

# Cooperative innovation and crises: Foreign subsidiaries, state-owned enterprises, and domestic private firms

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## Abstract

This article studies whether foreign subsidiaries (FSs) are able to cooperate for innovation with local partners during good and harsh economic times. It also enquires as to whether these companies and different types of domestic firms displayed similar cooperative behaviour during 2004–16. The period is divided into three sub-periods (boom, downturn, and recovery), and three logit models with panel data of a representative sample of Spanish firms are proposed. The ability of FSs to cooperate for innovation is maintained throughout the business cycle. These firms are better at cooperating than are unaffiliated firms but not significantly better than domestic business groups. State-owned enterprises strongly outperform both FSs and domestic private firms during the boom, the downturn, and the recovery. Unaffiliated domestic firms manage to cooperate during the boom and the recovery but not during the downturn. Predictors of cooperative innovation vary throughout the business cycle. The results contain policy implications.

**Key words:** business cycle; crisis; downturn; MNE; foreign subsidiaries; state-owned enterprises; cooperation for innovation; internationalisation of R&D.

## 1. Introduction

The increasing costs of Research and Development (R&D), the rapid pace of technological change, and the diversity of technological fields employed today to produce even ‘traditional’ goods (Molero and García 2008) are inducing firms to engage in open innovation with a variety of partners. This arrangement enables them to access new technology, reduce time to market, and share R&D expenditures, which constitute crucial considerations in times of crisis. One such open innovation strategy is cooperation for innovation, which consists of the active participation of a firm in innovative activities carried out either with other companies or with institutions, such as universities. Firms that engage in cooperation for innovation are more likely than others to exhibit good innovative performance (Arvanitis and Bolli 2013; Radicic et al. 2019). Beyond its importance at the microeconomic level, cooperative innovation may also contribute towards the development of the National Innovation System (NIS) (Liu et al. 2017).

In this new panorama, multinational enterprises (MNEs) are no exception. Although traditional international business (IB) studies have assumed that knowledge flows from the MNE to the host country, recent analyses show that knowledge also flows from the host country to the MNE (for a review, see Papanastassiou et al. 2019). These firms view cooperation with local partners as an opportunity to accelerate innovation and to access external resources and competencies. Conversely, both academics and policymakers have often advised governments to deploy policies to attract foreign direct investment (FDI) in R&D in the belief that this strategy would promote technology transfers to the host

country (Guimón 2011). However, there is no consensus as to whether MNEs are, in fact, willing and/or able to cooperate with local partners. Moreover, we know very little about their cooperative strategy during a crisis. Based largely on data from the Community Innovation Survey (CIS) of the European Union (EU), the relationship between foreign ownership and the probability of cooperation for innovation has been tested during ‘normal’ phases of the business cycle (Arvanitis and Bolli 2013; Dachs et al. 2008; Ebersberger and Herstad 2012; Ebersberger et al. 2011; García-Sánchez et al. 2016; Guimón and Salazar-Elena 2015; Srholec 2009; Veugelers and Cassiman 2004). With certain exceptions (García-Sánchez and Rama 2020), quantitative analyses of this relationship during downturns have yet to attract the interest of academics. The main drawback therein probably involves the lack of panel data.

Our study strives to contribute towards filling this gap. Crises may seriously hamper the innovative abilities of companies (Archibugi et al. 2013; Holl and Rama 2016; Madrid-Guijarro et al. 2013; Paunov 2012), and the capacity of foreign subsidiaries (FSs) to maintain cooperative<sup>1</sup> activities with local partners even during downturns could help domestic firms and institutions remain innovative. When faced with a global crisis, firms that are able to cooperate fare better than others (D’Agostino and Moreno 2018; Mendi et al. 2020; Zouaghi et al. 2018). However, during crises, cooperation for innovation may present additional difficulties to the FS and its local partners. Williams and Ecker (2011) note that the embeddedness of R&D subsidiaries should not be considered static, and instead, they recommend

the analysis of longitudinal evidence since certain circumstances may change, such as the availability of resources to the domestic partners of the FS. Moreover, the FS may judge that incurring the risks and effort required by cooperation (Lhuillery and Pfister 2009) are not worthwhile, given the contraction of the demand. Consequently, the risk of ‘branch plant syndrome’, characterised by the poor integration of FSs into the local milieu (Phelps 1993), may increase during a recession.

In a comparative framework, we also strive to fully understand the role of state-owned enterprises (SOEs)<sup>2</sup> since this constitutes another under-researched question. Although SOEs play a major role in the economies of certain EU countries (He et al. 2016; UNCTAD 2021), the empirical literature on innovation mostly focuses on their role in developing countries and emerging economies (Benassi and Landoni 2018).

This article ascertains as to whether FSs and different types of domestic firms are able to cooperate with local partners during both good and harsh economic times. In this respect, the analysis of the 2008 global crisis may prove highly useful since cooperation for innovation has often been seen as an arrangement also suited for other extraordinary circumstances, such as episodes of increased uncertainty (Srholec 2015). Such episodes may arise unpredictably, as shown by the Covid-19 crisis. Spanish firms are studied in the 2004–16 period. Spain constitutes a good choice for analysis since it is one of the European countries worst hit by the 2008 crisis. During the crisis, Spanish enterprises often abandoned R&D (Holl and Rama 2016; Zouaghi et al. 2018). The country suffered severe financial difficulties, and substantial cuts were made in public finance devoted to innovation (Cruz-Castro et al. 2018). In this article, the 2004–16 period is divided into three sub-periods: a pre-crisis phase (2004–7), a financial-crisis phase (2008–13), and a recovery phase (2014–16) (García-Sánchez and Montes-Luna 2022; Zouaghi et al. 2018). The first was characterised by high rates of growth, although Spain was subsequently badly hit by the financial crisis. Its recovery period started later than in other countries.

In this article, two contributions are made to the literature. Firstly, this is one of the rare studies on the evolution of local cooperation for innovation (hereinafter, LCI) throughout the business cycle. We use panel data, while most studies on cooperation for innovation ‘rely on cross-sectional evidence, which leaves us in the dark with regards to the dynamics’ (Srholec 2015: 53). Secondly, the local cooperative behaviour of FSs is compared with that of domestic business groups (DBGs), unaffiliated domestic firms (that is, companies not attached to a DBG), and SOEs. To the best of our knowledge, this is the first time that a study on foreign ownership and LCI in a developed country considers SOEs for comparison. An analysis of the Spanish experience may be useful not only for both managers of SOEs and policy-makers of countries in which these companies play a role in the economy but also regarding the recent creation of new SOEs in times of crises (He et al. 2016; UNCTAD 2021).

Section 2 provides the conceptual framework that informed our research work. Section 3 presents the methodology, and Section 4 the results and the discussion. Section 5 concludes.

## 2. Literature review and research questions

Our subject stands at the intersection of several lines of research.

### 2.1 Cooperation for innovation and type of ownership

This subsection discusses why the probability that a firm cooperates for innovation may be related to foreign ownership or to group membership. Firms cooperate for innovation for a variety of reasons: to share R&D costs, to reduce their risks, to shorten the product life cycle, to expand their product range, to access new knowledge and new markets, and/or to solve problems that they cannot tackle by themselves (Miotti and Sachwald 2003). Nevertheless, cooperation for innovation may imply risks, such as knowledge leakage or the opportunistic behaviour of a partner (Lhuillery and Pfister 2009; Williamson 1985). Economic sociology proposes that social networks provide an important tool for the prevention of and punishment for opportunistic economic behaviour and instead create trust between partners (for a review, see Granovetter 2005). According to Granovetter, economic activities are embedded in social structures and networks. Opportunities for cooperation may originate from different types of agreements and relationships, such as production subcontracting, common membership of associations, and professional connections. Interlocking directorates also contribute towards creating social structures and trust (Aguilera 1998). They are formed when an individual joins part of two or more boards of directors.

Firms sparsely endowed with social capital are more vulnerable to opportunistic behaviour and less likely to build enduring cooperative relationships (Walker et al. 1997). This may be the case of FSs in their host countries. Since their social capital is allegedly small, they may have to endure increased transaction costs (Williamson 1985). According to IB theory, FSs may incur a *liability of foreignness* due to the social and cultural barriers that these firms encounter in host countries (Zaheer 1995). Their opportunity to cooperate with local innovators may be reduced since trust between partners is an essential ingredient of cooperative innovation (Liu et al. 2017; Walker et al. 1997). Nevertheless, difficulties may be mitigated by previous knowledge of the market on the part of the FS or by their previous engagement in product subcontracting (Cozza et al. 2018; Holl and Rama 2014).

Analyses of the specificity of the cooperative behaviour of MNEs in host countries normally utilise domestic firms as a control group. In certain countries, most unaffiliated firms are small- and medium-sized enterprises (SMEs) that experience difficulties in establishing cooperative relationships (Belderbos et al. 2006; Ebersberger et al. 2011; Fernández-Esquinas and Ramos-Vielba 2011; Molero and Heijs 2002; Radicic et al. 2019). Therefore, a growing body of literature has started to consider the nature of domestic firms (affiliated or unaffiliated) since group membership appears to condition the propensity to cooperate for innovation (Ebersberger et al. 2011; Holl and Rama 2014; Srholec 2015; Un et al. 2009). A group consists of two or more legally defined enterprises under common ownership. Although there are exceptions (Holl and Rama 2014), most analyses find that foreign ownership has a negative or, at best, a neutral influence on the

probability that a firm engages in LCI (Arvanitis and Bolli 2013; Bianchi et al. 2019; Ebersberger et al. 2011; Ebersberger and Herstad 2012; Srholec 2009, 2015; Veugelers and Cassiman 2004; Wang 2021). ‘Neutral’ indicates here that the cooperative behaviour of the FS does not differ significantly from that of the control group, usually that of DBGs. An important approach to ‘neutrality’ is based on neo-institutional theory and proposes that, in similar environments, FSs tend to adopt ‘mimetic isomorphism’ (DiMaggio and Powell 2000). In other words, they are inclined to embrace local organisation practices.

Recently, new distinctions between domestic firms have been introduced. Native MNEs and DBGs that perform international cooperation for innovation are clearly better at cooperating locally than are FSs, probably due to their accurate knowledge of the local market and their substantial social capital (Cozza et al. 2018; Ebersberger and Herstad 2012; Holl and Rama 2019). In studying cooperation for innovation in Chinese companies, Wang (2021) adds SOEs, a new category of domestic firms, to the analysis. He finds that the effect of foreign ownership on cooperation is neutral, while that of state ownership is positive and statistically significant. The discussion confirms the necessity to take into account the heterogeneity of domestic firms.

We formulate the following research questions:

**RQ1a:** Are FSs better than unaffiliated domestic firms at cooperating for innovation with local partners?

**RQ1b:** Are FSs better than DBGs at cooperating for innovation with local partners?

## 2.2 State-owned enterprises

This subsection debates whether the firm’s decision to cooperate may be associated with state ownership. The Organisation for Co-operation and Development (OECD) defines SOEs as enterprises where the state has significant control through full, majority, or significant minority ownership<sup>3</sup>. In contrast to public service activities, such as policing, SOEs sell goods and services (Cuervo-Cazurra et al. 2014). Within the EU, their presence is substantial in countries such as Finland, France, Italy, Sweden, and in new Member Countries. Their emergence is explained by historical reasons, and their objectives go beyond mere profit maximisation to also include societal goals, industrial policy, monopoly control, support to emerging technologies, national defence, etc. (Antonelli et al. 2014; Archibugi and Mariella 2021; Benassi and Landoni 2018; Gershman et al. 2019; Palmberg 2002). Worldwide, their numbers were reduced during the wave of pro-market (neoliberal) reform that took place in the 1980–90s since such policies advocated for privatisation (Cuervo-Cazurra et al. 2014; Dau et al. 2020); they increased in number again, however, during the 2008 crisis and the Covid-19 crisis as a measure adopted by governments to support the economy in difficult times (He et al. 2016; UNCTAD 2021).

Landoni (2020) argues that the substantial role of SOEs in innovation has been largely underestimated. In his view, coordination with governments provides SOEs with strategic advantages in fields such as the development of unfamiliar technologies and the exploration of linkages between different industries. Due to their long-term perspective on profit-making and their easier access to finance, SOEs are more likely than private firms to devote resources to basic

research and to new technological fields that are risky and/or slow to come to fruition (Antonelli et al. 2014; Landoni 2020). It was found that, in China, state ownership has a negative impact on the probability that a firm patents an invention although this effect is moderated by location and sector (Kroll and Kou 2018). In contrast, case studies on Russian and Western European SOEs suggest that these companies are innovative (Archibugi and Mariella 2021; Benassi and Landoni 2018; Gershman et al. 2018; Palmberg 2002; Rama and Ferguson 2007). Antonelli et al. (2014) maintain that Italian SOEs played a major role in the growth of the Italian economy in 1950–94 due to their R&D activities in upstream national industries that produced general-purpose technology with a wide scope of applications. In Spain, certain SOEs may have contributed to the avoidance of the middle-income trap (García Calvo 2020).

The role played by SOEs in cooperative innovation remains an under-researched question. Evidence on Chinese SOEs remains inconclusive (Genin et al. 2020; Liu et al. 2017; Wang 2021). In contrast, Russian and Western European SOEs undoubtedly tend to engage in open innovation, cooperation for innovation included, with both domestic private firms and universities and, in the West, also with MNEs (Alonso-Gil and Vazquez-Barquero 2010; Antonelli et al. 2014; Calvo 2019; Gershman et al. 2018; López et al. 2002; Rama and Ferguson 2007). In Landoni’s (2020) view, SOEs may constitute vehicles to explore possible recombinations of knowledge due to their frequent networking with other organisations. Alliances implemented by high-tech European SOEs that successfully challenge their US rivals, central participation in EU networks that promote both intra-national and supra-national cooperation, and joint-work teams of SOEs and their suppliers constitute just three of the formulae reported through case studies (Archibugi and Mariella 2021; Benassi and Landoni 2018; López et al. 2002; Sanz Menéndez et al. 1999).

## 2.3 The case of the Spanish SOEs

As stated, one major condition is required for a firm to cooperate for innovation: social capital. In what follows, we maintain that governance, institutions, and policies may contribute towards enhancing the social capital of SOEs. This point is illustrated by analysing the case of Spanish SOEs. Firstly, these companies have often occupied central positions in subcontracting networks and have operated as flagship companies in industrial concentrations in Madrid, Seville, and Cadiz (Alonso-Gil and Vazquez-Barquero 2010; Rama and Ferguson 2007; Rodríguez-Ruiz 2015). In enhancing the social capital of SOEs, this form of production organisation may have reduced the probability of opportunistic behaviour in their cooperative partnerships.

Secondly, macro and micro institutions strongly influence the level of state ownership and control in SOEs (Bruton et al. 2015). At the beginning of the 1990s, the Spanish corporate structure, as evidenced by the analysis of interlocking directorates, was clearly led by national banks and SOEs that operated in key sectors, such as telecommunications and defence (Aguilera 1998). Instead, according to the aforementioned author, peripheral positions tended to be occupied by private domestic firms active in the light industries and by FSs, which had entered the market mainly after 1986 when Spain

joined the European Economic Community. This suggests that, historically, SOEs have been well-embedded into webs of firms, probably more so than have non-financial private firms.

With the advent of pro-market reform since 1985, non-profitable Spanish SOEs were sold mainly to foreign investors (Arocena 2006). In contrast, the state preserved a certain degree of control ('golden shares') over profitable SOEs until 2004. One consistent line of action was the strengthening of inter-firm linkages through cross-shareholdings between firms (Arocena 2006; Calvo 2019; Cuervo-Cazurra 2018). Policies to preserve the *nucleo duro* (hard core) of stable shareholders were similar to those implemented in France under similar circumstances (Lazonick 2007). Sequential privatisations, in terms of relatively small public-offering selling blocks and purchases by institutional investors and smaller investors, contributed towards preserving a certain degree of stability since these types of investors are less likely to demand abrupt changes in corporate policies or governance (Etchemendy 2004). These strategies aided in the consolidation of major domestic groups, native multinationals included (Cuervo-Cazurra 2018). Although they mainly aimed to retain control of key sectors in Spanish hands and to prevent hostile foreign takeovers (Arocena 2006), they also developed the social capital of companies. Despite privatisation, State Corporation of Industrial Participation (SEPI) remains a major state-owned group, with direct majority participation in 15 firms, minority participation in 9, and indirect control over 100.<sup>4</sup> Indirect control consists of the participation of a majority-owned SOE in the capital of another company. The discussion suggests that institutions and public policies have contributed towards the shaping of strong inter-firm linkages that, in turn, may have enhanced the potential of SOEs to cooperate for innovation.

Therefore, the following research question is proposed:

**RQ2.** Are FSs better than SOEs at cooperating for innovation with local partners?

## 2.4 Crises and innovation

No theory on crises and cooperation has yet been established, but guidance may be found in evolutionary theories of the multinational and theoretical approaches to SOEs. Most analyses find that innovation tends to be procyclical, with innovative activities increasing during growth periods and decreasing during downturns (Archibugi et al. 2013; Madrid-Guijarro et al. 2013; Paunov 2012; Holl and Rama 2016). However, specific conditions, such as open innovation, may contribute towards the resilience of firms in terms of their innovative activities (D'Agostino and Moreno 2018; Mendi et al. 2020; Zouaghi et al. 2018). In contrast, little is known about the possible effect of foreign ownership. In fact, certain studies suggest that MNEs were unlikely to adopt a countercyclical strategy during the 2008 crisis (Archibugi et al. 2013; D'Agostino and Moreno 2018; Holl and Rama 2016).

The few studies available on cooperative innovation during the 2008 crisis suggest that either companies in fact *decrease* cooperation during downturns (Azagra-Caro et al. 2019; Brancati et al. 2017; Hoffmann et al. 2017; Paunov 2012) or only specific categories of firms choose to cooperate during those periods (García-Sánchez and Rama 2020). Evolutionary theories of IB, which maintain that multinationals evolve

with their environment, state that MNEs may shift towards networked forms of organisation that provide more flexibility in order to respond to uncertainty in the host country (Cantwell et al. 2010). This theory seems to predict a greater involvement of MNEs in cooperative innovation since this is a networked form of organisation, but the evidence available provides no clear confirmation of this issue. In fact, two studies, whose focus is on Italy (Brancati et al. 2017) and on eight Latin American countries (Paunov, 202) suggest that, during the 2008 crisis, MNEs tended to *reduce* their involvement in LCI.

In contrast, on analysing the Spanish Information and Communication Technology (ICT) sector, García-Sánchez and Rama (2020) find that the crisis encouraged the local cooperative activities of FSs but not those of domestic firms. In their opinion, the behaviour of FSs may be explained by their easier access to international finance and their preference for collaboration with local suppliers, a formula that may contribute towards reducing costs even during a recession. A case study on the Hungarian automobile and electronics industries notes that FSs tended to cooperate with local universities during the crisis and the recovery (Sass and Szalavetz 2013). The discussion suggests that FSs tend to discontinue LCI during recessions, although FSs active in specific medium-tech and high-tech sectors may be willing to persist.

As for state ownership, we argue that it may induce the perception of a long time horizon concerning cooperation that could, in turn, influence the behaviour of SOEs faced with a crisis. Social capital not only contributes towards the creation of inter-firm networks but also explains their continuity over time (Walker et al. 1997). We maintain that the environment and vision of SOEs are often different from those of private firms SOEs are likely to encounter less market pressure from competitors and lower levels of uncertainty concerning their environment; furthermore, they display a long-term perspective of business (He et al. 2016). Certain authors speak of 'patient capital' (Alami and Dixon 2019; Landoni 2020). These authors observe that SOEs tend to display long-term horizons concerning profits. In contrast, the *short-termism* of most private firms is attributable to increased shareholder pressure for short-term profits and dissuades the companies from engaging in innovations that imply risk or that would only come to fruition in the long run (Mazzucato 2015). We expect that SOEs are reluctant to disrupt their long-term cooperative relationships during recessions given that these linkages often encompass collective learning acquired through previous collaborations (Alonso-Gil and Vazquez-Barquero 2010; Rama and Ferguson 2007). Lazonick (2007: 24) opines that patient capital 'enables the capabilities that derive from collective learning to cumulate over time'. The empirical literature reports that Russian and Western European SOEs display continuity in their open innovation practices (Antonelli et al. 2014; Calvo 2019; Gershman et al. 2019; Rama and Ferguson 2007). However, little is known concerning the cooperative behaviour of SOEs when specifically faced with a crisis.

Therefore, the following research questions concerning LCI during the crisis are formulated:

**RQ3a:** Have FSs performed better than unaffiliated domestic firms?

**RQ3b:** Have FSs performed better than DBGs?

**RQ3c:** Have FSs performed better than SOEs?



### 3. Methodology

The PITEC database utilised herein was collected by the Spanish National Statistics Institute). This database is the Spanish contribution to the CIS of the EU and complies with the Oslo Manual of the OECD on innovation statistics. However, PITEC has the advantage of providing panel data and of being a mandatory survey. Data are collected yearly, while CIS has a 2-year periodicity. The balanced panel includes observations for FSs, private domestic companies, and SOEs that were continuously active in Spain during the entire 2004–16 period in manufacturing and services. This period is subdivided into three sub-periods in accordance with the Spanish GDP path (García-Sánchez and Montes-Luna 2022; Zouaghi et al. 2018); unfortunately, data for 2017 up to the present are not yet available. Non-innovators are excluded since the survey asks questions regarding cooperation for innovation only to companies defined as innovators, that is, companies that have either implemented product or industrial process innovation, or have ongoing innovative activities, or have carried out innovation activities during the survey and 2 years before. According to the questionnaire, cooperation for innovation consists of two different organisations joining forces to share and develop knowledge. This definition excludes the acquisition of R&D services via the market or via R&D outsourcing but does include R&D collaboration. The database distinguishes between unaffiliated companies and companies belonging to a business group. Within the latter, information is provided regarding the location of the headquarters of the company. If they are located in a foreign country, then the company is classified here as an FS (*multinational*), otherwise it is classified as a DBG (*dom\_group*). Companies not belonging to a group are classified as unaffiliated domestic firms (*unaffiliated*). The PITEC questionnaire also enquires as to whether the company is a public enterprise (*state-owned*). Firms are asked to indicate the type of partner (e.g. supplier, client, and university) and the geographic location of the partner. Collaborations with partners located in Spain are selected for analysis. The question regards the physical location of the partners, not their nationality. Our focus is on cooperation for innovation with partners external to the focal company and its business group. Intra-group cooperation is excluded.

Our research strategy consists of an iterative estimation of logit models with panel data (estimations are calculated with inferences based on panel robust standard errors):

$$P(\text{CooperaLOCAL} = 1 | X_i^T, \beta^T, \alpha_i) = \Lambda(X_i^T \beta^T + \alpha_i)$$

Annex-Table 1 presents the correlation matrix. No evidence is found of any multicollinearity problems.

An estimation is performed for determinants of cooperation with local partners (*CooperaLOCAL*) in boom, crisis, and recovery phases. *CooperaLOCAL* (yes/no) is our dependent variable.

Our variables of interest are the types of firms (*multinational*, *unaffiliated*, and *state-owned*), our base category being DBG.

Following the literature, the model includes the following control variables:

*Local\_persistence*. This variable indicates continuity in LCI. An increase in cooperative activities may be attributable to a cumulative effect and not to a reaction to the crisis,

hence the need to control for previous cooperative experience. The variable takes the value 1 when the focal firm was engaged in LCI in the 2 previous consecutive years, 0 otherwise (Belderbos et al. 2015; García-Sánchez and Rama 2020).

*L\_turno*. The logarithm of turnover measures size.

*Innovativeness*. We also control for the innovativeness of the firm (Ebersberger et al. 2011; García-Sánchez et al. 2016; Holl and Rama 2014). Intensity is indicated by an ‘i’ before the name of the variable. The following variables are dummy variables that signal whether the focal firm is more innovation-intensive than the average firm that operates in its two-digit industry. When the variables display a positive, statistically significant coefficient, then the focal firm is above-average innovation-intensive. We use several variables that indicate innovativeness since R&D *per se* may be insufficient to capture innovation in SMEs and firms active in low-tech industries (Radice et al. 2019). On the other hand, we strive to ascertain which aspects of innovation and structure are crucial to facilitate cooperative innovation during a downturn.

*i\_RDpers*: Number of R&D employees. Following Cohen and Levinthal (1990), this variable signals whether the focal firm enjoys more absorptive capacity than does the average company in its two-digit industry.

*i\_intRDexp*: Internal R&D expenditures.

*i\_extRDexp*: External R&D expenditures.

*i\_other InnExp*: Innovation expenditures other than R&D, such as those incurred for marketing a new product.

*i\_newmar*: Share of products new to the market in turnover. This variable defines radical innovators since it points to the ability of the firm to introduce primary innovation into the market (Zouaghi et al. 2018).

*i\_newent*: Share of products new to the enterprise in turnover. This variable is employed to assess the capacity of the firm to generate incremental innovations (Zouaghi et al. 2018).

*i\_ownfund*: Share of its own resources in the total resources used by the company to finance R&D.

*Sources of information*. We also control for the sources of information, both internal and external, used by the company. When the variables display a positive, statistically significant coefficient, then the focal firm attributes an above-average interest to a specific source of information.

*h\_int\_source*: This variable denotes the perception of the firm regarding the usefulness of internal information coming from both the company itself and its business group. The *h\_tech\_source*, *h\_divul\_source*, and *h\_compet\_source* variables indicate, respectively, whether the focal firm values information coming from universities and research centres; sources of knowledge divulgation, such as journals and conferences; and competitors.

*Barriers to innovation*. Herein, various types of difficulties found by innovators are considered. The independent variables employed in the model include knowledge difficulties (*h\_knowl\_diff*), economic difficulties (*h\_eco\_diff*), market difficulties (*h\_mark\_diff*), and competitive difficulties (*h\_comp\_diff*). A positive and statistically significant coefficient means that the firm faces higher-than-average difficulties.

*Sectors*. Finally, we control for sectors: knowledge-intensive services and other services, as classified by

EUROSTAT. Manufacturing activities are classified according to a taxonomy based on patent analysis (Molero and García 2008).

## 4. Results and discussion

### 4.1 Descriptive statistics

Although SOEs and FSs account for relatively small percentages of the sample firms (Annex-Table 2), their accomplishments in other respects suggest that they have a role to play in the NIS. For instance, SOEs display the highest average number of R&D employees (49), followed by FSs (45) and DBGs (33). This is an essential characteristic for a company striving to benefit from cooperation for innovation since it points to absorptive capacity. Moreover, SOEs comprise the category that exhibits the highest percentage of cooperative companies, followed by DBGs and FSs (Annex-Table 3).

Annex-Table 4 shows that an increasing number of firms were involved in LCI during 2004–16. Furthermore, networks became increasingly complex since they tended to involve a greater variety of partners during this period (tables available upon request). These results suggest that firms reacted to the crisis by resorting to cooperation for innovation and that this trend continued during recovery. However, the econometric models show a different picture. We return to this question below.

### 4.2 Results of the model

Table 1 displays the determinants of LCI throughout the business cycle. The results of estimations are shown in columns: coefficients and standard errors (in parentheses) in columns (1), (3), and (5) and marginal effects ( $dy/dx$ ) in columns (2), (4), and (6); results for pre-crisis or boom period are in columns (1) and (2), while those for period of crisis are in columns (3) and (4); and finally, results for recovery period are in columns (5) and (6). The variables are given in rows, as previously described in Section 3. We found that FSs were more likely to cooperate with local partners during 2004–16 than were unaffiliated domestic firms (RQ1a) but not more than DBGs (RQ1b). The coefficient of the *multinational* variable has a negative sign during the three sub-periods and is tangentially significant only during the boom phase (columns 1, 3, and 5). The effect of foreign ownership on the probability that a firm cooperates for innovation is neutral, and this feature persists throughout the business cycle. As stated, our base category is that of DBGs. Our results confirm those of previous analyses of certain European countries, such as Denmark and Switzerland, that were studied during ‘normal’ phases of the business cycle (Arvanitis and Bolli 2013; Dachs et al. 2008). However, we are able to add that FSs behave similarly to DBGs *also* during the recession (columns 3 and 4). Therefore, our results do not support evolutionary theories of IB (Cantwell et al. 2010) since FSs do not seem more prone than DBGs to engage in networked forms of innovation organisation, that is, in cooperative innovation, during uncertain times; however, this may be a strategy adopted by multinationals of specific host sectors (García-Sánchez and Rama 2020; Sass and Szalavetz 2013). On the other hand, our results do not suggest a poor endowment of social capital that may result in *liability of foreignness*. Even during the in-crisis period, no symptoms of ‘branch plant syndrome’ could be detected in the sample FSs since they always established cooperative relationships similar to those of DBGs (RQ3b).

The results clearly suggest isomorphism. Neo-institutional theory seems especially apt in explaining the behaviour of FSs during the three sub-periods. In Spain, the engagement of FSs in LCI is probably related to their substantial participation in networks of production subcontracting, especially in the automobile and electronics industries (Aláez-Aller and Erro-Garcés 2006; Holl and Rama 2009). Production subcontracting is often associated with the integration of skills and knowledge from firms upstream. This is consistent with the vision of subcontracting as a strategy for the externalisation of certain productive activities while still retaining control of the innovative and technological content in the maturity phases of the product life cycle (Hymer 1972; Dunning 1993; Strange and Newton 2006). It is also compatible with an engagement of FSs with domestic high-quality and innovative suppliers of intermediate goods and services (parts and components), even in the growth and ‘early maturity’ phases of the product cycle. Such domestic firms would have upgraded their positions within Global Commodity Chains via improvements in their production processes and product quality levels and would therefore be able to diversify their client portfolio, as pointed out by Strange and Newton (2006). Furthermore, they could develop innovative and technological capabilities, and hence, they would be seen as significant and strategic partners by FSs.

During the boom and the recovery phases, the coefficient of the *unaffiliated* variable is negative but not statistically significant or only tangentially significant (columns 1 and 5). In contrast, during the in-crisis period, the coefficient is negative and statistically significant (column 3). During the downturn, these companies are less likely to cooperate than are DBGs or FSs (RQ3a). Being an unaffiliated domestic firm decreased the probability that a company participated in LCI during the crisis by 3 per cent (Table 1, column 4). This type of company may be able to cooperate during ‘normal’ phases of the business cycle but faces difficulties during a recession. Differences between our results and those of previous studies that note a systematic difficulty in cooperating in unaffiliated firms, even during ‘normal’ phases of the business cycle (Subsection 2.1), may be due to the methodology employed. As stated, we employ a broad spectrum of variables to define innovation, and this methodology is likely to encompass the case of non-R&D innovators typical of SMEs. In contrast, the majority of previous studies on LCI use exclusively R&D to measure innovativeness. To summarise, although cooperation is a worthy strategy (Zouaghi et al. 2018), Spanish unaffiliated firms had difficulties to resort to it during the crisis. Probably, these firms could not meet the new market and innovation-related conditions for them to cooperate. We return to this question below.

The coefficient of the *state-owned* variable is positive and statistically significant during the boom, the crisis, and the recovery. A consistent pattern emerges: SOEs are better at cooperating with local partners than are FSs (RQ3c) and private domestic firms, and this behaviour persists throughout the business cycle. After *local persistence*, *state-owned* is the most important predictor of LCI during 2004–16 (columns 2, 4, and 6). Compared to DBGs, state ownership increases the probability that a firm cooperates for innovation by 15–20 per cent. In this respect, FSs are unlikely to outperform SOEs, even when other characteristics of firms are taken into consideration (RQ2). The effect of foreign ownership on cooperation is neutral, while that of state ownership is positive

**Table 1.** Determinants of cooperation for innovation with local partners throughout the business cycle: boom (2004–7), crisis (2008–13), and recovery (2014–16)<sup>a,b</sup>.

	Boom (2004–7)		Crisis (2008–13)		Recovery (2014–16)	
	Coefficient/SE	dydx	Coefficient/SE	dydx	Coefficient/SE	dydx
	(1)	(2)	(3)	(4)	(5)	(6)
CooperaLOCAL						
lturno	0.27268*** (0.067)	0.02604***	0.22567*** (0.035)	0.02658***	0.30281*** (0.045)	0.03641***
<i>turnover, in log</i>						
i_newmar	0.29606+ (0.160)	0.02827+	0.26794** (0.090)	0.03156**	0.48696*** (0.137)	0.05855***
<i>% sales product new to market</i>						
i_newent	0.32706* (0.144)	0.03123*	0.07552 (0.083)	0.00889	-0.00724 (0.123)	-0.00087
<i>% sales product new to firm</i>						
mk_local/regional	-1.05437** (0.401)	-0.09767**	-0.44789* (0.225)	-0.04972*	-0.68982* (0.330)	-0.08047*
<i>focal market local or regional</i>						
mk_EU	-0.26204 (0.272)	-0.02546	0.09035 (0.146)	0.01055	-0.06207 (0.218)	-0.00760
<i>focal market includes EU</i>						
Local_persistence	0.41541+ (0.196)	0.03967*	2.55104*** (0.097)	0.30044***	2.63203*** (0.133)	0.31648***
<i>persistence cooperat. Local partners</i>						
EU_persistence	1.22912*** (0.345)	0.11737***	0.72146*** (0.172)	0.08497***	0.64285** (0.229)	0.07730**
<i>persistence in cooperat. EU partners</i>						
US_persistence	-0.35223 (0.715)	-0.03364	0.31875 (0.372)	0.03754	1.23442+ (0.673)	0.14843+
<i>persistence in cooperat. US partners</i>						
i_int_RDexp	0.26379 (0.178)	0.02519	0.48600*** (0.106)	0.05724***	0.38325* (0.150)	0.04608*
<i>internal R&amp;D expenditures</i>						
i_ext_RDexp	1.36671*** (0.163)	0.13051***	0.93753*** (0.090)	0.11041***	0.69831*** (0.146)	0.08397***
<i>external R&amp;D expenditures</i>						
i_other_innov_exp	0.46810*** (0.138)	0.04470***	0.16733* (0.081)	0.01971*	0.42970*** (0.124)	0.05167***
<i>innovation expend. other than R&amp;D</i>						
i_RDEmployees	0.90756*** (0.190)	0.08667***	0.68930*** (0.109)	0.08118***	0.69224*** (0.156)	0.08324***
<i>number of R&amp;D employees</i>						
i_owm_fundRD	-0.60582*** (0.152)	-0.05785***	-0.70647*** (0.088)	-0.08320***	-0.45122*** (0.127)	-0.05426***
<i>% own funds in total R&amp;D expend.</i>						
h_int_source	0.25924+ (0.142)	0.02476+	0.29512*** (0.081)	0.03476***	0.30031** (0.115)	0.03611**
<i>usefulness of internal information</i>						
h_tech_source	1.71336*** (0.370)	0.16362***	1.12858*** (0.182)	0.13292***	0.83355*** (0.251)	0.10023***
<i>usefuln. university &amp; research centre</i>						
h_divul_source	0.60719* (0.284)	0.05798*	0.02860 (0.169)	0.00337	-0.01039 (0.242)	-0.00125
<i>usefulness of knowledge divulgation</i>						
h_valuech_compet_source	0.33652+ (0.190)	0.03214+	0.37213*** (0.106)	0.04383***	0.02602 (0.152)	0.00313
<i>usefuln. informat. from competitors</i>						
h_knowl_diff	0.31185 (0.269)	0.02978	0.10110 (0.174)	0.01191	0.47333+ (0.254)	0.05691+
<i>knowledge difficulties</i>						
h_mark_diff	-0.14999 (0.392)	-0.01432	-0.84743** (0.299)	-0.09980**	-0.55400 (0.364)	-0.06661
<i>market difficulties</i>						
state-owned	2.01991** (0.661)	0.20753**	1.30293*** (0.329)	0.17059***	1.16193* (0.461)	0.14937*
<i>state-owned-enterprise</i>						
unaffiliated	-0.41485+ (0.247)	-0.04008+	-0.25470* (0.129)	-0.03029*	-0.02294 (0.158)	-0.00276
<i>unaffiliated domestic firm</i>						
multinational	-0.52977+ (0.297)	-0.05085+	-0.20457 (0.152)	-0.02443	-0.00526 (0.188)	-0.00063
<i>foreign subsidiary</i>						
Knowledge Intensive Business Services (KIBS)	0.69359* (0.329)	0.06902*	0.87671*** (0.172)	0.11052***	0.66588** (0.217)	0.08341**
<i>firm operates in a KIBS sector</i>						
Other_services	-1.05859** (0.326)	-0.09466**	-0.22298 (0.167)	-0.02582	-0.13066 (0.212)	-0.01549
<i>firm operates in other services</i>						
Constant	-6.85245*** (1.240)	***	-6.40023*** (0.643)	***	-7.47429*** (0.843)	***
Insig2u	2.26164*** (0.124)	***	0.74766*** (0.107)	***	0.79310*** (0.151)	***

(continued)

Table 1. (Continued)

	Boom (2004–7)		Crisis (2008–13)		Recovery (2014–16)	
	Coefficient/SE	dydx	Coefficient/SE	dydx	Coefficient/SE	dydx
	(1)	(2)	(3)	(4)	(5)	(6)
P > chi <sup>2</sup>	0.000		0.000		0.000	
No. of cases	5,287		10,542		4,911	
sigma_u	3.09820		1.45329		1.48669	
rho	0.74475		0.39098		0.40185	

Source: Authors' own from PITEC.

+P < 0.10,

\*P < 0.05,

\*\*P < 0.01,

\*\*\*P < 0.001.

Notes: <sup>a</sup>Excludes intra-firm or intra-group cooperation.

<sup>b</sup>The table includes only the statistically significant variables.

and statistically significant. Our results support those of Wang (2021).

In the Spanish case, several reasons may contribute towards explaining this result. Due to historical reasons, institutions, and pro-linkage policies, Spanish SOEs seem to have benefited from a substantial accumulation of social capital over the years. Cross-sharing between firms and previous personal relationships developed in inter-locked directories may have facilitated the rise of embedded ties, which in turn have enabled the emergence of trust, the exchange of fine-grained information, and joint problem-solving between companies. On the other hand, the sample SOEs display a broader search than do private firms This is in accordance with Gershman et al. (2019) concerning Russian SOEs. Unreported Bonferroni tests suggest that the sample SOEs are more likely than private firms, domestic or foreign, to cooperate with local research centres and universities and with local competitors (tables available upon request). Their relationships with universities are corroborated by case studies (Alonso-Gil and Vazquez-Barquero 2010; Calvo 2019; Rama and Ferguson 2007) and may be a result of the involvement of SOEs in basic research (Antonelli et al. 2014; Landoni 2020). Both SOEs and universities are less concerned than are private firms with immediate market applications of innovation. On the other hand, SOEs may also be less concerned with transaction costs than are private companies since governments may have a higher tolerance to risk owing to their large resources and their control of laws and regulations (Cuervo-Cazurra et al. 2014). One possible consequence may have been the sample SOEs willingness to cooperate even with competitors, which is a risky type of partnership.

Table 1 also enables us to observe the dynamics of LCI. Previous experience (*local\_persistence*) is significantly and positively associated to LCI throughout the business cycle. The introduction of this variable in the model shows that the growing number of firms engaged in cooperation and the increasing complexity of their networks during 2004–16 (Descriptive Statistics) is attributable to their previous cooperative experience rather than to their reaction to the crisis. The *local\_persistence* variable augmented the probability that a firm cooperated during the boom by 3 per cent; this figure rose to 30 per cent and 32 per cent during the crisis and the recovery, respectively (columns 2, 4, and 6). Our results confirm those of previous studies in that experience is a crucial factor towards cooperation for innovation (Belderbos et al. 2015; García-Sánchez and Rama 2020), but we reveal that this importance increased tenfold during the crisis.

Other characteristics of firms also became more important predictors of LCI in 2008–13 than they had been in the pre-crisis period. Above-average internal R&D expenditure (*i\_int\_RDexp*) is not statistically significant during the boom but increases the probability that a firm engages in LCI during the crisis and the recovery by 6 per cent and 5 per cent, respectively (columns 4 and 6). Difficulties in innovating derived from the presence of incumbents in the market (*b\_mark\_diff*) are not statistically significant during the boom but decrease the probability that a firm cooperates during the crisis by 10 per cent (column 4). In fact, it is the most important barrier to innovation during 2008–13. This corroborates previous studies in that both innovation-related characteristics and often forgotten structural factors influence the likelihood of LCI (García-Sánchez et al. 2017). In choosing a partnership, companies evaluate not only technical mastery but also market potential (Bianchi et al. 2019).

## 5. Conclusions

We have enquired as to whether FSs are able to cooperate with local partners during both good and harsh economic times, and we have investigated whether, in this respect, they react differently to economic crises than do various types of domestic firms, with especial emphasis on the differential role played by state-owned firms. A sample of Spanish firms has been analysed for the period 2004–16.

We found that FSs were more likely to cooperate with local partners throughout the business cycle than were unaffiliated domestic firms although not more than DBGs. However, our results do not suggest that FSs are poorly embedded as may be the case in other countries. The role played by policies in this respect needs to be investigated. A preliminary approach based on business history suggests that, in Spain, it was not that cooperative innovation was especially promoted by specific FDI-oriented policies but rather the other way around. Born in times of import substitution and subject later to international competition, clusters of skilled suppliers of components constituted by both domestic firms and joint ventures contributed towards attracting global firms (Catalan, 2017; Rama and Ferguson 2007). Multinationals helped to maintain a certain stability of local cooperative networks during the crisis since they outperformed unaffiliated domestic firms. However, in spite of their privileged access to international finance, they performed similarly to DBGs and worse than state-owned firms during that period. Our results do not support the evolutionary theory of MNEs (Cantwell et al.



2010) since, in the host country, FSs did not resort to networked forms of organisation of innovation during uncertain times. In contrast, they confirm the point of view of neo-institutional theory in that FSs display mimetic isomorphism vis-à-vis DBGs (DiMaggio and Powell 2000).

SOEs systematically outperformed private firms, domestic or multinational, during the boom, the crisis, and the recovery. A possible explanation is that public firms enjoy substantial social capital, which was enriched throughout the years *via* the action of institutions and pro-linkage policies. To summarise, the effect of foreign ownership on cooperation is neutral, while that of state ownership is positive and statistically significant. Our findings corroborate those of Wang (2021).

Unaffiliated domestic firms managed to cooperate to a similar level to that of DBGs during the pre-crisis period and the recovery, but they performed worse than DBGs during 2008–13. Unaffiliated firms were unlikely to benefit from a cooperative strategy during the crisis, probably due to their inability to meet the new market and innovation-related conditions required for cooperation to take place.

It was also found that predictors of cooperative innovation vary throughout the business cycle, and this finding is a contribution of our study. Previous experience, investment in internal R&D, and substantial internal sources of knowledge acquire critical importance as predictors of LCI during a downturn. Having to cope with a market dominated by incumbents strongly discourages cooperative innovation.

Our results have policy implications. They suggest that the potential for cooperative innovation and, hence, of possible technology transfers may come not only from FSs as pointed out by international organisations (Guimón 2011) but also from DBGs and, especially, SOEs. Although the focus of this article is on the association between foreign ownership and LCI, our results also provide evidence that public firms have a role to play in the creation of a cooperative culture. This corroborates the findings of Antonelli et al. (2014) for the case of Italy and may be a useful indication for managers of public enterprises and policymakers in those countries where these companies play a role in the economy. The decision to privatise profitable public firms needs to take into account, among other factors, their potential to irradiate knowledge towards the NIS. Although often disregarded by the literature, the substantial role of public enterprises in knowledge generation and diffusion deserves acknowledgement and proactive employment in innovation policymaking. On the other hand, our findings call for policies that support market competition, innovation, and collaboration during growth periods in order to anticipate the often-devastating consequences of crises on innovation.

While far from exhaustive, the evidence available suggests that our analysis has practical implications concerning the Covid-19 crisis. Below, several preliminary ideas are presented and certain inferences are drawn by confining our attention to certain significant recovery projects. The pandemic has had devastating effects on Spanish society and on its economy. After 6 years of growth, Spanish GDP fell by 10.8 per cent in 2020. As one of the worst-hit European countries, Spain has been assigned € 140 billion in loans and subsidies from the NextGenerationEU programme.<sup>5</sup> This temporary plan is designed to boost the recovery and promote a greener, digitalised, and more resilient European economy

through modernisation and innovation. Spanish projects will be developed by large consortia of companies, universities, and research centres. A case to the point is an electric-vehicle project recently won by a consortium comprised of a university and 62 companies, of which there are two FSs, several joint ventures, three native MNEs, a SOE, several DBGs, a large Spanish bank, and 38 SMEs active in the automobile value chain.<sup>6</sup> Innovation is at the heart of every production phase. For instance, Spain has lithium reserves. This is a critical earth metal utilised in the manufacture of batteries for electric vehicles: a metal upon whose imports Europe is almost totally dependent. However, the ‘green’ exploitation of these Spanish resources would necessitate substantial recycling know-how and new technical expertise. It is clear that the promotion of cooperative innovation skills along the whole value chain constitutes a crucial measure towards ensuring the success of such a huge and complex project, as well as that of other Spanish consortia supported by the EU recovery programme. Backing unaffiliated domestic firms, often of small size, will be particularly advisable since these firms not only face major difficulties in resorting to cooperative innovation in hard economic times, but they also often lack experience. Furthermore, since SOEs are especially skilled in this kind of collaboration, we definitely recommend their engagement in said projects.

Our study displays several limitations. Firstly, the data fail to enable us to single out native multinationals for analysis. Secondly, due to restrictions of space, the analysis of the breadth of innovative networks in which the different types of firms are engaged and of the types of partners that mostly matter to each thereof in good and harsh economic times has merely been outlined. This analysis would provide a promising avenue for future research. Despite these limitations, our results contribute towards the understanding of an under-researched issue concerning the cooperative strategies, during growth periods and crises, of FSs, and of a variety of types of domestic firms, with an emphasis on the role of SOEs.

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## Notes

1. In this article, the terms ‘cooperative’ and ‘cooperation’ refer to cooperation for innovation.
2. Also called public enterprises in the literature and in this article.
3. <https://www.pwc.com/gx/en/psrc/publications/assets/pwc-state-owned-enterprise-psrc.pdf>.
4. <https://www.sepi.es/es>, November 2021.
5. [https://ec.europa.eu/info/strategy/recovery-plan-europe\\_en](https://ec.europa.eu/info/strategy/recovery-plan-europe_en) June 2022.
6. <https://www.businessinsider.es/seat-vw-suman-telefonica-caixa-bank-iberdrola-perde-vec-1055467> June 2022.

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Annex-Table 1. Correlation matrix.

	localcoop	EUcoopera	UScoopera	localpers	EUpersis	USApersis	crisis
localcoopera	1.0000						
EUcoopera	0.4434*	1.0000					
UScoopera	0.2157*	0.3891*	1.0000				
localpersistence	0.5957*	0.3762*	0.2084*	1.0000			
EUpersistence	0.3240*	0.6273*	0.3228*	0.4631*	1.0000		
USpersistence	0.1609*	0.2871*	0.6310*	0.2212*	0.3935*	1.0000	
crisis	0.0268	0.0409*		0.1038*	0.0742*	0.0252	1.0000
type_firm_ownership	0.0495*	0.1415*	0.0896*	0.0481*	0.1235*	0.0801*	
sector		-0.0396*		-0.0281	-0.0288		
i_int_RDexp	0.1637*	0.0980*	0.0647*	0.1422*	0.0713*	0.0548*	
i_ext_RDexp	0.2283*	0.1457*	0.0977*	0.1868*	0.1256*	0.0909*	-0.0608*
i_other_exp	0.0810*	0.1018*	0.0770*	0.0559*	0.0778*	0.0632*	-0.0362*
i_RDemployee	0.1842*	0.1104*	0.0576*	0.1669*	0.0946*	0.0494*	
i_owm_fundRD		0.0285					
h_int_source	0.1143*	0.1262*	0.0726*	0.1073*	0.1025*	0.0539*	0.0309*
h_tech_source	0.1617*	0.1552*	0.1197*	0.1516*	0.1421*	0.1033*	.0375*
h_divul_source	0.0657*	0.0812*	0.0785*	0.0552*	0.0686*	0.0774*	
h_valuech_com-	0.1025*	0.1430*	0.1110*	0.0947*	0.1314*	0.1051*	
pet_source							
h_knowl_diff					-0.027		-0.0304*
h_eco_diff							0.0408*
h_comp_diff		0.0351*		0.0309*	0.0375*		
h_mark_diff	-0.0593*	-0.0449*		-0.0559*	-0.0407*		
lturn	0.1215*	0.2030*	0.1275*	0.1160*	0.1874*	0.1175*	
i_newmarl	0.1019*	0.0907*	0.0717*	0.0882*	0.0642*	0.0545*	-0.0323*
i_newent	0.0430*	0.0525*	0.0432*	0.0412*	0.0322*	0.0361*	-0.0320*
mkscope	0.0740*	0.1301*	0.0582*	0.0838*	0.1097*	0.0457*	0.0401*
type_firm_ownership		sector	i_int_RDexp	i_ext_RDexp	i_other_exp	i_RDempl	i_owm_fundRD
type_firm_ownership	1.0000						
sectorl	-0.0550*	1.0000					
i_int_RDexpl	-0.1301*	-0.1147*	1.0000				
i_ext_RDexpl		-0.0601*	0.2170*	1.0000			
i_other_expl	-0.0528*	0.0350*	0.0851*	0.0759*	1.0000		
i_RDemployee	-0.1359*	-0.1184*	0.6691*	0.1979*	0.0534*	1.0000	
i_owm_fundRD		-0.2137*	0.3562*		-0.0330*	0.3997*	1.0000
h_int_source	0.0923*	-0.0387*	0.1212*	0.0452*	0.0756*	0.1426*	0.1555*
h_tech_source		-0.0295*	0.0836*	0.1100*		0.0757*	
h_divul_source			0.0560*	0.0543*	0.0478*	0.0640*	0.0408*
h_valuech_com-		-0.0415*	0.0851*	0.0738*	0.0648*	0.0927*	0.0611*
pet_source							
h_knowl_diff	-0.0636*	-0.0460*				0.0403*	
h_eco_diff	-0.1527*	-0.0265*	0.0789*	0.0259		0.0720*	
h_comp_diff	-0.0988*	-0.0779*	0.0708*	0.0406*	0.0333*	0.0682*	0.0381*
h_mark_diff		0.0469*	-0.0696*	-0.0274		-0.0854*	-0.0919*
lturnl	0.5274*	0.0288	-0.2465*		-0.0685*	-0.2030*	
i_newmarl		-0.0338*	0.1451*	0.0670*	0.0832*	0.1347*	0.1042*
i_newentl		-0.0465*	0.0867*	0.0379*	0.0734*	0.0712*	0.0830*
markscope	0.1787*	-0.4898*	0.0973*	0.0662*		0.1166*	0.1892*
h_valuech_							
h_int_source		h_tech_source	h_divul_source	compet_source	h_knowl_diff	h_eco_diff	h_copm_diff
h_int_source	1.0000						
h_tech_source	0.0643*	1.0000					
h_divul_source	0.0604*	0.2131*	1.0000				
h_valuech_com-	0.1090*	0.1155*	0.1710*	1.0000			
pet_source							
h_knowl_diff					1.0000		
h_eco_diff		0.0419*	0.0636*	0.0655*	0.0919*	1.0000	
h_copm_diff		0.0375*	0.0532*	0.0883*	0.1591*	0.1966*	1.0000
h_mark_diff	-0.0566*				0.0332*		0.0566*
lturn	0.0945*	0.0410*			-0.0618*	-0.2186*	-0.1336*
i_newmarl	0.0970*	0.0366*	0.0601*	0.0689*			
i_newent	0.0474*	0.0301*	0.0254	0.0742*			
markscope	0.0855*	0.0474*		0.0708*			0.0577*

(continued)



**Annex-Table 1.** (Continued)

	localcoop	EUcoopera	UScoopera	localpers	EUpersis	USApersis	crisis
h_mark_diff	h_mark_diff 1.0000	lturn	i_newmar	i_newent	markscope		
lturnl		1.0000					
i_newmar	-0.0435*		1.0000				
i_newent	-0.0306*	-0.0257	0.1516*	1.0000			
markscope	-0.0561*	0.1297*	0.0726*	0.0484*	1.0000		

Source: Authors' own based on PITEC.

Printed if P < 0.10,

\*P < 0.01 (Bonferroni).

**Annex-Table 2.** Distribution of the sample per type of firm.

	Frequency	Percent	Cumulative
State-owned	910	2.93	2.93
Unaffiliated	15,561	50.15	53.08
Domestic group	10,140	32.68	85.76
Multinational	4,420	14.24	100
Total	31,031	100	

Source: Authors' own based on PITEC.

**Annex-Table 3.** Cooperation for innovation with local partners, per type of firm.

	State-owned	Unaffiliated	Domestic group	multinational	Total
No	1.5	55.69	27.97	14.85	100
	40.96	68.68	56.56	63.08	63.4
Yes	3.74	43.99	37.21	15.06	100
	59.04	31.32	43.44	36.92	36.6
Total	2.32	51.41	31.35	14.93	100
	100.00	100	100	100.00	100

Pearson  $\chi^2(3) = 393.1863$ ; P = 0.000.

cramer's V = 0.1325.

Source: Authors' own based on PITEC.

**Annex-Table 4.** Cooperation for innovation with local partners, per phase of the business cycle.

	Boom (2004–7)	Crisis (2008–13)	Recovery (2014–16)	Total
No	4,474	6,738	2,998	14,210
	64.29	63.92	61.05	63.4
Yes	2,485	3,804	1,913	8,202
	35.71	36.08	38.95	36.6
Total	6,959	10,542	4,911	22,412
	100	100	100.00	100

Pearson  $\chi^2(2) = 15.3105$ ; P = 0.000.

cramer's V = 0.0261.

Source: Authors' own based on PITEC.