Inovação em Serviços e Direitos de Propriedade Intelectual: evidências em nível de empresas do Chile

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Resumo: Esta pesquisa explora os fatores de nível micro que determinam a adoção de métodos formais de propriedade intelectual em empresas chilenas (patentes, marcas registradas, modelos de utilidade, registro de desenho e direitos autorais). Nossos resultados para o período 2021-2022 indicam que empresas chilenas que cooperam com outras empresas têm alta probabilidade de usar patentes como sua principal forma de propriedade intelectual. Por outro lado (devido à intangibilidade das atividades de inovação de serviços), nossa pesquisa também indica que empresas que introduzem novos tipos de serviços no mercado têm menos probabilidade de confiar em patentes como um meio apropriado de proteção. Observa-se também que empresas que atuam exclusivamente no setor de serviços dão maior importância ao uso de direitos autorais em comparação a outras empresas de fabricação. A adoção de marcas registradas, modelos de utilidade e registro de desenho são vistos como adequados para empresas que realizam atividades de inovação de produtos. Nossos resultados fornecem ampla base para a formulação de políticas, pois destacam caminhos para promover a adoção de instrumentos de PI e apontam diferenças entre as empresas em suas decisões de confiar neles.

Palavras-chave: Proteção da Propriedade Intelectual; Determinantes da inovação; Chile, Nível empresas

Código JEL: O10; O31; O32; O33

Área Temática: 6. Políticas públicas e regulação (6.5 Propriedade Intelectual)

Innovation in Services and the adoption of Intellectual Property Protection: Firm-level evidence from Chile.

Abstract: This research explores micro-level determinants shaping the adoption of formal methods of intellectual property protection across Chilean firms. These include the use of patents, trademarks, utility models, design registration as well as copyrights. Empirical analysis over the 2021-2022 period

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highlights the fact that large firms that engage on cooperative agreements with other entities are particularly prone to rely on patents to protect their return in R&D investment. On the other hand, given the intangibility and low codifiability of the scientific activities influencing innovation in services (as well as due to prevailing difficulties to exclude competitors from such inventive processes), firms of any sort that introduce to the market new inventive services are found to rely less on patents as an adequate means of protection. Firms exclusively operating within the service sector, on the other hand, are observed to attach higher relevance to the use of copyrights when compared to their manufacturing counterparts. The adoption of trademarks, utility models and design registration methods are found to be particularly suitable for those firms pursuing product innovation. Our results provide ample ground for policy making as they underscore avenues promote the adoption of intellectual property instruments while pointing out differences among firms on their decisions to rely on this.

Keywords: Intellectual Property Protection; Innovation determinants; Chile, Firm-level.

Código JEL: O10; O31; O32; O33

Área Temática: 6. Políticas públicas e regulação (6.5 Propriedade Intelectual)

1. Introduction.

This paper has a twofold objective: (1) explore those company-level factors shaping the adoption of intellectual property rights (IPR); (2) determine the role played by innovation in services on these strategic decisions. IPR are herein defined as those appropriability mechanisms that confer (under federal law) exclusive rights over a given invention, and that include the use of patents, utility models, trademarks, design registration, and copyrights.

This empirical assessment focuses on Chile as relevant case study. This country is one of Latin America's most inventive economies. In line with ECLAC (2022), this country has not only consistently reported one of the highest R&D investment in the region (as a proportion of GDP) but has also stood out as the economy with the greatest scientific productivity in relation to their peers. Chile has also aimed to steadily support private inventive activity over recent years. This is corroborated by the fact that, during 2019, the tax support that Chilean firms received per unit of currency invested on R&D (0.30 units) constituted one of the highest across OECD members (OECD, 2024). Nonetheless, Chile still lags behind frontier countries in terms of innovation capabilities. By 2019, the share of private business contribution to R&D investment in the country (31%) was still below the OECD average (64%) (OECD, 2024). This lower than the standard performance also prevails across other indicators such as patenting per capita, quality of scientific publications, intellectual property products and so forth (OECD/UN, 2018). Our focus on trends at the service sector is justified by the fact that GDP and employment across Latin American countries (and Chile, in particular) has been largely driven by trends within the service sectors (Alvarez et al., 2015).

The quantitative appraisal followed by this empirical study entails a Multivariate Probit Analysis. This method allows for a simultaneous assessment of the effect exerted by a given set of firm-level innovation related variables over the propensity to adopt instruments of intellectual property protection. The analytical method is based upon a representative (pooled) sample of Chilean firms surveyed from 2021 to 2022 in the context of the country's biennial innovation survey (*Encuesta Nacional de Innovación*, ENI). In line with prior studies (Savignac, 2008; Blanchard et al, 2013), we excluded from such pooled sample non-innovators to solely consider inventive firms and potential innovators.

Our research addresses innovation in services by not only studying the set of firms that operate at this sector, but also by accounting for the presence of two innovation related activities that embody the development of novel services: the introduction of brand-new services to the market as well as the

pursuit of inventive strategies involving substantial modifications to already prevailing services. While confirming Chilean companies' unwillingness to patent brand-new services, our results also show that firms operating at the service sector seeking to improve already existing services (logistics) are particularly prone to utilize copyrights as an adequate mean of intellectual property protection.

This document is structured as follows. Section 2 presents our review of literature with section 3 discussing our methodology and data. Section 4 and 5 show our general econometric results as well as the preliminary conclusions of this study.

2. Literature review.

2.1 Instruments of Intellectual Property Protection.

Intellectual property methods be classified into statutory and non-statutory instruments (Levin et al., 1987; Cohen et al., 2000). ***Statutory (formal) methods***, on the one hand, refer to the available appropriability tools that are protected under federal law and that generally comprise the use of patents, design registration, trademarks, copyrights, utility models, plant varieties and so forth (Gallie and Legros, 2012). These formal methods are adopted by firms as an adequate strategy to guarantee time-limited rights over a given invention (Hall et al., 2014) that also helps mitigate knowledge sharing related issues (Della Corte, 2018; Holgersson, 2018). Firms engaging in such statutory methods generally seek to protect codifiable and explicit information, pursue incremental innovation strategies, partner-up with competitors to access cutting-edge knowledge, and operate at dynamic industries that are characterized by a high-speed introduction of new to the market innovations (Le Roy et al., 2022; Telg et al., 2023)

Patents represent the most powerful mechanism to protect technological commercialization as they concede exclusive rights to fruitfully exploit the economic benefits of inventive efforts (Amara et al., 2008). Even though these are generally utilized as an indicator for intermediate innovation output -since they protect technological innovations- (Archibugi, 1992; Chang, 2012), they still show some empirical limitations because not all inventions are patented or patentable (Arundel and Kabla, 1998; Acs et al., 2002). While ***patents*** stand as a common protection mechanism for various industries (medical instruments, pharmaceuticals, chemicals and machinery parts), other less technological sectors such as services, retail, and the creative sector tend to utilize more other forms of protection such design rights, copyrights, trademarks and informal mechanisms (Hall et al., 2014, Hall and Sena, 2017).

Design registration entails the right to protect the visual appearance of a given invention without granting further legal merits neither on the materials nor on the mechanism through which the device works. In stark contrast to the extensive literature on patents as key element for intellectual property protection, design registration has received very little attention by economics and management scholars alike (Filitz et al., 2015; Schartinger, 2023). According to Livesey and Moultrie (2008), inventive firms in Europe relied more heavily on design registration than other non-innovators. Gemser and Wijnberg (2001) argued that this sort of method for intellectual property is generally utilized within design intensive industries (like furniture), while Mairesse and Mohnen (2004) showed that design rights stand as the most suitable protection method for low-tech industries rather than those at high-tech.

Trademark refers to a protected sign name or symbol which effectively allows the inventors to distinguish their company from other competitors (Howells et al., 2003). According to Block et al. (2025), trademarks can be utilized to identify services and/or business model innovations as well as any sort of innovation that takes places in non-technological industries like services, retail and the creative sector (Gotsch and Hipp, 2012; Castaldi, 2018). Trademarks are also highly relevant for the identification of inventive activities across scale-intensive and supplier dominated industries as well as in certain service sectors (Block et al., 2025). On the other hand, Trademarks have also been recently linked to green innovation. For instance, Morales et al. (2022) investigate the role of patents, trademarks, and other appropriation mechanisms in sustainable innovation and found that both patents and trademarks show no association with commercial success. In line with these authors, such empirical

results can be explained by factors such as high cost of patenting, ineffectiveness of these instruments for appropriation, obstructing diffusion and so forth.

Copyrights grant legal ownership over original artistic and literary works (such as books, music, painting, sculptures), as well as for the generation of computer programs, databases, advertisements, maps, and technical drawings. According to Boudreau et al. (2022), while products that are novel or distinct may be adequately protected by patents, copyright only tends to provide limited protection for technological innovations. They argue that this is related to the fact that imitators may be able to replicate the functionality without copying the code (the only protection that copyright provides). Conversely, Boudreau et al. (2022) also highlights that products that are differentiated on the basis of content would not be efficiently protected by patents since patents provided limited protection for specific expressions (text, images, or videos). Copyright would be a more suitable alternative for this since they are intended to protect specific expressions.

Utility models are usually conceived as a less strict form of patent. Even though this IPR instrument generally grants the same appropriability rights as those conferred by patenting legislation, utility models demand less stringent requirements and provide legal protection for lower periods of time than those in the former (Gallie and Legros, 2012). Utility models stand as a suitable intellectual property protection alternative for some innovators since these provide an easier, cheaper, and faster alternative/type of patent protection to the conventional patent system (Prud'homme,, 2017). Beneito (2006) provides a number of reason as to why utility models differ from patents. First, the requirements for obtaining a utility model are less rigorous than for patents; in practice, utility models are sought for innovations which may not meet the patentability criteria. Other factor relates to the temporal validity of these instruments. For instance, the term of protection for utility models is shorter than for patents and varies from country to country. A third reason deals with the fact that in most countries where utility model protection is available, patent offices do not examine applications as to substance prior to registration, which means that the registration process is simpler and faster. Finally, the last compelling reason provide by Beneito (2006) deals with the fact that in some countries, utility model protection can only be obtained for certain fields of technology and only for products but not for processes.

Finally, ***plant varieties*** represent a less common mean of intellectual property protection which is especially suitable for innovators operating at the agricultural sector. Plant breeders are herein conferred exclusive control and rights over the biological varieties they have produced (Campi and Nuvolari, 2015).

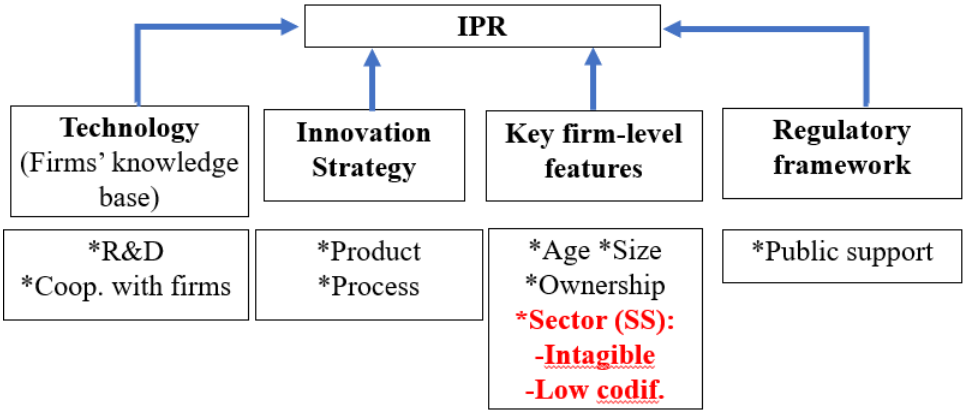
On the other hand, ***non-statutory (informal) instruments*** entail those informal mechanisms of intellectual property that are not subject to explicit legal regulation and that are mostly used for the case of those inventions embodying less codifiable knowledge. Secrecy, lead time advantages over competitors, and complexity of products constitute some of these informal means of protection (Utterback, 1994). These instruments are particularly suitable for those inventions that are complex and difficult to imitate and whose tacit knowledge allows the firm to maintain their use within the boundaries of the organization (Zobel et al., 2017). Given the fact that these types of methods by definition diminish knowledge sharing, these tend to be adopted by firms pursuing radical innovation strategies operating at the technological frontier (withing a fast-changing environment) and that are thus particularly reluctant to operate with other entities to enhance their inventive performance (Telg et al., 2023).

2.2. Firm-level factors shaping intellectual property adoption.

Figure (1) describes determinants shaping the adoption of methods of intellectual property protection according to the discussion posed by Amara et al. (2008) and Galia and Legros (2012). As can be observed, main type of innovation strategy being followed by the firm, the presence of cooperative inventive agreements with other entities, type of ownership (domestic or foreign), key sector of economic activity, firm size and age, as well as access to government funding constitute some of the

most relevant company level determinants shaping the adoption of a given instrument for intellectual property protection.

Figure (1): Firm-level drivers of IPR adoption.



Source: Amara et al. (2008) and Galia and Legros (2012).

Firms pursuing ***product innovation*** strategies are most likely to utilize patents as an effective means of protection. This is because product innovation projects usually entail higher knowledge codifiability and tangibility than other comparable inventive strategies (such as process innovation). In fact, it has been argued that innovators tend to avoid the patenting of ***process innovation*** activities given prevailing difficulties in identifying infringements by competitors (Arundel and Klaba, 1998). ***Collaborative R&D projects*** usually induce firms to rely on intellectual property mechanisms of any sort. This is because firms engaging on technological partnership typically first decide to legally protect their knowledge assets prior to sharing such information with other potential collaborators (Brouwer and Kleinknecht, 1999). Type of ownership also plays a role on the likelihood to adopt appropriability mechanisms. ***Foreign owned affiliates*** generally tend to rely on the available knowledge generated from within their parent company located abroad, and thus they are less likely to generate new inventive output at less developed economies (Arundel, 2001). Therefore, domestic firms are more prone to utilize instruments for intellectual protection than their foreign counterparts.

Given the fact that the cost of patenting also stands as prohibitive for the average inventive firm (small and medium-sized companies), large firms are more prone to engage on such kind of expenditures to safeguard their return on R&D investment. Similar reasoning applies to firms with **access to government aid** for innovation as they tend to be more aware of the need to protect their innovations under the framework of federal laws (Gallie and Legros, 2012).

2.3. IPR protection at the services sector.

When compared to manufacturers, firms in the ***service sector*** tend to rely less frequently on legal mechanisms the formally protect their inventions (Howells et al., 2003). The intangibility of ***service innovations*** as well as difficulties in adequately excluding imitators from such inventive processes largely account for this issue. Even though existing research indicates that the service sector generally attaches higher relevance to informal mechanisms of intellectual protection (Blümel et al., 2022), other empirical evidence highlights the idea that instruments like patents are still relevant for this sector (especially for the case of services produced by technology) (Battisti et al., 2015). According to Greenhalgh and Rogers (2006), large UK firms operating at the service sectors that are listed at the stock market and that possess a high degree of product diversification are more likely to adopt instruments of intellectual property (such as trademarks and patents) when compared to smaller firms. Knowledge-intensive business services are also prone to combining both statutory and non-statutory means of protection given the fact that formal means of protection also allow for higher inter-firm collaboration (Miozzo et al., 2016).

3. Data and methods.

Chilean innovation surveys biannually divulged by the country's statistical office (*Instituto Nacional de Estadísticas,* INE) constitute our main source of micro-level information. Such datasets report many innovation related variables including predominant type of innovation strategy being pursued (product, process, organizational and marketing), composition of R&D expenditures, availability of skilled workers, key statutory methods of intellectual property protection, policy instruments to support scientific activity, among others. Our research relies on a pooled sample of firms generated by INE which contains standardized micro information from the 13th iteration of the innovation survey covering the period 2021-2022, and that addresses trends at the agricultural, mining, manufacturing and service sector. Such dataset is representative of the entire population of formal enterprises in the country as it is derived from a probabilistic sample approach that considers all economic units being taxed after yearly sales of 2,400 fiscal units (INE, 2019).

A subsample of potential innovators is hereby produced to avoid for potential selection bias (Mohnen et al, 2008). Following Blanchard et al. (2012), we filtered out the initial pooled of Chilean firms' sample to solely consider those entities reporting innovation activities of any sort, that had ongoing or abandoned scientific projects and that have also applied for at least one instrument of IPR. Firms not meeting either of these criteria were then explicitly excluded from the analysis.

Following Galia and Legros (2012), we model as a binary variable firms' decision to adopt a given mean of intellectual property protection. Due to fact that Chilean innovation surveys do not report information on non-statutory intellectual property, we will solely focus on statutory (formal) methods of protection (use of patents, trademarks, copyrights, utility model and design registration). It is also worth noting that even though INE also asked innovators to indicate their preference for plant variety (as an alternative source of intellectual protection), none of the firms therein survey indicate reliance on such type of instrument.

In this background context, our research decided to conduct a multivariate probit analysis (MVP). This econometric procedure entails examining the resulting correlation between generalized residuals that originates after individually regressing each available instrument of intellectual property protection to a common and prearranged set of independent predictors. This is our case since we are interested in testing the effect of inventive strategies, R&D cooperation, type of ownership, affiliation to the service sector and use public subsidies over the choice of a particular instrument of IPR. The model can formally written as follows:

$$Y = \beta X + \epsilon \quad \textbf{(1)}$$

$$Y = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_5 \end{pmatrix} \quad \beta = \begin{pmatrix} b_{10} & b_{11} & b_{21} & \cdots & b_{15} \\ b_{20} & b_{21} & b_{22} & \cdots & b_{25} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ b_{50} & b_{51} & b_{52} & \cdots & b_{55} \end{pmatrix} \quad \textbf{(2)}$$

Y represents the vector of five binary dependent variables and X the vector of independent regressors for each of those five equations. These latter will be the same for all five dependent variables. β is the matrix of coefficients to be estimated, with ϵ indicating the vector of error terms for each given corresponding equation. The general MVP econometric analysis to analyze likelihood to adopt different intellectual property strategies is also briefly summarized below at equation (3).

$$For\ j = \begin{cases} Patent_{it} = 1\ and\ 0\ otherwise \\ Trademark_{it} = 1\ and\ 0\ otherwise \\ Copyright_{it} = 1\ and\ 0\ otherwise \\ UtilityM_{it} = 1\ and\ 0\ otherwise \\ DesignReg_{it} = 1\ and\ 0\ otherwise \end{cases} \quad \begin{cases} Patent^*_{ijt} = \theta_m + \varphi_m X_{im,t-1} + \varepsilon_{im,t} & (3.1) \\ Trademark^*_{ijt} = \theta_m + \varphi_m X_{im,t-1} + \varepsilon_{im,t} & (3.2) \\ Copyright^*_{ijt} = \theta_m + \varphi_m X_{im,t-1} + \varepsilon_{im,t} & (3.3) \\ UtilityMo^*_{ijt} = \theta_m + \varphi_m X_{im,t-1} + \varepsilon_{im,t} & (3.4) \\ DesignReg^*_{ijt} = \theta_m + \varphi_m X_{im,t-1} + \varepsilon_{im,t} & (3.4) \end{cases}$$

The set of dependent and independent variables utilized in this study are summarized at table (1.a). In addition, descriptive statistics for each of these set of regressors are also shown at table (1.b). Table (A.1.) and (A.2) at the appendix to this research shows no major correlation between these same regressor as well as no serious collinearity between the independent and control variables (Variance Inflations are lower than 10).

Table (1): Dependent and Independent variables used in this study.

Name	*Type of variable*	*Description*
IPR_instrument	Binary	Patent (1/0), Trademark (1/0), Copyright (1/0), Utility model (1/0), Design registration (1/0)
Size	Nominal	Total number of employees
Age	Nominal	Number of years since the establishment was founded
DOM_OWNED	Binary	Domestically owned firm
COOP_INNO	Binary	Whether the firm is engaged on cooperative inventive activities
SUBSIDY	Binary	Access to government aid
INN_PRODUCT	Binary	Whether the firm introduced new products
INN_SERVICES	Binary	Whether the firm generated new inventive services
INN_PRC_PM	Binary	Process innovation: whether the firm created new production methods and services
IN_PRC_LGT	Binary	Process innovation: whether the firm introduced new logistics methods
INN_PRC_SPP	Binary	Process innovation: whether the firm introduced new supportive activities
SERVICES_SEC	Binary	Whether the firm is affiliated to the services sector
Source: INE (2024).		

Table (1.b) Summary statistics

	N	Mean	Std. Dev.	min	max
TRADEMARK	1489	0.19	0.39	0	1
PATENTS	1489	0.11	0.32	0	1
UTILM	1489	0.01	0.10	0	1
DESREG	1489	0.01	0.11	0	1
COPYRGHT	1489	0.02	0.15	0	1
LN SIZE	1489	30.22	1.86	0	9.72
LN AGE	1489	20.53	0.89	0	4.8
DOM OWNED	1489	0.92	0.26	0	1
COOP INNO	1489	0.12	0.32	0	1
SUBSIDY	1489	0.06	0.24	0	1
INN PRODUCT	1489	0.24	0.43	0	1
INN SERVICES	1489	0.25	0.43	0	1
INN PROC PM	1488	0.4	0.49	0	1
INN PROC LOG	1488	0.22	0.41	0	1
INN PROC SUPP	1489	0.49	0.50	0	1
SERVICES dummy	1489	0.65	0.48	0	1
Source: INE (2024)					

4. Results.

The econometric estimation derived from our Multivariate Probit method is below introduced at table (2). This latter table is divided into five main columns which describe the likelihood of adopting a given IPR method: (a) trademark, (b) patent, (c) utility model, (d) design registration, (e) copyrights.

We first note that variables accounting for firm size (SIZE), product innovation (INN_PRODUCT), process innovation for production methods (INN_PROC_PM) as well as those for the introduction of new supportive activities (INN_PRC_SPP) primarily report a statistically significant influence over the

adoption of trademarks. Nevertheless, they seem to differently affect companies' likelihood of relying on trademarks. While firm size and product innovation are positively related to this type of IPR method, companies focusing on such later types of process innovation projects seem less likely to also rely on trademarks. We also note that firms introducing brand new services to the market (INN_SERVICES) are less likely to utilize patents as an instrument of intellectual property protection. The same situation goes for all the firms that operate in the service sector (SERVICES_dummy) -they are reluctant to protect their return to investment via the use of patents- and even those that rely on process innovation (new supporting activities) (INN_PRC_SPP). Cooperation between firms (COOP_INNO) represents an important driver of patenting activity. Along the same lines, the execution of product innovation strategies (INN_PRODUCT) reports at table (2) a statistically significant and positive effect for the case of innovators relying on utility models as well as those employing registration design methods. It is also worth noting that copyrights seem to be solely affected by service companies executing activities for new logistic methods (INN_PROC_LOG).

Table (2): Multivariate Probit regression on IPR adoption in Chile.

	(a)	**(b)**	**(c)**	**(d)**	**(e)**
	Trademark	**Patents**	**Utility model**	**Design registration**	**Copyrights**
LN_SIZE	**0.071****	**0.039****	-0.001	0.094	0.015
	(0.02)	**(0.03)**	(0.06)	(0.06)	(0.05)
LN_AGE	0.096	-0.009	0.067	-0.153	0.033
	(0.05)	(0.05)	(0.13)	(0.12)	(0.10)
DOM_OWNED	-0.056	-0.091	-0.196	-0.108	-0.203
	(0.15)	(0.16)	(0.31)	(0.27)	(0.27)
COOP_INNO	0.114	**0.254***	-0.070	0.304	-0.010
	(0.13)	**(0.13)**	(0.32)	(0.24)	(0.23)
SUBSIDY	-0.059	0.149	0.371	0.049	0.416
	(0.16)	(0.17)	(0.30)	(0.31)	(0.25)
INN_PRODUCT	**0.165***	0.122	**0.467***	**0.846*****	0.172
	(0.09)	(0.10)	**(0.23)**	**(0.22)**	(0.18)
INN_SERVICES	0.032	**-0.258***	-0.170	-0.211	0.128
	(0.10)	**(0.11)**	(0.25)	(0.22)	(0.17)
INN_PROC_PM	**-0.344*****	-0.136	-0.085	-0.140	-0.187
	(0.09)	(0.10)	(0.23)	(0.21)	(0.17)
INN_PROC_LOG	0.075	0.023	0.082	0.132	**0.374***
	(0.10)	(0.11)	(0.26)	(0.23)	**(0.17)**
INN_PROC_SUPP	**-0.270*****	**-0.195***	-0.011	0.041	0.043
	(0.08)	**(0.09)**	(0.22)	(0.21)	(0.16)
SERVICES_dummy	**-0.252****	**-0.191***	-0.275	-0.295	**0.273***
	(0.09)	**(0.10)**	(0.22)	(0.22)	**(0.19)**
_cons	-0.997***	-1.005***	-2.293***	-2.320***	-2.346***
	(0.21)	(0.23)	(0.50)	(0.45)	(0.41)
Numb. Observations	1487				
Log likelihood	-1373.88				
Wald chi (50)	132.87				
Prob > chi2	0.000				

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Other interesting insights also emerge from this latter table. Firms operating at the service sector (SERVICES_dummy) do not rely neither on patents nor on the use of trademarks. Given the nature of the independent regressors herein utilized (dummy variable), we therefore argue that these two types of instruments then report a higher likelihood to be utilized across manufacturing companies in Chile. We also note that this reluctance to rely on patents is not only observed for the case of companies belonging to the service sector. Our results also show that this is also the case for. manufacturing firms introducing brand new services to the market (INN_SERVICE) (they are less likely to rely on patents as an instrument of intellectual property protection).

In addition, we also highlight that firm-level regressors such as firm age (LN_AGE) and domestic ownership (DOM_OWNED) do not seem to report a positive or even significant influence over the adoption of any kind of sort of instrument of intellectual property protection herein considered. Furthermore, we note that access to government support for innovation (SUBSIDY) solely reports a weak and insignificant the same set of instruments outlined within this table.

5. Conclusions and points for discussion

This paper aimed to evaluate the mechanism through which firms decide to adopt different instruments of intellectual property protection. Previous research has extensively addressed this issue by focusing on the patents within manufacturing activities. We deviate from such existing literature in that we simultaneously consider firm-level determinants shaping the decision to utilize key statutory methods (such as copyrights, trademarks, patents, design registrations and utility models). Addressing the role played by different types of innovation in services as well as underscoring the relevance of firms operating at this sector also comprise novel elements shaping this empirical work. These analyses were herein performed through the lenses of a recent pooled sample of inventive enterprises which was compiled and produce by Chile' Statistical Office for period 2021-2022. Our general conclusions can be summarized as follows.

On the one hand, our results confirm prior empirical findings on patenting adoption. In line with Arundel and Klaba (1998) and Galia and Legros (2012), we also find that large innovators are particularly prone to rely on patents as an ideal instrument of intellectual property to safeguard their return on investment. The positive coefficient attached to cooperative activities also seems to confirm the fact that patenting firms are also more likely to engage in collaborative agreements due to their prior sharing of codifiable knowledge through this same means of protection. Along the same lines, we also corroborate the reluctancy of firms generating new inventive services to patent their scientific output. The intangibility of such type of service innovation as well as prevailing difficulties to exclude competitors from such process largely account for this issue (Howell et al., 2003). Firms solely focusing on process innovation (with particular focus on the introduction of new supporting activities) are also found to be less inclined to use patents.

Those firms that introduce new inventive products seem to rely on utility models and on design registration instruments given that these demand less strict requirements to formally protect their inventive output, as well as considering the limited commercial life of such type of inventions. Our econometric results also underscore that the use of copyrights seems to prevail across firms operating at the service sector. Following WIPO (2015), the use of such instrument across these firms might reflect the emergence of copyright-based industries in services which might include activities such as advertising, the generation of software, databases and computer games to name a few.

These results have strong policy implications as they indicate that firms participating in the services sector and that execute process innovation strategies in logistics methods and services tend to rely on formal methods of intellectual property protection such as the use of copyrights. Our results also confirm the idea that establishments seeking to generate new inventive services do not rely on either of the formal appropriability mechanisms herein studied (statutory methods) due to the intangibility of service innovations. Non-statutory methods such as secrecy, lead time advantages over competitors, and complexity of products might stand as more suitable instruments to protect the creation of brand-new services.

Appendix

Table (A.2) Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) TRADEMARK	1.000															
(2) PATENTS	0.358	1.000														
(3) UTILM	0.124	0.199	1.000													
(4) DESREG	0.145	0.206	0.408	1.000												
(5) COPYRGHT	0.190	0.138	0.217	0.272	1.000											
(6) LN_SIZE	0.133	0.073	0.021	0.060	0.011	1.000										
(7) LN_AGE	0.133	0.041	0.017	0.000	-0.014	0.441	1.000									
(8) DOM_OWNED	-0.044	-0.051	-0.022	-0.058	-0.027	-0.259	-0.075	1.000								
(9) COOP_INNO	0.047	0.060	0.005	0.069	0.017	0.233	0.122	-0.169	1.000							
(10) SUBSIDY	-0.011	0.022	0.029	0.020	0.038	-0.025	-0.010	0.012	0.161	1.000						
(11) INN_PRODUCT	0.074	0.045	0.070	0.133	0.036	0.056	0.071	-0.042	0.164	0.094	1.000					
(12) INN_SERVICES	-0.001	-0.042	0.004	0.018	0.043	-0.017	-0.024	-0.046	0.163	0.049	0.199	1.000				
(13) INN_PROC_PM	-0.070	-0.014	0.014	0.042	0.003	0.084	0.028	-0.099	0.164	0.077	0.135	0.164	1.000			
(14) INN_PROC_LOG	-0.014	-0.016	0.012	0.027	0.068	0.026	-0.030	0.034	0.054	-0.009	0.027	0.068	0.115	1.000		
(15) INN_PROC_SUPP	-0.092	-0.050	-0.005	0.008	0.031	0.117	-0.025	-0.009	0.072	-0.044	-0.124	-0.035	0.016	0.168	1.000	
(16) SERVICES_dummy	-0.123	-0.080	-0.039	-0.055	0.040	-0.257	-0.316	0.105	-0.080	-0.002	-0.136	0.123	-0.126	0.076	0.055	1.000

Table (A.2). Variance inflation factors

Variable	VIF	SQRT VIF	Tolerance	Squared
LN SIZE	1.42	1.19	0.7061	0.2939
LN AGE	1.33	1.15	0.7541	0.2459
DOM OWNED	1.1	1.05	0.9081	0.0919
COOP INNO	1.17	1.08	0.8558	0.1442
SUBSIDY	1.04	1.02	0.9598	0.0402
INN PRODUCT	1.11	1.06	0.8983	0.1017
INN SERVICES	1.12	1.06	0.8951	0.1049
INN PROC PM	1.1	1.05	0.9124	0.0876
INN PROC LOG	1.06	1.03	0.9462	0.0538
INN PROC SUPP	1.08	1.04	0.927	0.073
SERVICES dummy	1.21	1.1	0.8269	0.1731
Mean	VIF	1.16		

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