi-tech. | 0.333 | 0.471 | 0 | 0 | 1 |
| Hi-tech. | 0.074 | 0.262 | 0 | 0 | 1 |

**Table A3. Descriptive statistics (mean, standard deviation, median, minimum and maximum) for innovative firms**

| | Mean | SD | Median | Min | Max |
|---|---|---|---|---|---|
| Tech. info (medium-high) | 0.393 | 0.489 | 0 | 0 | 1 |
| Exporter dummy | 0.884 | 0.320 | 1 | 0 | 1 |
| Industrial group | 0.425 | 0.494 | 0 | 0 | 1 |
| ln(Age) | 3.200 | 0.659 | 3.258 | 0 | 4.834 |
| ln(Age) sq. | 10.676 | 4.076 | 10.620 | 0 | 23.334 |
| ln(Size) | 4.437 | 1.254 | 4.344 | 1.099 | 9.256 |
| ln(Size) sq. | 21.257 | 11.964 | 18.870 | 1.207 | 85.670 |
| Subsidy dummy | 0.493 | 0.500 | 0 | 0 | 1 |
| Cooperation | 0.411 | 0.492 | 0 | 0 | 1 |
| Tech. acquisition | 0.006 | 0.029 | 0 | 0 | 0.899 |
| External R&D | 0.007 | 0.030 | 0 | 0 | 0.936 |
| Info (clients) | 0.647 | 0.478 | 1 | 0 | 1 |
| Info (competitors) | 0.460 | 0.498 | 0 | 0 | 1 |
| Info (laboratories) | 0.344 | 0.475 | 0 | 0 | 1 |
| Info (suppliers) | 0.589 | 0.492 | 1 | 0 | 1 |
| Info (univers./publ. res. inst.) | 0.308 | 0.462 | 0 | 0 | 1 |
| Basic research (int.) | 0.002 | 0.015 | 0 | 0 | 0.503 |
| Appl. research (int.) | 0.015 | 0.065 | 0.001 | 0 | 2.420 |

**Table A4. PITEC questionnaire: barriers to innovation**

*During the three-year period, how important were the following factors in constraining your innovation activities or influencing your decision to innovate?*

| Barrier factors | Barrier items | Factors not experienced | Degree of importance | | |
|---|---|---|---|---|---|
| | | | Low | Medium | High |
| Cost factors | Lack of available finance within the firm | ☐ | ☐ | ☐ | ☐ |
| | Lack of available finance from other organisations | ☐ | ☐ | ☐ | ☐ |
| | Direct innovation costs too high | ☐ | ☐ | ☐ | ☐ |
| Knowledge factors | Lack of qualified personnel | ☐ | ☐ | ☐ | ☐ |
| | Lack of information on technology | ☐ | ☐ | ☐ | ☐ |
| | Lack of information on markets | ☐ | ☐ | ☐ | ☐ |
| | Difficulties in finding partners for innovation | ☐ | ☐ | ☐ | ☐ |
| Market factors | Market dominated by established enterprises | ☐ | ☐ | ☐ | ☐ |
| | Uncertain demand for innovative goods or services | | | | |

**2013**

**2013/1, Sánchez-Vidal, M.; González-Val, R.; Viladecans-Marsal, E.:** "Sequential city growth in the US: does age matter?"
**2013/2, Hortas Rico, M.:** "Sprawl, blight and the role of urban containment policies. Evidence from US cities"
**2013/3, Lampón, J.F.; Cabanelas-Lorenzo, P-; Lago-Peñas, S.:** "Why firms relocate their production overseas? The answer lies inside: corporate, logistic and technological determinants"
**2013/4, Montolio, D.; Planells, S.:** "Does tourism boost criminal activity? Evidence from a top touristic country"
**2013/5, Garcia-López, M.A.; Holl, A.; Viladecans-Marsal, E.:** "Suburbanization and highways: when the Romans, the Bourbons and the first cars still shape Spanish cities"
**2013/6, Bosch, N.; Espasa, M.; Montolio, D.:** "Should large Spanish municipalities be financially compensated? Costs and benefits of being a capital/central municipality"
**2013/7, Escardíbul, J.O.; Mora, T.:** "Teacher gender and student performance in mathematics. Evidence from Catalonia"
**2013/8, Arqué-Castells, P.; Viladecans-Marsal, E.:** "Banking towards development: evidence from the Spanish banking expansion plan"
**2013/9, Asensio, J.; Gómez-Lobo, A.; Matas, A.:** "How effective are policies to reduce gasoline consumption? Evaluating a quasi-natural experiment in Spain"
**2013/10, Jofre-Monseny, J.:** "The effects of unemployment benefits on migration in lagging regions"
**2013/11, Segarra, A.; García-Quevedo, J.; Teruel, M.:** "Financial constraints and the failure of innovation projects"
**2013/12, Jerrim, J.; Choi, A.:** "The mathematics skills of school children: How does England compare to the high performing East Asian jurisdictions?"
**2013/13, González-Val, R.; Tirado-Fabregat, D.A.; Viladecans-Marsal, E.:** "Market potential and city growth: Spain 1860-1960"
**2013/14, Lundqvist, H.:** "Is it worth it? On the returns to holding political office"
**2013/15, Ahlfeldt, G.M.; Maennig, W.:** "Homevoters vs. leasevoters: a spatial analysis of airport effects"
**2013/16, Lampón, J.F.; Lago-Peñas, S.:** "Factors behind international relocation and changes in production geography in the European automobile components industry"
**2013/17, Guío, J.M.; Choi, A.:** "Evolution of the school failure risk during the 2000 decade in Spain: analysis of Pisa results with a two-level logistic mode"
**2013/18, Dahlby, B.; Rodden, J.:** "A political economy model of the vertical fiscal gap and vertical fiscal imbalances in a federation"
**2013/19, Acacia, F.; Cubel, M.:** "Strategic voting and happiness"
**2013/20, Hellerstein, J.K.; Kutzbach, M.J.; Neumark, D.:** "Do labor market networks have an important spatial dimension?"
**2013/21, Pellegrino, G.; Savona, M.:** "Is money all? Financing versus knowledge and demand constraints to innovation"
**2013/22, Lin, J.:** "Regional resilience"
**2013/23, Costa-Campi, M.T.; Duch-Brown, N.; García-Quevedo, J.:** "R&D drivers and obstacles to innovation in the energy industry"
**2013/24, Huisman, R.; Stradnic, V.; Westgaard, S.:** "Renewable energy and electricity prices: indirect empirical evidence from hydro power"
**2013/25, Dargaud, E.; Mantovani, A.; Reggiani, C.:** "The fight against cartels: a transatlantic perspective"
**2013/26, Lambertini, L.; Mantovani, A.:** "Feedback equilibria in a dynamic renewable resource oligopoly: pre-emption, voracity and exhaustion"
**2013/27, Feld, L.P.; Kalb, A.; Moessinger, M.D.; Osterloh, S.:** "Sovereign bond market reactions to fiscal rules and no-bailout clauses – the Swiss experience"
**2013/28, Hilber, C.A.L.; Vermeulen, W.:** "The impact of supply constraints on house prices in England"
**2013/29, Revelli, F.:** "Tax limits and local democracy"
**2013/30, Wang, R.; Wang, W.:** "Dress-up contest: a dark side of fiscal decentralization"
**2013/31, Dargaud, E.; Mantovani, A.; Reggiani, C.:** "The fight against cartels: a transatlantic perspective"
**2013/32, Saarimaa, T.; Tukiainen, J.:** "Local representation and strategic voting: evidence from electoral boundary reforms"
**2013/33, Agasisti, T.; Murtinu, S.:** "Are we wasting public money? No! The effects of grants on Italian university students' performances"
**2013/34, Flacher, D.; Harari-Kermadec, H.; Moulin, L.:** "Financing higher education: a contributory scheme"
**2013/35, Carozzi, F.; Repetto, L.:** "Sending the pork home: birth town bias in transfers to Italian municipalities"
**2013/36, Coad, A.; Frankish, J.S.; Roberts, R.G.; Storey, D.J.:** "New venture survival and growth: Does the fog lift?"
**2013/37, Giulietti, M.; Grossi, L.; Waterson, M.:** "Revenues from storage in a competitive electricity market: Empirical evidence from Great Britain"

**2014**

**2014/1, Montolio, D.; Planells-Struse, S.:** "When police patrols matter. The effect of police proximity on citizens' crime risk perception"
**2014/2, Garcia-López, M.A.; Solé-Ollé, A.; Viladecans-Marsal, E.:** "Do land use policies follow road construction?"
**2014/3, Piolatto, A.; Rablen, M.D.:** "Prospect theory and tax evasion: a reconsideration of the Yitzhaki puzzle"
**2014/4, Cuberes, D.; González-Val, R.:** "The effect of the Spanish Reconquest on Iberian Cities"
**2014/5, Durán-Cabré, J.M.; Esteller-Moré, E.:** "Tax professionals' view of the Spanish tax system: efficiency, equity and tax planning"
**2014/6, Cubel, M.; Sanchez-Pages, S.:** "Difference-form group contests"
**2014/7, Del Rey, E.; Racionero, M.:** "Choosing the type of income-contingent loan: risk-sharing versus risk-pooling"
**2014/8, Torregrosa Hetland, S.:** "A fiscal revolution? Progressivity in the Spanish tax system, 1960-1990"
**2014/9, Piolatto, A.:** "Itemised deductions: a device to reduce tax evasion"
**2014/10, Costa, M.T.; García-Quevedo, J.; Segarra, A.:** "Energy efficiency determinants: an empirical analysis of Spanish innovative firms"
**2014/11, García-Quevedo, J.; Pellegrino, G.; Savona, M.:** "Reviving demand-pull perspectives: the effect of demand uncertainty and stagnancy on R&D strategy"
**2014/12, Calero, J.; Escardíbul, J.O.:** "Barriers to non-formal professional training in Spain in periods of economic growth and crisis. An analysis with special attention to the effect of the previous human capital of workers"
**2014/13, Cubel, M.; Sanchez-Pages, S.:** "Gender differences and stereotypes in the beauty"
**2014/14, Piolatto, A.; Schuett, F.:** "Media competition and electoral politics"
**2014/15, Montolio, D.; Trillas, F.; Trujillo-Baute, E.:** "Regulatory environment and firm performance in EU telecommunications services"
**2014/16, Lopez-Rodriguez, J.; Martinez, D.:** "Beyond the R&D effects on innovation: the contribution of non-R&D activities to TFP growth in the EU"
**2014/17, González-Val, R.:** "Cross-sectional growth in US cities from 1990 to 2000"
**2014/18, Vona, F.; Nicolli, F.:** "Energy market liberalization and renewable energy policies in OECD countries"
**2014/19, Curto-Grau, M.:** "Voters' responsiveness to public employment policies"
**2014/20, Duro, J.A.; Teixidó-Figueras, J.; Padilla, E.:** "The causal factors of international inequality in co2 emissions per capita: a regression-based inequality decomposition analysis"
**2014/21, Fleten, S.E.; Huisman, R.; Kilic, M.; Pennings, E.; Westgaard, S.:** "Electricity futures prices: time varying sensitivity to fundamentals"
**2014/22, Afcha, S.; García-Quevedo, J,:** "The impact of R&D subsidies on R&D employment composition"
**2014/23, Mir-Artigues, P.; del Río, P.:** "Combining tariffs, investment subsidies and soft loans in a renewable electricity deployment policy"
**2014/24, Romero-Jordán, D.; del Río, P.; Peñasco, C.:** "Household electricity demand in Spanish regions. Public policy implications"
**2014/25, Salinas, P.:** "The effect of decentralization on educational outcomes: real autonomy matters!"
**2014/26, Solé-Ollé, A.; Sorribas-Navarro, P.:** "Does corruption erode trust in government? Evidence from a recent surge of local scandals in Spain"
**2014/27, Costas-Pérez, E.:** "Political corruption and voter turnout: mobilization or disaffection?"
**2014/28, Cubel, M.; Nuevo-Chiquero, A.; Sanchez-Pages, S.; Vidal-Fernandez, M.:** "Do personality traits affect productivity? Evidence from the LAB"
**2014/29, Teresa Costa, M.T.; Trujillo-Baute, E.:** "Retail price effects of feed-in tariff regulation"
**2014/30, Kilic, M.; Trujillo-Baute, E.:** "The stabilizing effect of hydro reservoir levels on intraday power prices under wind forecast errors"
**2014/31, Costa-Campi, M.T.; Duch-Brown, N.:** "The diffusion of patented oil and gas technology with environmental uses: a forward patent citation analysis"
**2014/32, Ramos, R.; Sanromá, E.; Simón, H.:** "Public-private sector wage differentials by type of contract: evidence from Spain"
**2014/33, Backus, P.; Esteller-Moré, A.:** "Is income redistribution a form of insurance, a public good or both?"
**2014/34, Huisman, R.; Trujillo-Baute, E.:** "Costs of power supply flexibility: the indirect impact of a Spanish policy change"
**2014/35, Jerrim, J.; Choi, A.; Simancas Rodríguez, R.:** "Two-sample two-stage least squares (TSTSLS) estimates of earnings mobility: how consistent are they?"
**2014/36, Mantovani, A.; Tarola, O.; Vergari, C.:** "Hedonic quality, social norms, and environmental campaigns"
**2014/37, Ferraresi, M.; Galmarini, U.; Rizzo, L.:** "Local infrastructures and externalities: Does the size matter?"
**2014/38, Ferraresi, M.; Rizzo, L.; Zanardi, A.:** "Policy outcomes of single and double-ballot elections"

**2015**

**2015/1, Foremny, D.; Freier, R.; Moessinger, M-D.; Yeter, M.:** "Overlapping political budget cycles in the legislative and the executive"
**2015/2, Colombo, L.; Galmarini, U.:** "Optimality and distortionary lobbying: regulating tobacco consumption"
**2015/3, Pellegrino, G.:** "Barriers to innovation: Can firm age help lower them?"
**2015/4, Hémet, C.:** "Diversity and employment prospects: neighbors matter!"
**2015/5, Cubel, M.; Sanchez-Pages, S.:** "An axiomatization of difference-form contest success functions"
**2015/6, Choi, A.; Jerrim, J.:** "The use (and misuse) of Pisa in guiding policy reform: the case of Spain"
**2015/7, Durán-Cabré, J.M.; Esteller-Moré, A.; Salvadori, L.:** "Empirical evidence on tax cooperation between sub-central administrations"
**2015/8, Batalla-Bejerano, J.; Trujillo-Baute, E.:** "Analysing the sensitivity of electricity system operational costs to deviations in supply and demand"
**2015/9, Salvadori, L.:** "Does tax enforcement counteract the negative effects of terrorism? A case study of the Basque Country"
**2015/10, Montolio, D.; Planells-Struse, S.:** "How time shapes crime: the temporal impacts of football matches on crime"
**2015/11, Piolatto, A.:** "Online booking and information: competition and welfare consequences of review aggregators"
**2015/12, Boffa, F.; Pingali, V.; Sala, F.:** "Strategic investment in merchant transmission: the impact of capacity utilization rules"
**2015/13, Slemrod, J.:** "Tax administration and tax systems"
**2015/14, Arqué-Castells, P.; Cartaxo, R.M.; García-Quevedo, J.; Mira Godinho, M.:** "How inventor royalty shares affect patenting and income in Portugal and Spain"
**2015/15, Montolio, D.; Planells-Struse, S.:** "Measuring the negative externalities of a private leisure activity: hooligans and pickpockets around the stadium"
**2015/16, Batalla-Bejerano, J.; Costa-Campi, M.T.; Trujillo-Baute, E.:** "Unexpected consequences of liberalisation: metering, losses, load profiles and cost settlement in Spain's electricity system"
**2015/17, Batalla-Bejerano, J.; Trujillo-Baute, E.:** "Impacts of intermittent renewable generation on electricity system costs"
**2015/18, Costa-Campi, M.T.; Paniagua, J.; Trujillo-Baute, E.:** "Are energy market integrations a green light for FDI?"
**2015/19, Jofre-Monseny, J.; Sánchez-Vidal, M.; Viladecans-Marsal, E.:** "Big plant closures and agglomeration economies"
**2015/20, Garcia-López, M.A.; Hémet, C.; Viladecans-Marsal, E.:** "How does transportation shape intrametropolitan growth? An answer from the regional express rail"
**2015/21, Esteller-Moré, A.; Galmarini, U.; Rizzo, L.:** "Fiscal equalization under political pressures"
**2015/22, Escardíbul, J.O.; Afcha, S.:** "Determinants of doctorate holders' job satisfaction. An analysis by employment sector and type of satisfaction in Spain"
**2015/23, Aidt, T.; Asatryan, Z.; Badalyan, L.; Heinemann, F.:** "Vote buying or (political) business (cycles) as usual?"
**2015/24, Albæk, K.:** "A test of the 'lose it or use it' hypothesis in labour markets around the world"
**2015/25, Angelucci, C.; Russo, A.:** "Petty corruption and citizen feedback"
**2015/26, Moriconi, S.; Picard, P.M.; Zanaj, S.:** "Commodity taxation and regulatory competition"
**2015/27, Brekke, K.R.; Garcia Pires, A.J.; Schindler, D.; Schjelderup, G.:** "Capital taxation and imperfect competition: ACE vs. CBIT"
**2015/28, Redonda, A.:** "Market structure, the functional form of demand and the sensitivity of the vertical reaction function"
**2015/29, Ramos, R.; Sanromá, E.; Simón, H.:** "An analysis of wage differentials between full-and part-time workers in Spain"
**2015/30, Garcia-López, M.A.; Pasidis, I.; Viladecans-Marsal, E.:** "Express delivery to the suburbs the effects of transportation in Europe's heterogeneous cities"
**2015/31, Torregrosa, S.:** "Bypassing progressive taxation: fraud and base erosion in the Spanish income tax (1970-2001)"
**2015/32, Choi, H.; Choi, A.:** "When one door closes: the impact of the hagwon curfew on the consumption of private tutoring in the republic of Korea"
**2015/33, Escardíbul, J.O.; Helmy, N.:** "Decentralisation and school autonomy impact on the quality of education: the case of two MENA countries"
**2015/34, González-Val, R.; Marcén, M.:** "Divorce and the business cycle: a cross-country analysis"

**2015/35, Calero, J.; Choi, A.:** "The distribution of skills among the European adult population and unemployment: a comparative approach"
**2015/36, Mediavilla, M.; Zancajo, A.:** "Is there real freedom of school choice? An analysis from Chile"
**2015/37, Daniele, G.:** "Strike one to educate one hundred: organized crime, political selection and politicians' ability"
**2015/38, González-Val, R.; Marcén, M.:** "Regional unemployment, marriage, and divorce"
**2015/39, Foremny, D.; Jofre-Monseny, J.; Solé-Ollé, A.:** "'Hold that ghost': using notches to identify manipulation of population-based grants"
**2015/40, Mancebón, M.J.; Ximénez-de-Embún, D.P.; Mediavilla, M.; Gómez-Sancho, J.M.:** "Does educational management model matter? New evidence for Spain by a quasiexperimental approach"
**2015/41, Daniele, G.; Geys, B.:** "Exposing politicians' ties to criminal organizations: the effects of local government dissolutions on electoral outcomes in Southern Italian municipalities"
**2015/42, Ooghe, E.:** "Wage policies, employment, and redistributive efficiency"

**2016**

**2016/1, Galletta, S.:** "Law enforcement, municipal budgets and spillover effects: evidence from a quasi-experiment in Italy"
**2016/2, Flatley, L.; Giulietti, M.; Grossi, L.; Trujillo-Baute, E.; Waterson, M.:** "Analysing the potential economic value of energy storage"
**2016/3, Calero, J.; Murillo Huertas, I.P.; Raymond Bara, J.L.:** "Education, age and skills: an analysis using the PIAAC survey"
**2016/4, Costa-Campi, M.T.; Daví-Arderius, D.; Trujillo-Baute, E.:** "The economic impact of electricity losses"
**2016/5, Falck, O.; Heimisch, A.; Wiederhold, S.:** "Returns to ICT skills"
**2016/6, Halmenschlager, C.; Mantovani, A.:** "On the private and social desirability of mixed bundling in complementary markets with cost savings"
**2016/7, Choi, A.; Gil, M.; Mediavilla, M.; Valbuena, J.:** "Double toil and trouble: grade retention and academic performance"
**2016/8, González-Val, R.:** "Historical urban growth in Europe (1300–1800)"
**2016/9, Guio, J.; Choi, A.; Escardíbul, J.O.:** "Labor markets, academic performance and the risk of school dropout: evidence for Spain"
**2016/10, Bianchini, S.; Pellegrino, G.; Tamagni, F.:** "Innovation strategies and firm growth"
**2016/11, Jofre-Monseny, J.; Silva, J.I.; Vázquez-Grenno, J.:** "Local labor market effects of public employment"
**2016/12, Sanchez-Vidal, M.:** "Small shops for sale! The effects of big-box openings on grocery stores"
**2016/13, Costa-Campi, M.T.; García-Quevedo, J.; Martínez-Ros, E.:** "What are the determinants of investment in environmental R&D?"
**2016/14**, **García-López, M.A; Hémet, C.; Viladecans-Marsal, E.:** "Next train to the polycentric city: The effect of railroads on subcenter formation"
**2016/15, Matas, A.; Raymond, J.L.; Dominguez, A.:** "Changes in fuel economy: An analysis of the Spanish car market"
**2016/16, Leme, A.; Escardíbul, J.O.:** "The effect of a specialized versus a general upper secondary school curriculum on students' performance and inequality. A difference-in-differences cross country comparison"
**2016/17**, **Scandurra, R.I.; Calero, J.**: "Modelling adult skills in OECD countries"
**2016/18**, **Fernández-Gutiérrez, M.; Calero, J.**: "Leisure and education: insights from a time-use analysis"
**2016/19, Del Rio, P.; Mir-Artigues, P.; Trujillo-Baute, E.**: "Analysing the impact of renewable energy regulation on retail electricity prices"
**2016/20, Taltavull de la Paz, P.; Juárez, F.; Monllor, P.:** "Fuel Poverty: Evidence from housing perspective"
**2016/21, Ferraresi, M.; Galmarini, U.; Rizzo, L.; Zanardi, A.:** "Switch towards tax centralization in Italy: A wake up for the local political budget cycle"
**2016/22, Ferraresi, M.; Migali, G.; Nordi, F.; Rizzo, L.: "**Spatial interaction in local expenditures among Italian municipalities: evidence from Italy 2001-2011"
**2016/23, Daví-Arderius, D.; Sanin, M.E.; Trujillo-Baute, E.: "**CO2 content of electricity losses"
**2016/24, Arqué-Castells, P.; Viladecans-Marsal, E.:** "Banking the unbanked: Evidence from the Spanish banking expansion plan"
**2016/25 Choi, Á.; Gil, M.; Mediavilla, M.; Valbuena, J.:** "The evolution of educational inequalities in Spain: Dynamic evidence from repeated cross-sections"
**2016/26, Brutti, Z.**: "Cities drifting apart: Heterogeneous outcomes of decentralizing public education"
**2016/27, Backus, P.; Cubel, M.; Guid, M.; Sánchez-Pages, S.; Lopez Manas, E.**: "Gender, competition and performance: evidence from real tournaments"
**2016/28, Costa-Campi, M.T.; Duch-Brown, N.; García-Quevedo, J.**: "Innovation strategies of energy firms"
**2016/29, Daniele, G.; Dipoppa, G.**: "Mafia, elections and violence against politicians"

**2016/30, Di Cosmo, V.; Malaguzzi Valeri, L.**: "Wind, storage, interconnection and the cost of electricity"

**2017**

**2017/1, González Pampillón, N.; Jofre-Monseny, J.; Viladecans-Marsal, E.:** "Can urban renewal policies reverse neighborhood ethnic dynamics?"
**2017/2, Gómez San Román, T.:** "Integration of DERs on power systems: challenges and opportunities"
**2017/3, Bianchini, S.; Pellegrino, G.:** "Innovation persistence and employment dynamics"
**2017/4, Curto-Grau, M.; Solé-Ollé, A.; Sorribas-Navarro, P.:** "Does electoral competition curb party favoritism?"
**2017/5, Solé-Ollé, A.; Viladecans-Marsal, E.:** "Housing booms and busts and local fiscal policy"
**2017/6, Esteller, A.; Piolatto, A.; Rablen, M.D.:** "Taxing high-income earners: Tax avoidance and mobility"
**2017/7, Combes, P.P.; Duranton, G.; Gobillon, L.:** "The production function for housing: Evidence from France"
**2017/8, Nepal, R.; Cram, L.; Jamasb, T.; Sen, A.:** "Small systems, big targets: power sector reforms and renewable energy development in small electricity systems"
**2017/9, Carozzi, F.; Repetto, L.:** "Distributive politics inside the city? The political economy of Spain's plan E"
**2017/10, Neisser, C.:** "The elasticity of taxable income: A meta-regression analysis"
**2017/11, Baker, E.; Bosetti, V.; Salo, A.:** "Finding common ground when experts disagree: robust portfolio decision analysis"
**2017/12, Murillo, I.P; Raymond, J.L; Calero, J.:** "Efficiency in the transformation of schooling into competences: A cross-country analysis using PIAAC data"
**2017/13**, **Ferrer-Esteban, G.; Mediavilla, M.:** "The more educated, the more engaged? An analysis of social capital and education"
**2017/14, Sanchis-Guarner, R.:** "Decomposing the impact of immigration on house prices"
**2017/15, Schwab, T.; Todtenhaupt, M.:** "Spillover from the haven: Cross-border externalities of patent box regimes within multinational firms"
**2017/16, Chacón, M.; Jensen, J.:** "The institutional determinants of Southern secession"
**2017/17, Gancia, G.; Ponzetto, G.A.M.; Ventura, J.:** "Globalization and political structure"
**2017/18, González-Val, R.:** "City size distribution and space"

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