

To what extent do Young Innovative Companies take advantage of policy support to enact innovation appropriation mechanisms?

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ABSTRACT

Innovative entrepreneurship is at the heart of economic development in all modern economic systems. However, we observe in several developed countries - especially Europe - a languishing in the capacity to foster creative destruction (i.e. Schumpeter Mark 1, SM1) dynamics and to create young innovative companies (YICs), capable to establish themselves as leaders in markets or become successful innovators. One key issue that is often advocated in this respect is the deficit suffered from YICs in fully protecting their innovations and appropriate (at least in part) returns from it. The usage of formal (e.g., intellectual property rights) and informal (e.g., secrecy, lead time, access to complementary assets) instruments to protect intellectual property assets has the potential to overcome this difficulty. Different types of policy mechanisms have been put in place to help YIC. However, high implicit and explicit costs and barriers prevent YICs' use of protection strategies, limiting the ability to generate SM1 dynamics or accessing market for ideas, even upon policy support. By relying on the resource-based view (RBV) of the firm, our paper investigates to what extent a comprehensive set of policy measures recently introduced in the Italian context and focused on alleviating the hurdles suffered by YICs is associated with the choice of YICs to protect their innovation. The econometric analyses based on more than 1,600 Italian YICs show how the use of financial policy measures are associated to both formal and informal instruments, while labour policy measures are only related to the former instruments.

Keywords: Entrepreneurship policy; Institutional reform; Young innovative companies; Intellectual property rights; appropriation mechanisms.

1. INTRODUCTION

In recent years, research has been devoting increasing attention to the strategic process of adoption of appropriation mechanisms by Young Innovative Companies (YICs). In particular, YICs are companies that are knowledge-intensive and research-based, young and independent and devote significant resources to R&D and innovation (Dumont, 2017). They are small in numbers but accountable for high innovative performance (Schneider and Veugelers, 2010).

In several developed countries - especially Europe – we observe a languishing in the capacity to foster creative destruction (i.e. Schumpeter Mark 1, SM1) dynamics and to create young innovative companies (YICs), capable to establish themselves as leaders in markets or become successful innovators. The difficulty for YICs to emerge as *successful* innovators is contingent on their capacity to protect innovation and capture some of the value they create (Gans et al., 2002). Hence, research has started investigating causes and patterns of YICs' appropriation strategies (Veugelers and Schneider, 2018), as well as their consequences, such as obtaining venture capital investments (Audretsch et al., 2012) and achieving growth (Helmers and Roger, 2011). Beyond financial constraints, several strategic challenges (e.g., reaching critical scale, access to complementary resources, lack of reputation) are prominent to this type of firms (Teece, 1986), especially in Europe, where YICs face structural gaps that threaten their development (Cincera and Veugelers, 2014). In light of this, a conspicuous body of research in the R&D policy literature has investigated the role of public policies at both national (e.g., Grillitsch et al., 2018) and regional levels (e.g., Vecchiato and Roveda, 2014) in supporting YICs.

However, it is not clear yet to what extent YICs are able and willing to leverage on policy initiatives to enact appropriation strategies. In general, “there is surprisingly little analysis and evidence on the appropriability strategies of young innovative companies” (Veugelers and Schneider, 2018, p. 114). As to the specific effect of using policy support, while a vivid debate

exists on the rigorous evaluation of policy initiatives (Söderblom et al., 2015), there is also a growing stream of research that focuses on the strategies pursued by firms that have actually used these policy incentives (Schneider and Veugelers, 2010). This literature offers at least three areas that deserve further investigation. First, research has suggested that different types of appropriation strategies exist, which can be grouped into *formal* (including intellectual property rights – henceforth IPRs – like patents, trademarks and copyrights) and *informal* (secrecy, exploitation of lead time and the use of complementary assets). These have different antecedents and outcomes (Hall and Sena, 2017) and can be used by firms as complement or as substitute (Veugelers and Schneider, 2018). Nevertheless, to date, very little research has focused on how YICs can actually take advantage of policy support to implement formal rather than informal strategies (Czarnitzki and Delanote, 2015). Second, policy mechanisms are quite comprehensive and address several resource shortages. These, in turn, might differently affect formal and informal appropriation strategies. Since extant research mostly focused on financial barriers (Schneider and Veugelers, 2010), it has overlooked the different and complementary effects of policy interventions that are devoted to labour and human capital gaps, together with those addressing financial barriers. Third and last, non-representative samples with small datasets are said to be limiting the generalizability of the findings on the use of policy support by YICs (Söderblom et al., 2015).

The purpose of this paper is to address these gaps by investigating to what extent YICs that have used different policy instruments are more likely to enact formal rather than informal appropriation strategies. The baseline of our arguments draws on the resource-based view (RBV) of the firm (Barney, 1991), and posits that when an institutional reform manages to alleviate YICs' (financial) constraints, the freed resources will flow (at least in part) towards protecting innovation. Furthermore, we expect a relationship between “flexibility” of resources (behind policy mechanisms) and the type of appropriability mechanism chosen by the YIC (Chatterjee and Wernerfelt, 1991).

To test our predictions, we take advantage of a unique context, which is a recent policy reform developed in Italy. We focus on Italy as an unexplored and extremely relevant case. In fact, Italy has a structurally weak national innovation system (Nuvolari and Vasta, 2015) and has a lack of capacity to generate viable and successful start-ups in knowledge-intensive industries (Grilli and Murtinu, 2014). However, an institutional reform introduced by the Italian government in 2012 called the Italian Startup Act (the Law 221/2012) was the first to specifically target YICs, and provide a number of benefits for easing their business, and above all, innovative activities. We take advantage of a survey launched by the National Committee of the Italian Ministry for Economic Development on the “Monitoring and Evaluation of National policies for the Eco-system of Italian Innovative Start-ups” and administered by the Italian National Institute of Statistics (ISTAT) in 2016. The questionnaire collected information along a series of dimensions, including information regarding the founding team and employees, the innovation strategies, growth performances and, importantly for our study, the adoption of the different public policy measures that were available. As to this latter aspect, entrepreneurs were explicitly asked to declare whether they had used some among the specific instruments of the implemented reform, which is the central information we exploit in the analysis. While other recent works have investigated YICs from the Italian Startup Act sample (e.g., Colombelli, 2016; Grilli, 2018; Hahn et al. 2019; Colombelli and Quatraro, 2019), our restricted access to the National Committee survey confers us two particular advantages: first, the access to an extensive and highly representative subset of the whole population; second, a satisfying depth of information on the utilized policy mechanisms and their association with appropriation strategies. On the other side, however, it is worth stressing that the National Committee survey provides us with cross-sectional data, so that we cannot interpret results in terms of causation. By drawing on the resource-based view (RBV) of the firm (Barney, 1991), we interpret our findings to shed light on the possible aggregate and individual effects of policy mechanisms such as: Equity and Debt instruments (financial

measures); Flexible contracts, Dynamic salary, Stock option, and Low tax high skills instruments (labour measures).

Our paper offers several contributions to the literature. First, we extend YICs and innovation theory by adding nuanced views on the link between resources and innovation strategy, in particular on to what extent, and how, YICs use the support from different policy instruments to enact their appropriation strategies. Although our analysis does not allow to interpret results in terms of causation, the informative capacity of mere correlations in this field is quite relevant, since the issue of YICs' use of policy measures to pursue IP protection strategies has been overlooked by previous research. Given the early age of firms under consideration, it is very likely that the two phenomena jointly co-evolve and reinforce one the other in an indistinguishable order, at least in the intentions of the entrepreneurial teams. Our findings indicate that, while financial support is positively associated to both types of strategies, labour support tends to be associated only with formal protection strategies. Second, the literature on YICs is enriched by a novel empirical context that allows evaluating a number of aspects of firm's behaviour, including the exact assessment of whether a specific policy mechanism has been used. Third, from a policy perspective, we are the first in the literature to offer a theoretically-reasoned and empirical-grounded taxonomy illustrating how different policy instruments associate with different YICs' appropriability mechanisms. The picture that emerges from this taxonomy is particularly informative for policy makers who aim at strengthening YICs' capabilities to protect their innovation and so to prosper in markets, whether they are for products or for ideas.

2. THEORETICAL FRAMEWORK AND HYPOTHESES

2.1 Formal vs. informal instruments to protect innovation

Since Schumpeter (1934), it has been widely acknowledged that entrepreneurs and new firms play a major role in innovative activities. Start-ups, and YICs in particular, are more and more

considered the engine of technological change and economic growth and are often responsible for the introduction of radical innovations onto the market (Henderson and Clark, 1990; Baumol, 2004; Henderson 1993; Colombelli et al., 2016; Veugelers and Schneider, 2018; Henkel et al., 2015). However, the generation and the introduction of innovations do not automatically translate into superior economic performances for the innovator (Teece, 1986). In order to gain, sustain and exploit a competitive advantage, YICs need to appropriate the returns of their innovative activities by protecting their knowledge assets through “isolating mechanisms” or “resource position barriers” (Wernerfelt, 1984; Rumelt, 1987; Barney, 1991).

Concerning how to appropriate the return of their innovation activities, YICs face two main strategic choices by opting for either formal or informal appropriation mechanisms. Each mechanism is associated with specific advantages. From the innovator perspective, formal appropriation mechanisms provide the advantages associated with the exclusive right to use or sell its invention. Innovators may also make “strategic” use of IPRs. For example, patents can be used to enhance reputation, to create barriers with the purpose of increasing imitation costs, to build up bargaining chips to be used in establishing strategic alliances or collaterals to attract sources of finance (Helmers and Roger, 2011; Audretsch et al., 2012; Hoenen et al., 2014; Hoenig and Henkel, 2015; Söderblom et al., 2015). Nevertheless, formal mechanisms also have some drawbacks. First, a large amount of financial resources is required, to properly enact formal mechanisms of protection (Hall, 2005). Second, patents require disclosure of important information and knowledge that can be used by competitors to invent around and, actually, imitate the invention (Levin et al. 1987). Third and last, formal mechanisms require human, social and reputational capital to lead to innovation outcomes (Audretsch et al., 2012; Söderblom et al., 2015).

As far as informal mechanisms are concerned, lead time gives the innovator a ‘first mover’ advantage as the replication of an invention is often time consuming and costly. The first mover advantage, in turn, allows inventors to recover the costs of innovation. Secrecy avoids the

disclosure of information concerning the invention and is protected by law, although to a limited extent. It thus gives a first mover advantage, limits the ability of competitors to imitate the invention and may impede reverse engineering. Appropriating the returns from innovation also requires the use of complementary assets, like marketing, competitive manufacturing, and after-sales support (Teece, 1986). These assets that are rare, valuable and difficult to imitate, represent entry barriers, thus give their owner a competitive advantage (Barney, 1991). Clearly, also informal mechanisms have important disadvantages. In fact, all these informal mechanisms may entail important implicit or explicit costs, which may simply make them out of reach for most YICs (e.g., Colombo et al., 2006). Moreover, informal mechanisms are somewhat risky as they require internal capabilities to be enacted or are not entirely under control of the firm, as they might depend on other external factors (such as availability of complementary resources through partners, customer loyalty, possible exogenous shocks in the technology sector, etc.).

2.2 YICs' appropriation barriers and policy instruments

The strategic choice concerning whether or not using protection mechanisms to defend innovation may be influenced by a number of barriers or incentives with which YICs are confronted due to their liabilities of newness and size (Autio, 2005; Baughn and Neupert, 2003)

The main barriers YICs face are related with their primary inputs, i.e. capital and labour (Söderblom et al., 2015). It is almost universally acknowledged that YICs are subject to important financial constraints (Storey and Tether, 1998; Revest and Sapio, 2012). The financial literature has provided ample evidence about the existence of resource constraints and of their negative effects on YICs' innovative performances (e.g., Fazzari et al., 1988; Evans and Jovanovic, 1989; Holtz-Eakin et al., 1994; Blanchflower and Oswald, 1998). These financial constraints may indeed impede YICs to bear the high expenses associated to innovative process (Hall, 2005). Previous literature empirically confirms that the high costs associated to formal protection mechanisms are

one of the main obstacles for innovative start-ups and lead to a relatively low demand for patent protection (van Pottelsberghe and François, 2009; Graham et al. 2010). These costs include process and translation costs, external expenses, maintaining, monitoring and enforcing costs (see van Pottelsberghe and François, 2009). On the other hand, YICs often lack financial resources to get access and control over complementary assets and resources (e.g., distribution channels, capital, knowledge) that are needed to commercialise the results of their innovation activities and are thus forced to rely on cooperation with external partners - at least in their early stage of development - and thus partially fail to appropriate the returns of their innovative activities.

As far as labour is concerned, the main barrier faced by YICs concerns the rigidity of the labour market (Arvanitis, 2005; Zohu et al., 2011). This means that YICs face problems concerning how to reduce high labour fixed costs, to find qualified workers and to retain them by providing the right incentives. These barriers may hamper the innovative performance of YICs. In this respect, the labour economics and innovation literatures have provided evidence about the positive effects that qualified personnel exert on the innovative performances of firms, especially YICs, and have argued that flexibility may be particularly critical for firms in their early stage (e.g., Autio, 2005; Baughn and Neupert, 2003; Baughn et al., 2008).¹ Flexibility of contracts allows YICs to use labour forces according to their availability of capital and, thus, to reduce overall fixed labour costs (e.g., Storey et al., 2002; Zhou et al., 2011). This helps YICs invest higher resources into innovative activities. Moreover, the flexibility of contracts allows YICs improving employer-employee matches and acquiring new knowledge and networks of connections embedded in new skilled employees (Kalleberg and Mardsen, 2005; Malcomson, 1997; Matusik and Hill, 1998; Martínez-Sánchez et al., 2011). Finally, flexibility of wages can contribute enhancing YICs

¹ Although the labour economic literature has provided mixed results concerning the effects of the flexibility of contracts on innovation (e.g., Amabile et al., 1996; Guest, 1997; Trott, 1998, Michie and Sheehan, 2003; Zhou et al., 2011; Kleinknecht et al., 2014; Wachsen and Blind, 2016), for what concern YICs arguments in favour of a positive relationship seem to prevail (Kato and Zhou, 2016).

innovative activities by attracting high-skilled workers, increasing worker effort and easing knowledge sharing within the organisation (Kruse, 1992; Collins and Smith 2006; Liu, Gong and Huang 2017; Datta et al. 2005).

Driven by the belief that for YICs facing financial and labour barriers public policy intervention is required, governments around the world have pursued and implemented specific national (and pan-national) policy actions with the explicit aim of offering support to YICs (Lerner, 2010; Colombelli et al., 2016). By taking advantage of national Startup Acts, YICs receive facilitations like tax reliefs, eased access to resources, as well as other benefits that are supposed to prompt their development and, most notably, innovation processes. These measures include instruments that facilitate easier access to external finance (e.g., both banks and equity financing²) and instruments that increase the flexibility of labour like flexible contracts to employees, performance-related pay schemes and tax credit for the employment of highly skilled personnel.

It is not clear, however, to what extent and how YICs are actually willing and able to take advantage of this support when innovating, due to possible inherent costs and complexity of doing so. In this paper, we ask to what extent YICs manage to take advantage of the removal of financial and labour barriers enabled by an institutional reform by reporting higher likelihood to adopt protection mechanisms. Moreover, we aim at understanding whether the specific measures to ease access to capital and increase the flexibility of labour promoted by the institutional reform may induce YICs to opt more for formal rather than informal protection mechanisms.

² The legislation can promote indirect financial instruments, meaning measures that facilitate accessory costs in the fund raising process (life tax relief for equity investor and guarantee for debt), rather than direct financial provision such as government-backed venture capital funds. This is the focus of the present paper.

2.3 Policy instruments and different YICs' innovation protection strategies

We investigate the possible aggregate and individual effects of policy mechanisms such as: Equity and Debt instruments (financial measures); Flexible contracts, Dynamic salary, Stock option, and Low tax high skills instruments (labour measures). Different policy instruments may exert different effects on the preferred appropriation strategy pursued by YICs. Theoretical insights from the literature may help identifying the possible mechanisms that induce YICs to adopt specific appropriation strategies.

2.3.1 Financial policy instruments

Starting the analysis from the financial policy instruments and relying on the RBV of the firm, a first important remark to make is that financial resources “are the most flexible of all resources because they can be used to buy all other types of productive resources” (Chatterjee and Wernerfelt, 1991, p. 35). Thus, all those policy mechanisms that ultimately aim at injecting new financial resources into a YIC should foster the use of protection mechanisms, both formal and informal. Equity and debt financial instruments may however exert different effects on YICs appropriation strategies.

Equity. A theoretical lens that can be used in order to identify the possible mechanisms that induce YICs to react to the policy equity incentives by adopting a specific appropriation strategy is based on the appropriability hazards plus the reputational and signalling logic. Appropriability hazards (Levin et al., 1987) are associated to transactions between the innovator and other contractual parties like potential investors. Such contract hazards arise because of the unique trading characteristics of information as described by the Arrowian “fundamental paradox” of information (Arrow, 1962). The paradox stresses how the value of an innovation to the purchaser is not known until the innovator does not disclose it, which is necessary in the fundraising process

itself, the consequence being that in effect the purchaser acquires such innovation without cost. This argument is used by Arrow to posit the need for patent protection. In the case of YICs an appropriation hazard may arise during the screening phases by investors, like Venture Capitalists (VCs) and Business Angels (BAs), who may expropriate innovative entrepreneurs (Ueda 2004). This suggests that YICs, once they have freed *financial resources*, might be incrementally inclined to use them to protect their innovation by means of formal mechanisms.

Appropriability hazards, however, depend on the reputational risks the external resource providers face if they behave opportunistically at the expense of the YIC. Reputation is an economically important asset as it can generate future rents when information among actors is asymmetric (Shapiro, 1983; Biglaiser, 1993; Spence, 1974). As YICs lack reputation capital, they may rely on the quality of their affiliates as a signal of their own quality (Megginson and Weiss, 1991; Biglaiser, 1993; and Stuart et al., 1999; Hsu, 2004). In this case, YICs are less concerned with the risk of expropriation by investors like VCs or BAs. Moreover, from the investors' perspective, reputation may affect the price at which they are able to acquire equity in a given start-up (Hsu 2004). If VCs or BAs "steal" ideas of the entrepreneurs, although it can be difficult to prove, their reputation will suffer and, as a consequence, their future rents will diminish. Additionally, appropriating the returns of innovation typically requires complementary assets, which VCs/BAs can facilitate through their networks. VCs/BAs indeed can act as brokers of strategically important information for YICs (Lindsey, 2002; Hsu, 2004). They may help in recruiting senior executive officers (Gorman and Sahlman, 1989; Hellmann and Puri, 2002), in establishing strategic alliances (Stuart et al., 1999; Gans et al., 2002) and in obtaining additional funds (Barry et al., 1990; Megginson and Weiss, 1991). All these dynamics may thus mitigate appropriability hazards. In light of the weakened concern for appropriability hazards and given the value added that equity investors can provide in the innovation process, YICs may opt for informal protection mechanisms, once they get financially supported by the policy intervention.

Finally, a third lens of investigation is offered by the signalling theory (Spence, 1973; Connelly et al., 2011), which supports the idea that start-ups may especially use intellectual property rights to signal their value to investors (Hsu and Ziedonis, 2013). Ample evidence reveals signalling effects of formal appropriation mechanisms on equity financing (Audretsch et al., 2012; Hoenig and Henkel, 2015; Conti et al., 2013). Since equity investments in innovation usually occurs along subsequent rounds, where intellectual property will be further evaluated (Hoenen et al., 2014), access to equity by the policy support might encourage YICs to prompt formal protection mechanisms, in view of future fund raising efforts.

Debt. Also, in the case of debt financing the appropriability hazards and reputational logic arguments apply. However, further arguments can be put forward. Previous works reveal that the market for lending to start-ups is quite important (Ibrahim, 2010; Robb and Robinson, 2014; Cosh et al., 2009) and that start-up lending is stimulated by intellectual property rights. Banks are less willing to invest in risky innovative activities and have less competences to understand the real value of an innovation (Carpenter and Petersen, 2002; Beck, Demirgüç-Kunt and Maksimovic, 2005; Colombo and Grilli, 2007). For banks indeed both the signalling and the economic value of formal protection mechanisms is important. On the one hand, intellectual property rights signal the quality of a start-up to the lenders while, on the other hand, they represent to banks the most marketable intangible assets and are valued from a collateral perspective. It seems reasonable to expect that, anticipating the need to sustain further and subsequent fund raising rounds from the bank, as in the case when the firm is growing, YICs whose (debt) financial constraints are alleviated by the policy intervention will find formal protection mechanisms, ceteris paribus, more appealing.

Finally, debt could also matter to informal protection. Banks are shifting their approach from mere lending to supporting innovation in an open and comprehensive way (Brancati, 2015). It is reasonable to expect that YICs who have a facilitated access to debt will benefit from the relationship with the bank in terms of networks, partnerships, alliances and access to market

resources (Schneider and Veugelers, 2010; Minola and Giorgino, 2008). They will also gain higher market knowledge and be updated on the technological frontiers, thus benefiting in terms of innovation lead times. These complementary assets might encourage YICs to opt, *ceteris paribus*, for informal protection strategies.

2.3.2 Labour policy instruments

Different mechanisms may induce YICs to react to the policy labour incentives by adopting a specific appropriation strategy.

Flexible contracts. As the RBV of the firm suggests, YICs are subject to resource constraints because of the liabilities of newness and size (e.g., Autio, 2005; Baughn and Neupert, 2003). Flexibility of contracts may alleviate resource constraints of YICs and, in turn, increase, among others, their innovation efforts due to reduced overall fixed labour costs and better employer-employees matches (Storey et al., 2002; Zhou et al., 2011; Malcomson, 1997; Matusik and Hill, 1998). However, labour policy instruments that aim at the flexibility of contracts may allegedly produce an increased mobility and turnover of highly skilled employees. Then, an appropriation hazard problem could arise because employees can, in principle, expropriate the entrepreneurial idea or technology, and earn profits. The threat is particularly acute in contexts where noncompete covenants are difficult to enforce (e.g. Starr et al., 2018). Previous works have confirmed that high external labour turnover can reduce the loyalty and commitment of employees to their firms. The risk with less loyal and less committed employees is that they can easily leak relevant information to competitors (Naastepad and Storm, 2006). This will be difficult to prove, and will likely have no significant consequences for their future careers. The reputational capital is indeed less important for skilled employees as compared to institutional investors. In order to impede leakage of relevant information, while at the same time taking the upside of better access to labour force, YICs relying on these instruments may thus opt for formal protection mechanisms. In line with this argument, the empirical work by Kim and Marschke (2005) on a sample of U.S. firms have confirmed that

the departure of key employees from a firm increases its patenting propensity. Consistently, Kaiser et al. (2015) find that labour mobility increases the total patenting activity of both the new and the old employer. Thus, this evidence provides support to the possible positive relationship between the flexible contracts policy instrument and the adoption of formal protection mechanisms.

Flexible contracts policy mechanisms might also increase YICs adoption of informal protection strategies. Under the threat of the above-mentioned risks associated with labour mobility, YICs might see informal protection mechanisms, maybe after or in combination with formal mechanisms, as valuable protection mechanisms since they are firm-level protection; this might be the case for example of complementary assets and strategic partnership, which could be considered effective protection mechanisms not only vis-à-vis other firms, but also against internal (workforce leakage) threats.

Low tax high skill hiring. The access to high human capital favoured by the institutional reform through low tax high skill schemes may also affect the appropriation strategies of YICs. In these firms, innovative capabilities are mainly embedded in specific high-skilled workers, rather than in practices rooted in the organization (Aubert et al., 2006; Ouimet and Zarutskie, 2014; Coad, 2018). Highly skilled individuals can be more able to face the complexity associated with the development and the writing of a patent. Thus, facilitated access to high human capital made available by the institutional reform may enable YICs to use formal mechanisms to a higher extent. Additionally, in case these specific individuals leave the firm, important knowledge and competences are lost. The use of formal protection mechanisms by the firm may reduce the risk to lose the ownership of such relevant knowledge and capabilities. From the inventor perspective, high-skilled workers can be more willing to patent an invention to increase their reputational capital. Being the inventor of a patent can be a valuable resource to the worker, particularly considering the high failure rate of start-ups; hence, higher access to skilled worker could lead to higher use of formal mechanisms.

Given the complexity and human capital barriers often related to the design and implementation of informal protection mechanisms, which require adequate skills to be managed (as it is in the case of strategic partnerships, for example), an eased access to skilled worker could lead YICs to higher use of informal mechanisms, too.

Performance-related pay schemes. Finally, also labour policy instruments that aim at supporting the use of performance-related pay schemes (such as dynamic salaries and stock options) can be associated with appropriation strategies of YICs. The existing literature argues that performance-related payments are particularly effective in knowledge intensive contexts, like in the case of YICs (Collins and Smith, 2006). Performance-related payments indeed provide workers with the incentives to share their knowledge and help create collaborative environments (Nahapiet and Ghoshal, 1998; Lazear, 1999). However, knowledge workers may see their tacit knowledge as a source of job security and power (Davenport and Prusak, 1998). The policy instrument may also induce them to protect their intellectual capital through formal protection mechanisms so to maintain ownership of the knowledge that has been shared within the company. From the YIC perspective, formal appropriation mechanisms may be a way to codify and protect knowledge generated through collective learning and processes induced by the performance-related payments policy instruments. At the same time, collaborative innovation environments are likely conducive to shared learning that ends up being embedded in relationships, partnerships and other implicit dimensions of the innovation process. This makes informal protection strategies also potentially more likely to occur for YICs that have benefited policy support in terms of performance-related pay schemes.

Overall all these arguments offer a nuanced picture of the possible mechanisms that induce YICs to adopt specific appropriation strategies by leveraging the policy instruments made available by an institutional reform. The arguments offered by the literature are summarized in Table 1.

– Table 1 around here –

2.4 Contribution of the paper

Despite the above arguments suggest potentially positive association of using policy support on appropriation strategies, little research has specifically examined such relationship (Veugelers, 2008; Czarnitzki and Delanote, 2015). Additionally, and most importantly, literature also offers evidence and rationales for which firms, including small and innovative firms, might not pursue (or decide not to) innovation appropriation strategies (Rogers et al., 2007; Nikzad, 2015). First, it is not straightforward that firms using policy support, including YICs, innovate more or have higher quality of knowledge and innovation assets (de Rassenfosse, 2012); this would question the fact that they have higher likelihood of incurring into appropriation strategies. Second, managers and principals of YICs, even those that do innovate, might incur in a somewhat myopic behaviour (WIPO, 2004): they might consider that critical innovative assets are only those already possessed by the firm at founding, and hence overlook the importance of a continuous strategy of innovation appropriation, for example by taking advantage of some post-founding resources that are freed by the policy support; hence devoting such resources to other business activities such as marketing, logistics and operations. Third and last, it remains unclear whether – albeit positive – and to what extent the effect of policy support might counterbalance the direct and indirect, financial and non-financial burdens (including learning and organizational complexity) of embracing appropriation strategies (OECD, 2011; Shukla et al., 2011).

To sum up, according to the literature, there are arguments why facilitated access to resources should flow towards formal and informal protection mechanisms. However, it is not clear whether – albeit positive – and to what extent this should actually happen in YICs. Therefore, given the puzzle in the literature of whether YICs would actually decide to engage in IP-protection and the scarcity of works in this area, following the spirit of works like Veugelers and Schneider (2018), in

the empirical analysis we observe the association between both financial and labour instruments and the adoption of both informal and formal mechanisms by YICs.

3. DATA AND METHODS

3.1 Empirical setting

The study takes advantage of the recent institutional change directed at YICs that took place in Italy. The Italian Government issued the so-called *Italian Startup Act* in 2012 (the Law 221/2012, modified by further amendments) with the goal of spurring the national innovation system by offering a plethora of benefits to YICs. We investigate what impact this institutional change and its specific instruments had on the appropriability strategies of entrepreneurial ventures.

In order to be eligible for the benefits introduced by the Law, start-ups need to comply with a range of basic criteria for young innovative companies. First, they need to be genuine start-ups, meaning that they cannot be in their sixth year of life, they cannot distribute dividends (or have not distributed dividends in the past), and they cannot be listed on a stock market. They also cannot have annual revenues higher than 5 million euros, and they cannot be created as a divestiture of an existing company. Furthermore, the start-ups need to be recognized as innovative based one of the following three criteria: *(i)* the start-up (or its founders) should be in possession of tangible intellectual property rights, such as a patent or a license; *(ii)* start-ups' investments in R&D should account for at least 15 percent of the revenues (or operating costs if they exceed the revenues); or *(iii)* at least one third of the employees (including founders) must hold a PhD or a research tenure or at least two thirds must have obtained a Master degree. Lastly, the policy was of retroactive nature, allowing access to these measures not only to new ventures,

but also to those firms that already existed before the promulgation of the Startup Act provided that these firms fulfilled all the prescribed requirements.

As soon as start-ups are recognized as YICs, they can enjoy all the benefits introduced by the institutional reform, i.e. a range of mechanics that target different aspects of the entrepreneurial activity (Hiatt and Sine, 2014). Most prominently, two groups of instruments that reduce the barriers to growth of new innovative ventures are available.³ The first group focuses on easing access to external finance, including tax incentives for equity investments made by professional private investors (VCs or BAs) and government-guaranteed bank loans. The second group of instruments enables easier access to highly skilled labour by more flexible and beneficial labour regulations. Summary of the implemented instruments is presented in Table 2.

– Table 2 around here –

3.2 Data

The empirical analysis is based on data collected via a survey launched by the National Committee of the Italian Ministry for Economic Development on the “Monitoring and Evaluation of National policies for the Eco-system of Italian Innovative Start-ups” and administered by the Italian National Institute of Statistics (ISTAT) in April and May 2016. The questionnaire collected an array of information on the YICs including the founders’ and employees’ characteristics, their innovation strategies, firm performances, as well as entrepreneurs’ assessment of the public policy measures that were put in place in this domain. Specifically, as to this latter aspect, entrepreneurs were explicitly asked to declare whether they had already used each of the implemented reform instruments.

³ A brief synopsis of the Italian Startup Act (and a comparison with similar legislations in other EU Member States) is provided by the European Digital Forum (2016). A complete description of the eligibility criteria and all support measures are available on the governmental website (<http://www.mise.gov.it>) and in Italian Ministry of Economic Development (2015) and (2017).

The questionnaire targeted the population of all registered Italian YICs, which as of December 2015 was equal to 5,150 YICs. The questionnaire was filled with partial information from 2,275 firms, leading to a considerable 44 percent response rate, and with complete information for the variables of interest of this study for 1,608 YICs. The representativeness of the sample with respect to the population is ensured on all relevant dimensions on which ISTAT, including firms' geographic location, industry affiliation, age and legal status. Furthermore, we also check whether a potential survivorship bias could represent a serious concern in our setting as only the YICs that had survived until the moment of the survey could be sampled. Specifically, we collect information on the survival of companies exactly one year after the survey took place (May 2017) drawing from AIDA database (provided by Bureau Van Dijk which reports complete financial accounting data for public and private Italian firms), and replicate the main analyses exposed in Section 4 by conducting a two-stage procedure. In the first stage, the dichotomous variable capturing eventual exit/survival was regressed on a set of features of the companies and entrepreneurs using a probit estimator, which allows us to estimate the inverse mills ratio (IMR). Then, at the second stage, we repeat the analysis on the use of protection mechanisms by adding the IMR variable in the model's specification, and thus, (partially) controlling for the probability of an YIC to be sampled. The obtained results stay unchanged, while the coefficient of IMR yield to be insignificant.

3.3 Measures

3.3.1 Dependent variables

In our framework, we use different variables to capture the YICs' appropriability strategy, following a general-to specific modelling logic, closely following Veugelers and Schneider (2018). First, we deploy a binary dependent variable ***IP protection*** that equals one if the firm used any of the mechanisms to protect innovation, and zero otherwise. Second, we use two binary dependent variables that mark the type of IP protection mechanism used. ***Formal IP protection***

denotes if a formal mechanism such as a patent, a license or registered software is used, while ***Informal IP protection*** measures if an informal mechanism such as secrecy, lead time, complementary assets in sales, marketing or manufacturing was utilized to shield the innovation. Third, we also used the most-fine-grained appropriability strategies: **Secrecy**, **Lead Time**, **Complementary assets: commercial** and **Complementary assets: production** are dummy variables taking value one if the firm adopted informal mechanism such as secrecy, lead time, complementary assets in sales and marketing or manufacturing, respectively.

3.3.2 Explanatory variables

We capture the use of six instruments that were introduced by the institutional reform, two related to the financial sphere⁴ and four to labour policy. Specifically, the variables ***Equity instrument*** and ***Debt instrument*** equal one if the YIC used the indicated policy instrument that facilitate easier access to external finance (equity investors and loans, respectively), and zero otherwise. As to labour policy instruments, the variables ***Flexible contracts instrument***, ***Dynamic salary instrument***, ***Stock option instrument***, and ***Low tax high skills instrument*** instead equal one if the YIC used one of the indicated instruments that facilitate easier access to highly skilled labour (through less rigid contract requirements, performance-based, equity compensation options, and tax credit for the employment of highly skilled personnel, respectively), and zero otherwise.

⁴ The Law originally included also measures to ease access to crowdfunding campaigns. But, at the moment of the survey, the number of YICs that made effective use of the crowdfunding policy instrument was negligible, since that specific measure needed the deployment of subsequent specific administrative and regulatory acts after the Startup Act in order to be operative. Thus, we are not in the condition to analyse the use of that specific policy instrument in the present study.

3.3.3 Controls

We follow previous studies on IP protection mechanisms to complete the econometric model specification. We primarily control for relevant firm characteristics that could impact the IP protection mechanisms choice. In particular, we include the size of the founding team (***Number of founders***), size of the company in terms of the employees with permanent and temporary contracts (***Number of permanent employees*** and ***Number of temporary employees***), human capital of the founders in terms of the average (among founders) of total years of education and experience (***Human capital of founders***), age of the firm (***Firm age***), as well as motivation for founding the company. As to this latter, entrepreneurs were asked to indicate what was their main motivation behind the creation of the firm, where options were represented by pure monetary incentives (i.e. ***Motivation profit***), the willingness to introduce an innovative service or product into the market (i.e. ***Motivation innovation***) and the aim of transferring to society technologies developed in academia (i.e. ***Motivation research implementation***), where each of these three variables capture the percentage of founders who indicate that specific reason as the prominent one. Furthermore, we control for innovation inputs such as the expenditures in research and development (R&D) as a percentage of total investments made (***R&D expenditures***), information on whether the R&D was performed internally and for the benefit of the YIC itself (binary variable ***In-house R&D***), and if YICs have any R&D cooperation contract with another company (***R&D cooperation***). We also control for the type of innovation outcomes such as if the company has introduced product innovation (***Product innovation***) and process innovation (***Process Innovation***). Additionally, we control for firm performance. In particular, we control whether the firm is offering the products or services internationally (***International***), whether it has already obtained external financing (***Externally funded***) or it has been incubated (***Incubated***). Then, we control for the regional (Nuts 1 level) and industry (Nace Rev. 2-digit level) effects.

Finally, the possible different (formal) appropriability regimes on which YICs are called to operate are taken into consideration. The preferred appropriation mechanisms may indeed depend upon sector-specific characteristics. The results of previous studies have revealed that the propensity of firms to patent is quite heterogeneous across industries (Pakes and Griliches, 1984; De Rassenfosse & van Pottelsberghe, 2013; Cohen et al., 2001; Cassiman & Veugelers, 2002; Arundel, 2001; Hall et al., 2014). This is due to the fact that in sectors where knowledge is highly codified, for example in the pharmaceutical and biotechnology fields, patents may offer a stronger protection from imitation (Hall et al 2014). These sectors usually show a high patent intensity. On the contrary, in other sectors, for example in the electronic field, patents are less effective, and firms rely more on other mechanisms, such as secrecy and lead times or reverse-engineering and inventing-around, in order to appropriate the returns from their innovation (Cohen et al., 2001; Arundel, 2001; Hall et al, 2014). These sectors generally show a low patent intensity. In order to account for the differential role of appropriability regimes, the sampled industrial sectors are divided according to their ability to appropriate the returns of innovation by relying on patent protection mechanisms. In particular, similarly to Caviggioli et al. (2018), we use worldwide data from ORBIS dataset and construct an index labelled ***Appropriability regime*** at the industry-level (NACE Rev. 2 classification) based on the average number of patents per firm for each of the sectors considered.

4. RESULTS

4.1 Descriptive statistics

We show descriptive statistics of the variables included in the study in Table 3, as well as their correlation matrix in Table 4 based on 1,608 YICs. Most of the YICs (close to 80%) are founded with the goal of creating innovation and they back up that motivation with high R&D investments

(more than 37% of total) and fairly high rate of innovative product and processes (75.4% and 35.9%, respectively). Furthermore, the YICs are on average around two years old (on the date of the survey), have almost three founders who have on average around 20 years of education and previous work experience, combined. As expected, most of the founders are based in Northern regions (21.1% in Lombardy, 10.8% in Emilia-Romagna, 8.8% in Veneto and 7.7% in Piedmont), and are active in information technology (33.6%) and scientific research and development (17.2%) sectors.

Importantly, turning to the focus of our study, interesting information is revealed. First, one may notice a higher use of the financial policy instruments (29.8% of firms) than labour policy instruments (only around 18.8%), as well as higher use of informal instead of formal IP protection mechanisms (66.3% vs. 39.6%, respectively). The most commonly used ones being secrecy (49.8%), lead time (41.6%), patents (37.5%) and complementary assets in terms of access to market (36.9%).

– Table 3 and Table 4 around here –

Correlations on the usage of policy instrument conditional on having used at least one instrument are shown in Table 5. Financial instruments appear to be mutually exclusive, i.e. the companies that use the reform to reach one type of funding (equity or debt) are less likely to use the reform to seek for the other type of funding as well. On the contrary, and as expected, labour policy instruments are more commonly combined. Particularly, flexible contracts, dynamic salary and stock options positively correlate on the subsample of firms that used at least one of the provided policy instruments.

– Table 5 around here –

Another interesting result, in line with the findings of Veugelers and Schneider (2018) is the rare use of formal protection mechanisms in isolation and the common combination of formal and

informal mechanisms. Table 6 reports a 2-way table highlighting frequency of combined uses of the protection mechanisms and the policy instruments. Only around 6% of firms use a formal protection mechanism only, whereas almost 34% does so together with an informal one, which are frequently used even on isolated basis (32.8%).

– Table 6 around here –

4.2 Use of policy and of IP protection mechanisms

4.2.1 Main Analysis

First, we estimate a probit model that aims at capturing how the probability of IP protection is affected by the identified six policy instruments (Table 7, models 7a that reports regression coefficients and 7b that reports marginal effects). The correlation between both financial policy instruments and the use of protection mechanisms is found to be positive and statistically significant (at 10% level), with the marginal effects of 5.6% and 5.9%. In other words, policy mechanisms that aim at facilitating the injection of new financial resources into a YIC appear to foster the use of protection mechanisms (without distinguishing formal and informal). This result is consistent with the RBV argument that financial resources are the most flexible of all resources as they can be invested to acquire all other types of resources. On the other hand, the only labour instrument that exhibits a statistically significant relationship (at 5% level) with the use of IP protection by YICs is flexible contracts instrument, with an even higher marginal effect of 9.4%. In line with the RBV, this finding suggests that labour flexibility may alleviate resource constraints of YICs – due to their liabilities of newness and size – and, in turn, affect their innovation efforts and the related appropriation strategies.

Secondly, we run a bivariate probit model that distinguishes between the two types of IP protection mechanisms (formal and informal) to better understand the impact of the policy

instruments on these two different strategic outcomes (Table 7, models 7c-7e). The results spell out a positive association between debt instruments introduced by the institutional reform and the use of both formal and informal IP protection mechanisms (significant at 1% and 5% levels, respectively), and a statistically significant association between the use of informal protection mechanisms and equity instruments. The use of debt instruments increases probability to use formal mechanisms by 11.9% and informal mechanisms by 7.1%, while the use of equity instruments increase the use of informal ones by 6.6%.

The positive association between the debt instrument and the use of formal protection mechanisms can be interpreted in light of the appropriation hazard and signalling arguments. On the one hand, YICs may use formal protection mechanisms to signal their value to lenders, as banks have fewer competences than investors like VCs to understand the real value of an innovation. On the other hand, YICs may adopt formal protection mechanisms to provide banks with marketable intangible assets, as banks are less willing to invest in risky innovative activities than investors as VCs and BAs. The reputational logic can instead be used to interpret the positive link between the adoption of informal protection mechanisms and the policy instruments that aim at easing the access to equity and debt financing.

As far as labour instruments are concerned, use of flexible contracts and stock options are the only labour instruments that are significantly correlated to the use of some protection mechanisms, yet only the formal ones (the marginal effect is 9.1% and 11.3%, respectively). Again, these results are consistent with the reputational logic. On the one hand, a policy instrument – as flexible contracts – that increases mobility and turnover of highly skilled employees may induce YICs to adopt formal protection mechanisms to face the risk that less loyal and less committed temporary employees leak relevant information to competitors. On the other hand, performance-related payments induce YICs to protect their intellectual capital through formal protection mechanisms so to maintain ownership of the knowledge that has been generated through collective learning.

4.2.2 Robustness checks

We perform a series of robustness checks and additional analyses to corroborate and deepen these findings. First, we test whether the YICs selection criteria could interfere with these findings. In particular, one of the YIC's selection criteria is directly related to the formal appropriability strategy of the firm, which may confound the analysis and introduce some type of bias in our estimates. We perform the robustness analysis by directly controlling for the 2 alternative criteria in model's specification for, where the third criterion (i.e. possession of tangible intellectual property rights) represents the benchmark (alternatively, we also run regressions excluding YICs fulfilling just this criterion, with comparable results to those exposed here). Second, we adopt more fine-grained measures of the founder's human capital endowment. In fact, we distinguish the specific vs. the generic component of the variable **Human capital of founders**,⁵ while introducing also an **International experience** index that is built on study, work and entrepreneurial experience abroad gained by entrepreneurs in the past (the value is averaged among founders, the higher the value, the greater the international experience of the entrepreneurial team). Since the quality of the entrepreneurial team may have impact on both the YIC's capability to access policy measures and the pursuing of specific appropriability strategies, these additional controls aim at excluding possible confounding effects at the team level. Third,

⁵ Following Becker (1975), generic human capital includes all the knowledge that an individual may acquire through education and work experience that, albeit important, has no direct and exclusive application to a well-defined domain. While specific human capital encompasses all those competences that can be immediately and with no-filter be applied only in a specific context. In our framework, these capabilities (see Colombo and Grilli 2005, p. 796) point to "industry-specific human capital obtained by founders through prior work experience in the same industry. They also include knowledge of how to manage a new firm, which is entrepreneur-specific human capital; this is developed by founders through "leadership experience" (Bruderl et al. 1992).

we verify whether the freed resources made available through the use by YICs of the specific financial and labour policy instruments do impact the appropriability strategies pursued by firms in the same way we highlighted in the main analysis. In all these checks, we verified whether the substitution of the ***Appropriability regime*** variable with the corresponding vector of NACE rev. 2 industry dummies produces any remarkable change in our findings.

Results of all these bivariate probit models are reported in Table 8. They fully comply with the already exposed findings. Specifically, the augmented model specifications of columns 8a-8d, are fully in line with the results of Table 7, while the analysis reported in column 8e and 8f confirms a neater and less nuanced impact exerted by financial rather than labour resources freed by the underlying policy measures.

– Table 8 around here –

4.2.3 Additional evidence

Having tested the robustness of the main findings, we dig more into the type of appropriability strategies pursued by YICs. Descriptive statistics (see Table 6) showed a high incidence of YICs pursuing at the same time both formal and informal mechanisms of IP protection. To further explore the matter, we run a multinomial logit model distinguishing firms according to four different categories: those that do not adopt any protection, those which adopt only formal mechanisms, the ones adopting only informal mechanisms and, finally, the YICs adopting both. Results of this analysis are presented in Table 9 (see Panel A and Panel B), and corroborate the findings of the descriptive statistics and the main analysis. The debt instruments and flexible contracts have the most significant association to the joint use of both protection mechanisms. To that end, the result show that taking advantage of the debt benefits of the policy increases the probability of using both IPR protection mechanisms by 12.6%. The flexible contracts instrument also significantly

impacts the exclusive use of the formal mechanisms, the use of which is 3.7% more probable in that scenario.

– Table 9 around here –

Finally, similarly to Veugelers and Schneider (2018), through the means of a multivariate probit model, we also dig into the different types of informal IP protection mechanisms used, where formal ones are compared to the most-fine-grained informal appropriability strategies. Results are exposed in Table 10. In line with the reputational logic, use probability of secrecy and lead time strategies for protecting IPR is shown to be significantly increased by the use of instruments that ease access to bank loans. On the other hand, the use of commercial complementary assets – eased by VCs and BAs through their networks – are more likely to be utilized together with the use of equity instruments; whereas production complementary assets – that require the availability of specific employees, in line with varying start-ups' capital investments – are associated with the use of flexible contracts.

Consistently with our previous results, the analysis also reveals that larger YICs in terms of permanent employees appear more likely to choose lead time and complementary assets as IPR protection mechanisms, and are less probable to opt for formal mechanisms. YICs are less likely to be concerned about the risk that loyal and committed permanent employees leak relevant information to competitors. Moreover, firm age increases probability of choosing formal mechanisms as well. Both findings point to the high cost of formal protection mechanisms that appear to be difficult to be overcome by young companies that need to hire additional employees and emphasize the need for freeing resources by the reform.

– Table 10 around here –

5. DISCUSSION

“The problem for high-tech start-ups is that protecting innovation is costly: start-ups need money for patents. And to obtain money, they often need to approach several potential external investors, revealing them the nature of their business idea and the characteristics of the underlying technology, thus exposing themselves to the risk of expropriation. Thus, they fear that following that road they would not have anything to protect at the end of the day”.

These words - said by the executive director of a consultancy firm specialized in the management of IPRs to the authors of this paper - well-exemplifies and summarizes the vicious cycle that may characterize the issue of IP protection in YICs and its systemic failures.

Our analysis suggests that the backlashes of this vicious cycle on which YICs are trapped can at least to some extent be mitigated by the actual *use* by YICs of policy measures. Beyond that, the findings here exposed also indicate that this action should not necessarily be *direct*, i.e., aiming at directly influencing the cost in the usage of or the returns achievable from adopting protection mechanisms (e.g., patent boxes); it can also be *indirect*, i.e., easing the use of those financial and labour resources which are important ingredients in determining growth prospects of a start-up and its ultimate performance (Cooper and Bruno, 1977; Cooper et al., 1994; Colombo and Grilli, 2005) and that we show can be complementary to the IP protection strategy of an YIC. Finance and labour are in fact the two domains where YICs are reputed to suffer most heavily from market imperfections (Grilli, 2014). In fact, entrepreneurial projects – especially when innovative – often need external financial and labour resources to be realized. In their search for these external resources, entrepreneurs often face a problem of asymmetric information, given that entrepreneurs know much better than potential workers and external investors the technicalities of the project and its possibilities of success. Besides, as highlighted by the

aforementioned quote, entrepreneurs could be reluctant to reduce this asymmetric information for considerations related to appropriability hazards; and even if this is not the case, workers and investors may lack the competencies in order to fully understand and evaluate the entrepreneurial project. Whatever the specific reason behind, the resulting asymmetric information may be rather sticky overtime, leading to the presence of both “funding” and “knowledge” gaps (Colombo and Piva, 2008) that seriously undermine the prospects of an YIC regardless of its true (unrealized) potential. In this area, our analysis indicates that filling these gaps by a YIC may also pass through the implementation of an IP strategy.

Relying on the RBV framework of Chatterjee and Wernerfelt (2001), and translating it into our policy setting, our findings may suggest the presence of a relationship between the “flexibility” of the resource made accessible by the underlying policy action and the type of IP protection strategy pursued by the YIC (see Figure 1). Overall, if the financial resources freed by the financial policy instrument are conducive to both formal and informal protection mechanisms, the additional labour resources made available with the corresponding policy instrument are only associated to formal rather than informal protection mechanisms.

– Figure 1 around here –

Specifically, our findings show that eased access to both equity and loan financing may increase YICs’ reliance on informal appropriation mechanisms. Financial providers are more and more incline to support innovation in an open and comprehensive way (Brancati, 2015). This leads them to confer networking resources, including alliances and partnership to the firms they invest or lend money to; this is particularly important for YICs that lack reputational capital and suffer from the liabilities of newness (Schneider and Veugelers, 2010; Minola and Giorgino, 2008). Our findings also reveal that facilitated access to debt may increase YICs’ reliance on formal appropriation mechanisms to mitigate risks and “collateralize” the intangible value of innovation

(Carpenter and Petersen, 2002). This might be the case of YICs who benefit from a financial support by the policy, as this might likely represent the initial stage of a funding life cycle; in such initial stage, the entrepreneurs could anticipate the need of future funding and strategically use the available and freed resources to purposefully implement an appropriation strategy that is valuable in that respect.

(Some) labour policy incentives also appear to be valuable for YICs to embrace (formal) appropriation strategies. In line with the labour economics literature on the flexibility of labour and performance-related pay schemes (e.g. Storey et al., 2002; Collins and Smith 2006; Zhou et al. 2011), it appears that the increased mobility and turnover of workers, better employer-employee matching and performance-related incentives, indeed induce YICs - and their employees - that use the labour policy support to formally protect their innovation and knowledge.

6. CONCLUSIONS

One fundamental milestone in the innovation literature for the “incentives school” (Varian et al., 2004) is that, innovation requires effort, and this effort will come only in the expectation of a great reward. Accordingly, the capacity to protect inventions and innovations, and in doing so, appropriate (most of) the returns from their commercialization (through accessing market for products and/or ideas) is a key stepping stone in order to ensure that inventions and innovations will come to light, and in doing so, a high degree of dynamic efficiency will be achieved by the economic system. But protecting innovation is particularly impervious for YICs, given the unavoidable market failures which most of the time characterize the operations of these firms and limit their possibilities to adopt costly methods of protection. However, since the seminal contribution of Schumpeter (1934), we know that this and other similar typologies of firms are the fundamental engine to create virtuous creative destruction dynamics, challenging existing

paradigms and replacing them with new ones. Thus, a natural question arises: can YICs that use government's support actually benefit in terms of appropriation strategies? And if yes, how?

This issue is particularly compelling in Europe where SM1 dynamics appear absent or indeed sluggish at best. Therefore, the study takes advantage of a recent institutional reform introduced by the Italian government in 2012 (the *Italian Startup Act*, i.e., the Law 221/2012), specifically targeted to YICs, to analyse if and to what extent different policy mechanisms in the domain of finance and labour can positively affect the appropriability strategies of these firms. At this scope, through the use of survey-based data collected in 2016, we have analysed the behaviour of more than 1,600 YICs. Despite the cross-sectional nature of the data which prevents use to argue in terms of causality, our econometric analyses highlight how financial policy instruments increase the probability to adopt both formal and informal methods of IP protection, while labour policy instruments are only associated to the use of the former ones.

In providing theoretical and empirical advancements, our paper offers the following contributions to the literature on YICs: we add evidence that indeed these firms end up taking advantage of the policy support in both formal and informal strategies; we specifically clarify which of these approaches is differently related to financial (debt and equity) and labour (flexible contracts, dynamic salary, stock option, and low tax high skills instruments) policy mechanisms; we do so by utilizing a novel dataset, resulting from a unique setting related to the implementation of a national policy in Italy, that allows a very high representation of the whole population and a resulting high degree of generalizability.

Our analysis also provides a high-resolution picture illustrating how specific policy measures combine with different fine-grained appropriability strategies pursued by YICs. In doing so, it is able to inform policy makers not only on what associates with what, but also, and probably even more interestingly, it reveals which policy measure is *not* related to any protection mechanism,

and so it is unlikely to cause an enhancement in the capabilities of YICs to appropriate returns from their innovations.

Thus, from one hand, even if causation cannot be claimed, it appears prominent the role that debt (and its underlying policy support) may have in freeing resources which can (at least in part) flow towards the protection of innovations by YICs. Therefore, if this source of financing is generally deemed less apt and suitable than equity for highly innovative firms, the implications we can draw from our findings, is that this is not always necessarily true. To the extent that policy makers want to offer the opportunity to YICs to strengthen their capabilities in terms of appropriability, the introduction of governmental guarantees on bank loans appears as a promising powerful instrument.

On the other hand, the fact that policy had-hoc tax measures sustaining the recruitment of highly qualified personnel by YICs do not correlate with any appropriability mechanism is again informative, from a policy perspective, that the lack of appropriability strategies by YICs do not probably reside neither in the “human scale” of the firm nor on the quality of its employees; rather it has probably much more to deal with the human capital (and attitudes) of its founders, as testified by our analysis. In turn, this is suggestive of the fact that if appropriability strategies require skills and competences, these competences are probably not “on-the-shelf” human resources easily acquirable in the labour market; conversely, they are intrinsically inherent to entrepreneurs. Any policy program that aims at sustaining protection mechanisms by YICs should duly take into consideration this fact.

Overall, this study represents an important step forward in the understanding of the mechanisms behind the adoption of appropriation strategies by YICs and opens up new avenues for future studies. First, by relying on a longitudinal dataset, future research could investigate the effects of the appropriation strategies induced by the institutional reform on the long-term performance of YICs. A longitudinal dataset would also allow to investigate causal relations rather

than simple correlations between policy instruments adopted by YICs and their appropriation strategies; in particular, this could allow better disentangling ability-related and willingness-related mechanisms in the decision-making of YICs. Finally, the study could be replicated at the international level in order to use the institutional context as a contingency on the relationship between the use of policy instruments and appropriation strategies for YICs.

REFERENCES

- Arrow, K. J. (1962). Economic Welfare and the Allocation of Resources for Invention, in *The Rate and Direction of Inventive Activity*, 609, National Bureau of Econ. Research.
- Arundel, A., (2001). The relative effectiveness of patents and secrecy for appropriation, *Research Policy*, 30 (4), 611-624.
- Arvanitis S. (2005). Modes of labour flexibility at firm level: Are there any implications for performance and innovation? Evidence for the Swiss economy, *Industrial and Corporate Change*, 14: 6, 993–1016.
- Aubert, P., Caroli, E., Roger, M., (2006). New Technologies, Organisation and Age: Firm-Level Evidence. *The Economic Journal* 116 (509), F73–F93.
- Audretsch, D. B. & Bönte, W. & Mahagaonkar, P. (2012). Financial signalling by innovative nascent ventures: The relevance of patents and prototypes, *Research Policy*, Elsevier, vol. 41(8), pages 1407-1421.
- Autio, E. (2005). *Global Entrepreneurship Report, (2005). Report on high-expectation entrepreneurship*. London Business School, London.
- Barney, J., (1991). Firm Resources and Sustained Competitive Advantage. *J. Manage.* 17, 99–120. doi:10.1177/014920639101700108
- Barry, C. B., Muscarella, C. J. Peavy, III J. W., Vetsuypens, M. R. (1990). The role of venture

- capital in the creation of public companies: Evidence from the going-public process, *Journal of Financial Economics* 27, 447–471.
- Baughn, C.C. & Neupert, K.E. (2003). Culture and national condition facilitating entrepreneurial start-ups. *Journal of International Entrepreneurship*, 1, 313-330.
- Baughn, C.C., Sugheir, J. & Neupert, K.E. (2008). Labor flexibility and the prevalence of high-growth entrepreneurial activity, *Frontiers of Entrepreneurship Research*, 28(18), Article 1.
- Baumol, W. (2004), Education for Innovation: Entrepreneurial Breakthrough vs. Corporate Incremental Improvements, NBER Working Paper, No. 10578.
- Beck, T., Demirgüç-Kunt, A. and V. Maksimovic (2005). Financial and legal constraints to growth: does firm size matter? *Journal of Finance* 60, 137–177.
- Biglaiser, Gary, 1993, Middlemen as experts, *RAND Journal of Economics* 24, 212–223.
- Becker GS (1975). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education* 2nd ed. (NBER, New York City, NY).
- Blanchflower, D.G., Oswald, A.J., (1998). What makes an entrepreneur? *Journal of Labor Economics* 16 (1), 26–60.
- Brancati, E. (2015). Innovation financing and the role of relationship lending for SMEs. *Small Business Economics*, 44(2), 449-473.
- Bruderl J, Preisendorfer P, Ziegler R (1992). Survival Chances of Newly Founded Business Organizations. *Am. Sociol. Rev.* 57(2):227–242.
- Carpenter, R.E. and B.C. Petersen (2002). Capital market imperfections, high-tech investment, and new equity financing. *Economic Journal* 122 (477), F54–F72.
- Cassiman, B. and Veugelers, R., (2002). R&D Cooperation and Spillovers: some empirical evidence from Belgium, *American Economic Review*, 92(4), 1169-1184.
- Caviggioli, F., Colombelli, A., De Marco, A., Paolucci E. (2018). How venture capitalists evaluate young innovative companies patent portfolios: empirical evidence from Europe.
- Chatterjee, S., Wernerfelt, B., (1991). The Link between Resources and Type of Diversification:

- Theory and Evidence. *Strateg. Manag. J.* 12, 33–48.
- Cincera M., Veugelers R. (2014). Differences in the rates of return to R&D for European and US young leading R&D firms, *Research Policy*, 43, Issue 8, Pages 1413-1421.
- Coad, A., (2018). Firm age: a survey. *Journal of Evolutionary Economics* 28 (1), 13–43.
- Cohen, W., R. Nelson, and J. Walsh (2001). "Protecting Their Intellectual Assets: Appropriability Conditions and Why Firms Patent and Why They Do Not in the American Manufacturing Sector." NBER working paper 7552.
- Collins, C. J. and K. G. Smith. (2006). Knowledge exchange and combination: The role of human resource practices in the performance of high-technology firms. *Academy of Management Journal* 49(3):544-560.
- Colombelli, A. (2016). The impact of local knowledge bases on the creation of innovative start-ups in Italy, *Small Business Economics*, 47 (2), 383–396.
- Colombelli, A., Krafft, J., & Vivarelli, M. (2016). To be born is not enough: the key role of innovative start-ups. *Small Business Economics*, 47(2), 277-291.
- Colombelli, A., Quatraro, F. (2019). Green start-ups and local knowledge spillovers from clean and dirty technologies. *Small Business Economics*, 52,4, pp 773–792.
- Colombo, M. G., and Grilli, L. (2005). Founders' human capital and the growth of new technology-based firms: A competence-based view. *Research policy*, 34(6), 795-816.
- Colombo, M.G. and L. Grilli (2007). Funding gaps? Access to bank loans by high-tech start-ups. *Small Business Economics* 29 (1–2), 25–46.
- Colombo, M. G., Grilli, L., & Piva, E. (2006). In search of complementary assets: The determinants of alliance formation of high-tech start-ups. *Research policy*, 35(8), 1166-1199.
- Colombo, M. G., & Piva, E. (2008). Strengths and weaknesses of academic startups: a conceptual model. *IEEE Transactions on Engineering Management*, 55(1), 37-49.
- Connelly, B.L., Certo, S.T., Ireland, R.D., Reutzel, C.R. (2011). Signaling theory: a review and assessment. *Journal of Management* 37(1), 39-67.

- Conti, A., Thursby, M. and Rothaermel, F. (2013). Show me the right stuff: signals for high-tech startups, *Journal of Economics & Management Strategy*, 22, 2, 341-364.
- Cooper, A.C., Bruno, A.V. (1977). Success among high-technology firms. *Business Horizons* 20, 16–22.
- Cooper, A.C., Gimeno-Gascon, F.J., Woo, C.Y. (1994). Initial human capital and financial capital as predictors of new venture performance. *Journal of Business Venturing* 9, 371–396.
- Cosh, A., D. Cumming, A. Hughes (2009). Outside Entrepreneurial Capital. *The Economic Journal*. 119(October): 1494-1533.
- Czarnitzki, D. and Delanote, J. (2015). R&D Policies for Young SMEs: Input and Output Effects. *Small Business Economics*. 45:465–485.
- Datta, D. K., J. P. Guthrie and P. M. Wright. 2005. "Human resource management and labor productivity: Does industry matter?." *Academy of Management Journal* 48(1): 135-145.
- Davenport, T. H., & Prusak, L. (1998). *Working knowledge: How organizations manage what they know*. *Harvard Business Press*.
- De Rassenfosse, G. (2012). How SMEs exploit their intellectual property assets: evidence from survey data. *Small Business Economics*, 39(2), 437-452.
- De Rassenfosse, G., & Van Pottelsberghe de la Potterie, B. (2013). "The role of fees in patent systems: Theory and evidence". *Journal of Economic Surveys*, 27(4), 696-716.
- Dumont, M., (2017). Assessing the policy mix of public support to business R&D, *Research Policy* 46 (10), 1851-1862.
- European Digital Forum, (2016). *The 2016 Startup Nation Scoreboard*. London, U.K.
- Evans, D.S., Jovanovic, B., 1989. An estimated model of entrepreneurial choice under liquidity constraints. *Journal of Political Economy* 97 (4), 808–827.
- Fazzari, S., Hubbard, R.G., Petersen, B.C., (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity* 78 (2), 141–195.
- Gans, J. S., Hsu D. H., and Stern S., (2002). When does start-up innovation spur the gale of

- creative destruction? *RAND Journal of Economics* 33, 571–586.
- Gorman, Michael, and William A. Sahlman, (1989). What do venture capitalists do? *Journal of Business Venturing* 4, 231–248.
- Graham, S. J. H., R. Merges, P. Samuelson, and T. Sichelman (2010). High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey, *Berkeley Technology Law Journal* 24(4): 1255-1328.
- Grilli, L. (2014). High-tech entrepreneurship in Europe: A heuristic firm growth model and three “(un-) easy pieces” for policy-making. *Industry and Innovation*, 21(4), 267-284.
- Grilli, L., Murtinu, S., (2014). Government, venture capital and the growth of European high-tech entrepreneurial firms. *Res. Policy* 43, 1523–1543. doi:10.1016/j.respol.2014.04.002
- Grilli, L., (2018). There must be an angel? Local financial markets, business angels, and the financing of innovative start-ups. *Regional Studies*, forthcoming.
- Grillitsch, M., Hansen, T., Coenen, L., Miörner, J., & Moodysson, J. (2018). Innovation policy for system wide transformation: The case of Strategic Innovation Programs (SIPs) in Sweden. *Research Policy*.
- Hall, B.H., C. Helmers, M. Rogers and V. Sena (2013). The importance (or not) of patents to UK firms, *Oxford Economic Papers*, Oxford University Press, vol. 65(3), pages 603-629.
- Hall B.H., C. Helmers, M. Rogers and V. Sena (2014). The choice between formal and informal intellectual property: a review”, *Journal of Economic Literature*, 52(2), 375-423
- Hahn, D., Minola, T., Eddleston, K.A., (2018). How do scientists contribute to the performance of innovative startups? An imprinting perspective on open innovation. *Journal of Management Studies*, forthcoming.
- Helmers, C. & Rogers, M. (2011). Does patenting help high-tech start-ups?, *Research Policy*, Elsevier, vol. 40(7), pages 1016-1027.
- Henderson R, Clark K. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly* 35(1): 9-

- Henderson, R., (1993). Underinvestment and Incompetence as Responses to Radical Innovation: Evidence from the Photolithographic Alignment Equipment Industry. *RAND J. Econ.* 24, 248–270.
- Hellmann, Thomas, and Manju Puri, (2002). Venture capital and the professionalization of start-up firms: Empirical evidence, *Journal of Finance* 57, 169–197.
- Henkel, J., Rønde, T., Wagner, M., (2015). And the winner is - Acquired. Entrepreneurship as a contest yielding radical innovations. *Res. Policy* 44, 295–310.
doi:10.1016/j.respol.2014.09.004
- Hiatt, S.R., Sine, W.D., (2014). Clear and Present Danger: Planning and New Venture Survival Amid Political and Civil Violence. *Strateg. Manag. J.* 35, 773–785.
- Hoenen, S., Kolympiris, C., Schoenmakers, W., & Kalaitzandonakes, N. (2014). The diminishing signaling value of patents between early rounds of venture capital financing. *Research Policy*, 43(6), 956-989.
- Hoening, D., & Henkel, J. (2015). Quality signals? The role of patents, alliances, and team experience in venture capital financing. *Research Policy*, 44(5), 1049-1064.
- Holtz-Eakin, D., Joulfaian, D., Rosen, H.S., (1994). Sticking it out: Entrepreneurial survival and liquidity constraints. *Journal of Political Economy* 102 (1), 53–75.
- Hsu, D. H. (2004), What Do Entrepreneurs Pay for Venture Capital Affiliation?. *The Journal of Finance*, 59: 1805-1844.
- Hsu, D.H, Ziedonis, R.H. (2013). Resources as Dual Sources of Advantage: Implications for Valuing Entrepreneurial-Firm Patents,” *Strategic Management Journal*, 34 (7), 761-781.
- Ibrahim, D.M. (2010). Debt as venture capital. *Univ. Illinois Law Rev.* 2010(4): 1169-1210.
- Italian Ministry of Economic Development (2015). Executive Summary of the new Italian legislation on innovative startups. Official Report, Minister’s Technical Secretariat DG for Industrial Policy, Competitiveness and SMEs - MISE - 26 May 2015.

- Italian Ministry of Economic Development (2017). The Italian legislation in support of innovative startups. Official Report, DG for Industrial Policy, Competitiveness and SMEs - MISE - 23 February 2017.
- Kaiser, U., H.C. Kongsted and T. Rønde (2015). Does the mobility of R&D labor increase innovation? *Journal of Economic Behavior & Organization* 110 91–105
- Kalleberg, A. & Mardsen, P. (2005). Externalizing organizational activities: where and how U.S. establishments use employment intermediaries. *Socio-Economic Review*, 3, 389–415.
- Kim, J. and G. Marschke (2005). Labor mobility of scientists, technological diffusion, and the firm's patenting decision, *RAND Journal of Economics*, 36, 298–317
- Kruse, D. L. (1992). Profit sharing and productivity: Microeconomic evidence from the United States. *The Economic Journal* 102(410):24-36.
- Lazear, E. P. (1999). Personnel economics: Past lessons and future directions presidential address to the society of labor economists. *Journal of Labor Economics* 17(2):199-236.
- Leiponen, A. and J. Byma (2009). If you cannot block, you better run: Small firms, cooperative innovation, and appropriation strategies, *Research Policy* 38: 1478–1488.
- Levin, R. C., A. K. Klevorick, R. R. Nelson and S. G. Winter (1987). Appropriating the Returns from Industrial Research and Development. *Brookings Papers on Economic Activity* (3): 783-820.
- Lindsey, L. (2002). The venture capital keiretsu effect: An empirical analysis of strategic alliances among portfolio firms, Working paper, Stanford University.
- Liu, D., Z. J. Gong, and J. C. Huang. (2017). Human resource systems, employee creativity, and firm innovation: The moderating role of firm ownership. *Academy of Management Journal* 60(3):1164-1188.
- Malcomson J. M. (1997). Contracts, hold-up, and labour markets, *Journal of Economic Literature*, 35, 1916–1957.
- Mann, R.J., and Sager, T.W. (2007). Patents, venture capital and software start-ups, *Research*

Policy, 36, 2, pp. 193-208

- Martínez-Sánchez, A., Vela-Jiménez, María-José., Pérez-Pérez, M. & de-Luis-Carnicer, P. (2011). The dynamics of labour flexibility: relationship between employment type and innovativeness. *Journal of Management Studies*. 48(4), 715-736.
- Matusik, S.F. & Hill, C.W.L. (1998). The utilization of contingent work, knowledge creation, and competitive advantage. *Academy of Management Review*, 23(4),680–697.
- Meggison,William, and KathleenWeiss, (1991). Venture capital certification in initial public offerings, *Journal of Finance* 46, 879–903.
- Mindruta, D. (2013). Value creation in university-firm research collaborations: A matching approach. *Strat. Mgmt. J.*, 34: 644-665.
- Minola, T., & Giorgino, M. (2008). Who's going to provide the funding for high tech start-ups? A model for the analysis of determinants with a fuzzy approach. *R&D Management*, 38(3), 335-351. ISO 690
- Nahapiet, J. and S. Ghoshal (1998). “Social capital, intellectual capital and the organisational advantage.” *Academy of Management Review* 23(2): 242-266.
- Naastepad, C. W. M. and S. Storm (2006). The innovating firm in a societal context: labour-management relations and labour productivity,’ in R. M. Verburg, J. R. Ortt and W. M. Dicke (eds), *Managing Technology and Innovation*. Routledge: London, pp. 170–191.
- Nikzad, R. (2014). Small and medium-sized enterprises, intellectual property, and public policy. *Science and Public Policy*. 42. 176-187.
- Nuvolari, A., Vasta, M., (2015). The Ghost in the Attic? The Italian National Innovation System in Historical Perspective, 1861–2011. *Enterp. Soc.* 16, 270–290. doi:10.1017/eso.2014.25.
- OECD (2011), *Intellectual Assets and Innovation: The SME Dimension*, OECD Studies on SMEs and Entrepreneurship, OECD Publishing. <http://dx.doi.org/10.1787/9789264118263-en>
- Ouimet, P., Zarutskie, R., (2014). Who works for startups? The relation between firm age, employee age, and growth. *Journal of Financial Economics* 112 (3), 386–407.

- Pakes, A., Griliches, Z. (1984). Patents and R&D at the firm level: A first look". In: Griliches, Z. (Ed.), *Research and Development, Patents and Productivity*. The University of Chicago Press, USA, pp. 55–72.
- Revest, V., Sapio, A., (2012). Financing Technology-based Small Firms in Europe: What do we Know? *Small Business Economics* 39, 179-205.
- Robb, A., D. Robinson (2014). The capital structure decisions of new firms. *Rev. Financial Studies*.67(6): 2247-2293.
- Schneider, C., Veugelers, R., (2010). On young highly innovative companies: why they matter and how (not) to policy support them. *Ind. Corp. Chang.* 19, 969–1007. doi:10.1093/icc/dtp052.
- Schumpeter, J. A. (1934). *The theory of economic development*. Cambridge, Mass.: Harvard University Press.
- Shapiro, Carl, (1983). Premiums for high quality products as returns to reputation, *Quarterly Journal of Economics* 98, 659–680.
- Shukla, R., Oparah, D. and Kiatkulpiboone, T. (2011) 'The United States: Balancing robust protection with rapid innovation', *Intellectual Assets and Innovation: The SME Dimension*, OECD (ed.), pp. 141–67. Paris: OECD.
- Söderblom, Anna & Samuelsson, Mikael & Wiklund, Johan & Sandberg, Rickard, (2015). Inside the black box of outcome additionality: Effects of early-stage government subsidies on resource accumulation and new venture performance, *Research Policy*, Elsevier, vol. 44(8), pages 1501-1512.
- Spence M. (1973). Job market signaling. *Quarterly Journal of Economics* 87(3): 355–374.
- Spence, M. (1974). *Market Signaling: Informational Transfer in Hiring and Related Screening Processes* (Harvard University Press, Cambridge, MA).
- Starr, E. Balasubramanian, N. & Sakakibara, M. (2017). Screening Spinouts? How Noncomplete Enforceability Affects the Creation, Growth, and Survival of New Firms. *Management*

- Science, 64(2), 552-572.
- Storey, D. J., & Tether, B. S. (1998). Public policy measures to support new technology-based firms in the European Union. *Research Policy*, 26(9), 1037-1057.
- Storey, J. Quintas, P., Taylor, P. & Fowle, W. (2002). Flexible employment contracts and their implications for product and process innovation, *International Journal of Human Resource Management*, 13(1), 1-18.
- Stuart T. E., Hoang H., and Hybels R., (1999). Interorganizational endorsements and the performance of entrepreneurial ventures, *Administrative Science Quarterly* 44, 315–349.
- Teece, D.J., (1986). Profiting from technological innovation: implications for integration, collaboration, licensing, and public policy. *Research Policy* 15, 285–305.
- Ueda, M. (2004). Bank Versus Venture Capital. Project Evaluation, Screening, and Expropriation. *Journal of Finance* 59: 601–621.
- van Pottelsberghe de la Potterie B. and D. François (2009). The cost factor in patent systems”, *The Journal of Industry, Competition and Trade*, 9(4), 329-355.
- Varian, H. R., Farrell, J., & Shapiro, C. (2004). *The economics of information technology: An introduction*. Cambridge University Press.
- Vecchiato, R., Roveda, C. (2014). Foresight for public procurement and regional innovation policy: The case of Lombardy, *Research Policy*, 43 (2), 438-450.
- Veugelers, R. (2008). The Role of SMEs in Innovation in the EU. A Case for Policy Intervention?, *Review of Business and Economic Literature*, vol. 0(3), pp 239-262.
- Veugelers, R. & Schneider, C. (2018). Which IP strategies do young highly innovative firms choose? *Small Business Economics* 50: 113.
- Zhou H., Dekker R. and Kleinknecht A. (2011). Flexible labor and innovation performance: evidence from longitudinal firm-level data, *Industrial and Corporate Change*, 20: 3, 941–968.

TABLES AND FIGURES

Table 1. Policy instruments and IP protection by YICs: summary of theoretical arguments.

	<i>Formal IP protection</i>	<i>Informal IP protection</i>
<i>Equity instrument</i>	<ul style="list-style-type: none"> - Appropriability hazard - Arrowian “fundamental paradox” of information - Signaling theory 	<ul style="list-style-type: none"> - Reputational logic and liabilities of newness - Investors ease access to complementary assets
<i>Debt instrument</i>	<ul style="list-style-type: none"> - Appropriability hazard - Arrowian “fundamental paradox” of information - Signaling theory - Collateral perspective 	<ul style="list-style-type: none"> - Reputational logic for both the YICs and lenders / Reputational logic and liabilities of newness - Lenders ease access to complementary assets
<i>Flexible contracts instrument</i>	<ul style="list-style-type: none"> - Appropriability hazard due to increased mobility and turnover of highly skilled employees 	<ul style="list-style-type: none"> - Appropriability hazard due to increased mobility and turnover of highly skilled employees (complementary assets and strategic partnership)
<i>Performance-related pay schemes</i>	<ul style="list-style-type: none"> - Incentives to maintain ownership of knowledge generated through collective learning 	<ul style="list-style-type: none"> - Collaborative innovation leading to shared learning that ends up being embedded in relationships, partnerships and other implicit dimensions of the innovation process
<i>Low tax high skills instrument</i>	<ul style="list-style-type: none"> - Reputational logic for the high-skilled worker - Skilled workers able to face complexity associated to IPR 	<ul style="list-style-type: none"> - Skilled workers able to face complexity associated to managing informal protection such as strategic partnerships and lead time

Table 2. Description and taxonomy of the instruments implemented in 2012 under the Startup Act intended to facilitate the creation of YICs in the Italian economy.

Instrument group	Individual Instrument	Instrument definition
Financial policy instruments	Equity	Tax incentives for equity investment: 20% fiscal deduction, up to a maximum investment of € 1.8 million, for legal entities; and 19% fiscal deduction, up to a maximum investment of € 0.5 million, for individuals.
	Debt	A government-guaranteed bank loan fund is provided to ensure up to 80% of the credit issued of the bank, up to a total amount of €2.5 million.
Labour policy instruments	Flexible contracts	Less rigid contract requirements.
	Dynamic salary	Performance-based compensation option.
	Stock option (and work for equity)	Employee compensation based on equity.
	Low tax high skills	Tax credit for the employment of highly skilled personnel.

Note: As to labour measures, from the Italian Ministry of Economic Development (2017, pp. 17-18): "**Tailor-made labour law [flexible contracts]:** [...] innovative startups can hire a staffer on a fixed-term contract for a maximum of 36 months. However, in derogation to Jobs Act's provisions, innovative startups can hire personnel through fixed-term contracts of any duration, even very short, which can be renewed as many times as wished. After 36 months, the contract can be renewed only once, for 12 months maximum, leading to an overall employment duration of 48 months [...]; **Flexible remuneration system [dynamic salary]:** salaries due to workers employed in innovative startups can have a variable component linked to efficiency or profitability of the company, the productivity of the employee or the team of employees, or to other objectives and parameters for output and performance as agreed upon by the parties [...]. **Remuneration through stock options and work for equity schemes:** startups [...] may offer to their collaborators, employees, and even suppliers and consultants such as lawyers and accountants, capital shares by way of additional remuneration. The revenues resulting from these financial instruments are tax deductible for both fiscal and contributory purposes." The measure of **Low tax high skills** envisaged, up to the end of 2014, "priority access to benefits [...] that consist in a tax credit of 35% of the company's total cost for permanent employment, even with an apprenticeship contract, during the first year of the new working relationship." (see the Italian Ministry of Economic Development, 2015, p. 9). For more details on these and also the other measures of the Law please refer to the aforementioned governmental sources.

Table 3. Descriptive statistics of used variables.

Variable	Mean	Std. Dev.	Min	Max
(1) IP protection	0.723	0.447	0	1
(2) Formal IP protection	0.396	0.489	0	1
(3) Informal IP protection	0.664	0.473	0	1
(4) Equity instrument	0.182	0.386	0	1
(5) Debt instrument	0.174	0.379	0	1
(6) Flexible contracts instrument	0.096	0.295	0	1
(7) Dynamic salary instrument	0.030	0.172	0	1
(8) Stock options instrument	0.044	0.206	0	1
(9) Low tax high skills instrument	0.075	0.264	0	1
(10) No. of founders	2.924	1.763	1	11
(11) No. of permanent employees	1.483	3.253	0	56
(12) No. of temporary employees	0.172	0.867	0	21
(13) Firm age	1.202	1.170	0	5
(14) Human capital of founders	19.688	9.942	0	55
(15) Motivation profit	0.621	0.454	0	1
(16) Motivation innovation	0.789	0.368	0	1
(17) Motivation research implement.	0.214	0.371	0	1
(18) R&D expenditures	0.373	0.308	0	1
(19) In-house R&D	0.590	0.492	0	1
(20) Product innovation	0.754	0.431	0	1
(21) Process innovation	0.359	0.480	0	1
(22) International	0.590	0.492	0	1
(23) Externally funded	0.413	0.493	0	1
(24) Incubated	0.280	0.449	0	1
(25) Appropriability regime	0.210	0.408	0	1

Notes: Statistics are based on 1,608 YICs.

Table 4. Mutual correlation among all the variables.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	
<i>(1) IP protection</i>	1.00																								
<i>(2) Formal IP protection</i>	0.50	1.00																							
<i>(3) Informal IP protection</i>	0.87	0.32	1.00																						
<i>(4) Equity instrument</i>	0.09	0.06	0.10	1.00																					
<i>(5) Debt instrument</i>	0.11	0.15	0.12	0.18	1.00																				
<i>(6) Flexible contracts instrument</i>	0.08	0.08	0.06	0.12	0.11	1.00																			
<i>(7) Dynamic salary instrument</i>	0.02	0.03	0.03	0.10	0.07	0.31	1.00																		
<i>(8) Stock options instrument</i>	0.03	0.07	0.04	0.22	0.14	0.18	0.23	1.00																	
<i>(9) Low tax high skills instrument</i>	0.06	0.04	0.07	0.11	0.17	0.12	0.11	0.09	1.00																
<i>(10) No. of founders</i>	0.01	-0.02	0.02	0.04	0.01	0.01	0.01	0.08	-0.01	1.00															
<i>(11) No. of permanent employees</i>	0.06	0.02	0.06	0.13	0.13	0.15	0.10	0.15	0.19	0.03	1.00														
<i>(12) No. of temporary employees</i>	0.03	0.03	0.02	0.01	0.08	0.22	0.05	0.01	0.04	0.03	0.27	1.00													
<i>(13) Firm age</i>	0.07	0.07	0.07	0.05	0.05	0.12	0.02	0.07	0.11	-0.02	0.27	0.08	1.00												
<i>(14) Human capital of founders</i>	0.09	0.12	0.07	0.02	0.06	0.06	-0.01	-0.02	0.03	-0.06	0.01	0.02	-0.06	1.00											
<i>(15) Motivation profit</i>	0.09	0.05	0.11	0.05	0.06	0.04	0.04	0.06	0.01	0.04	-0.01	-0.01	-0.05	-0.06	1.00										
<i>(16) Motivation innovation</i>	0.05	0.02	0.06	0.02	-0.01	-0.02	-0.06	-0.04	-0.05	-0.10	-0.07	-0.05	-0.05	0.03	-0.03	1.00									
<i>(17) Motivation research implementation</i>	-0.01	-0.04	0.01	-0.03	-0.11	0.01	-0.01	-0.03	-0.01	0.16	-0.07	0.02	0.09	-0.11	-0.07	0.05	1.00								
<i>(18) R&D expenditures</i>	0.17	0.12	0.18	0.06	0.07	0.04	0.04	0.03	0.07	0.03	-0.02	-0.04	-0.01	-0.02	-0.01	0.02	0.04	1.00							
<i>(19) In-house R&D</i>	0.20	0.12	0.20	0.09	0.07	0.07	0.06	0.06	0.11	0.03	0.14	0.01	0.13	-0.01	0.07	0.02	0.03	0.36	1.00						
<i>(20) Product innovation</i>	0.18	0.19	0.17	0.03	0.01	0.01	0.02	0.02	0.05	0.02	0.05	0.03	0.05	0.06	0.01	0.09	0.09	0.13	0.13	1.00					
<i>(21) Process innovation</i>	0.01	-0.03	0.02	0.03	0.03	0.01	0.03	0.05	0.01	0.03	0.04	-0.03	0.06	-0.03	0.01	0.02	0.09	-0.04	0.08	-0.17	1.00				
<i>(22) International</i>	0.19	0.21	0.20	0.01	0.06	0.04	0.01	-0.04	0.01	0.01	0.02	0.01	-0.04	0.07	0.08	0.06	0.04	0.18	0.10	0.15	-0.01	1.00			
<i>(23) Externally funded</i>	0.10	0.09	0.09	0.14	0.34	0.06	0.06	0.10	0.08	-0.01	0.11	0.01	0.10	0.01	0.05	-0.01	-0.08	0.06	0.09	0.02	0.02	0.05	1.00		
<i>(24) Incubated</i>	0.01	-0.01	0.02	0.04	0.04	0.03	0.03	0.05	0.01	0.05	-0.02	-0.02	0.02	-0.09	0.03	-0.04	0.06	0.05	0.04	0.02	0.02	0.08	0.05	1.00	
<i>(25) Appropriability regime</i>	0.06	0.13	0.02	0.06	0.06	-0.01	-0.02	0.01	0.03	-0.01	0.03	0.06	-0.03	0.11	-0.02	0.01	-0.06	0.01	0.01	0.11	-0.02	0.13	0.05	-0.02	1.00

Notes: Statistics are based on 1,608 YICs.

Table 5. Correlation matrix on the usage of instruments conditional on using at least one instrument by YICs.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) Equity instrument	1.000					
(2) Debt instrument	-0.239	1.000				
(3) Flexible contracts instrument	-0.160	-0.176	1.000			
(4) Dynamic salary instrument	-0.035	-0.072	0.246	1.000		
(5) Stock options instrument	0.079	-0.019	0.074	0.177	1.000	
(6) Low tax high skills instrument	-0.135	-0.043	-0.029	0.038	0.003	1.000

Notes: Statistics are based on 624 YICs.

Table 6. Use of policy instruments and appropriability strategies.

Instrument type	Equity	Debt	Flexible contracts	Dynamic salary	Stock options	Low tax high skills	No instrument	Total (percentage)
Only formal IP	0.8%	0.9%	0.7%	0.1%	0.1%	0.2%	4.2%	6.0%
Only informal IP	6.5%	4.9%	3.0%	0.9%	1.1%	2.7%	20.1%	32.8%
Both IPs	7.5%	8.8%	4.3%	1.3%	2.3%	3.2%	17.2%	33.6%
No mechanism	3.4%	2.9%	1.6%	0.7%	0.9%	1.4%	19.7%	27.6%
Total (percentage)	18.2%	17.4%	9.6%	3.0%	4.4%	7.5%	61.2%	100.0%

Notes: Statistics are based on 1,608 YICs.

Table 7. Probit model on IP protection: the role of finance and labour policy instruments.

Analysis type	Probit model	Probit model	Bivariate probit model		Bivariate probit model	
Column	(7a)	(7b)	(7c)	(7d)	(7e)	(7f)
Dep. variable	<i>IP protection</i>	<i>IP protection (dy/dx)</i>	<i>Formal IP protection</i>	<i>Informal IP protection</i>	<i>Formal IP protection (dy/dx)</i>	<i>Informal IP protection (dy/dx)</i>
<i>Equity instrument</i>	0.194* (0.104)	0.0566* (0.030)	0.005 (0.091)	0.203** (0.098)	0.002 (0.031)	0.066** (0.031)
<i>Debt instrument</i>	0.201* (0.112)	0.0587* (0.033)	0.346*** (0.095)	0.218** (0.104)	0.119*** (0.032)	0.071** (0.034)
<i>Flexible contracts instrument</i>	0.322** (0.145)	0.0940** (0.042)	0.264** (0.121)	0.131 (0.131)	0.091** (0.042)	0.042 (0.042)
<i>Dynamic salary instrument</i>	-0.201 (0.231)	-0.0587 (0.067)	-0.130 (0.203)	-0.089 (0.221)	-0.045 (0.070)	-0.029 (0.071)
<i>Stock option instrument</i>	-0.045 (0.193)	-0.0131 (0.056)	0.329* (0.171)	0.053 (0.187)	0.113* (0.058)	0.017 (0.060)
<i>Low tax high skills instrument</i>	0.037 (0.149)	0.0108 (0.044)	-0.057 (0.128)	0.142 (0.142)	-0.020 (0.044)	0.046 (0.046)
<i>No. of founders</i>	0.005 (0.021)	0.00145 (0.006)	-0.017 (0.019)	0.009 (0.020)	-0.006 (0.006)	0.003 (0.006)
<i>No. of permanent employees</i>	0.004 (0.013)	0.00127 (0.004)	-0.017 (0.011)	0.006 (0.013)	-0.006 (0.004)	0.002 (0.004)
<i>No. of temporary employees</i>	0.018 (0.042)	0.00538 (0.012)	0.021 (0.039)	0.009 (0.041)	0.007 (0.013)	0.003 (0.013)
<i>Firm age</i>	0.065* (0.033)	0.0189* (0.010)	0.077** (0.030)	0.061* (0.032)	0.026** (0.010)	0.020* (0.010)
<i>Human capital of founders</i>	0.009** (0.004)	0.00271** (0.001)	0.010*** (0.003)	0.008** (0.004)	0.004*** (0.001)	0.003** (0.001)
<i>Motivation profit</i>	0.272*** (0.078)	0.0795*** (0.023)	0.098 (0.075)	0.297*** (0.075)	0.034 (0.026)	0.096*** (0.024)
<i>Motivation innovation</i>	0.103 (0.097)	0.0300 (0.028)	-0.009 (0.093)	0.148 (0.094)	-0.003 (0.032)	0.048 (0.030)
<i>Motivation research implement.</i>	0.014 (0.100)	0.00406 (0.029)	-0.140 (0.096)	0.029 (0.096)	-0.048 (0.033)	0.009 (0.031)
<i>R&D expenditures</i>	0.409*** (0.129)	0.119*** (0.037)	0.248** (0.117)	0.431*** (0.123)	0.085** (0.040)	0.139*** (0.039)
<i>In-house R&D</i>	0.314*** (0.079)	0.0917*** (0.023)	0.169** (0.075)	0.272*** (0.075)	0.058** (0.026)	0.088*** (0.024)
<i>Product innovation</i>	0.365*** (0.083)	0.106*** (0.024)	0.499*** (0.085)	0.349*** (0.080)	0.171*** (0.028)	0.113*** (0.026)
<i>Process innovation</i>	0.039 (0.076)	0.0113 (0.022)	0.018 (0.072)	0.079 (0.073)	0.006 (0.025)	0.025 (0.024)
<i>International</i>	0.371*** (0.074)	0.108*** (0.021)	0.427*** (0.071)	0.400*** (0.071)	0.147*** (0.023)	0.129*** (0.022)
<i>Externally funded</i>	0.118 (0.078)	0.0346 (0.023)	0.062 (0.072)	0.071 (0.074)	0.021 (0.025)	0.023 (0.024)
<i>Incubated</i>	-0.099 (0.080)	-0.0290 (0.023)	-0.112 (0.075)	-0.052 (0.077)	-0.038 (0.026)	-0.017 (0.025)
<i>Appropriability regime</i>	0.052 (0.092)	0.0153 (0.027)	0.242*** (0.082)	-0.101 (0.086)	0.083*** (0.028)	-0.033 (0.028)
<i>Constant</i>	-0.943*** (0.182)		-1.469*** (0.177)	-1.153*** (0.178)		
Regional controls	Included		Included			
Observations	1,608		1,608			
Log. likelihood	-811.571		-1836.7861			
Pseudo R² / AtRho	0.144		0.456***			

Notes: Regional (Nuts 1 level) controls are included in all models. Standard errors are reported in parenthesis. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 8. Bivariate probit model on IP protection: robustness checks.

Analysis type Column	Controlling for YICs criteria		Inspecting founders' HC		Freed resources	
	(8a)	(8b)	(8c)	(8d)	(8e)	(8f)
Dep. variable	Formal IP protection	Informal IP protection	Formal IP protection	Informal IP protection	Formal IP protection	Informal IP protection
<i>Equity instrument</i>	0.003 (0.095)	0.207** (0.100)	0.018 (0.093)	0.214** (0.100)	-	-
<i>Debt instrument</i>	0.357*** (0.102)	0.227** (0.108)	0.367*** (0.099)	0.233** (0.108)	-	-
<i>Flexible contracts instrument</i>	0.284** (0.129)	0.113 (0.134)	0.277** (0.125)	0.113 (0.134)	-	-
<i>Dynamic salary instrument</i>	-0.029 (0.214)	-0.086 (0.224)	-0.074 (0.209)	-0.099 (0.224)	-	-
<i>Stock option instrument</i>	0.350* (0.180)	0.018 (0.191)	0.330* (0.175)	0.020 (0.191)	-	-
<i>Low tax high skills instrument</i>	-0.007 (0.135)	0.114 (0.145)	-0.092 (0.131)	0.090 (0.144)	-	-
<i>Freed resource: finance</i>	-	-	-	-	0.303** (0.130)	0.478*** (0.131)
<i>Freed resource: labour</i>	-	-	-	-	0.017 (0.084)	-0.063 (0.090)
<i>No. of founders</i>	-0.020 (0.021)	0.007 (0.021)	-0.015 (0.020)	0.008 (0.021)	-0.015 (0.020)	0.007 (0.020)
<i>No. of permanent employees</i>	-0.006 (0.012)	0.011 (0.014)	-0.008 (0.012)	0.010 (0.014)	-0.005 (0.013)	0.017 (0.016)
<i>No. of temporary employees</i>	0.013 (0.046)	0.019 (0.045)	0.014 (0.042)	0.020 (0.045)	0.042 (0.041)	0.024 (0.045)
<i>Firm age</i>	0.066** (0.032)	0.059* (0.032)	0.067** (0.031)	0.059* (0.032)	0.069** (0.031)	0.058* (0.033)
<i>Human capital of founders</i>	0.009** (0.004)	0.008** (0.004)	-	-	0.008** (0.004)	0.008** (0.004)
<i>Generic Human capital of f.</i>	-	-	0.008** (0.004)	0.009** (0.004)	-	-
<i>Specific Human capital of f.</i>	-	-	0.005 (0.005)	0.005 (0.005)	-	-
<i>International experience of f.</i>	-	-	0.094 (0.065)	-0.005 (0.068)	-	-
<i>Motivation profit</i>	0.113 (0.079)	0.310*** (0.077)	0.107 (0.077)	0.309*** (0.078)	0.128* (0.076)	0.308*** (0.077)
<i>Motivation innovation</i>	0.025 (0.100)	0.164* (0.096)	-0.002 (0.096)	0.155 (0.096)	0.009 (0.095)	0.167* (0.096)
<i>Motivation research implement.</i>	-0.151 (0.105)	0.031 (0.105)	-0.210** (0.100)	0.020 (0.102)	-0.216** (0.099)	0.024 (0.102)
<i>R&D expenditures</i>	0.303** (0.125)	0.408*** (0.127)	0.230* (0.121)	0.398*** (0.126)	0.251** (0.120)	0.409*** (0.125)
<i>In-house R&D</i>	0.215*** (0.080)	0.298*** (0.078)	0.158** (0.077)	0.289*** (0.078)	0.160** (0.077)	0.301*** (0.078)
<i>Product innovation</i>	0.543*** (0.092)	0.316*** (0.084)	0.519*** (0.089)	0.321*** (0.083)	0.507*** (0.088)	0.325*** (0.084)
<i>Process innovation</i>	0.025 (0.075)	0.082 (0.075)	0.009 (0.074)	0.082 (0.075)	0.027 (0.073)	0.091 (0.075)
<i>International</i>	0.376*** (0.075)	0.380*** (0.073)	0.372*** (0.073)	0.388*** (0.073)	0.382*** (0.073)	0.386*** (0.073)
<i>Externally funded</i>	0.049 (0.077)	0.034 (0.076)	0.042 (0.074)	0.031 (0.076)	-0.084 (0.120)	-0.237** (0.118)
<i>Incubated</i>	-0.114 (0.078)	-0.060 (0.079)	-0.136* (0.077)	-0.065 (0.079)	-0.127* (0.076)	-0.072 (0.079)
<i>R&D criterion for YIC</i>	-0.877*** (0.089)	-0.171* (0.088)	-	-	-	-
<i>Human capital criterion for YIC</i>	-0.754*** (0.093)	-0.153* (0.092)	-	-	-	-
<i>Constant</i>	-0.019 (0.878)	-2.291*** (0.886)	-0.588 (0.839)	-2.366*** (0.885)	-7.013 (1583)	-1.488* (0.903)
Industry controls	Included		Included		Included	
Regional controls	Included		Included		Included	
Observations	1,608		1,608		1,608	
Log. likelihood	-1733.648		-1791.784		-1803.458	
Rho	0.461***		0.464***		0.468***	

Notes: Industry (NACE Rev. 2 intermediate aggregation) and regional (Nuts 1 level) controls are included in all models. Standard errors are reported in parenthesis. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 9 - Panel a. Multinomial logit on IP protection strategies: additional evidence

Analysis type Column	Multinomial logit		
	(9a) <i>Only formal IP protection strategy</i>	(9b) <i>Only informal IP protection strategy</i>	(9c) <i>Both formal and informal IP protection strategies</i>
<i>Equity instrument</i>	-0.013 (0.349)	0.346* (0.197)	0.312 (0.205)
<i>Debt instrument</i>	0.090 (0.365)	0.053 (0.223)	0.697*** (0.218)
<i>Flexible contracts instrument</i>	1.019** (0.417)	0.404 (0.286)	0.627** (0.288)
<i>Dynamic salary instrument</i>	-0.658 (0.835)	-0.321 (0.449)	-0.366 (0.447)
<i>Stock option instrument</i>	-0.642 (0.803)	-0.488 (0.395)	0.351 (0.366)
<i>Low tax high skills instrument</i>	-0.526 (0.577)	0.171 (0.290)	0.083 (0.295)
<i>No. of founders</i>	-0.010 (0.067)	0.030 (0.039)	-0.010 (0.042)
<i>No. of permanent employees</i>	-0.010 (0.047)	0.025 (0.025)	-0.015 (0.027)
<i>No. of temporary employees</i>	0.047 (0.117)	0.037 (0.092)	0.045 (0.094)
<i>Firm age</i>	0.065 (0.106)	0.049 (0.063)	0.180*** (0.066)
<i>Human capital of founders</i>	0.013 (0.012)	0.009 (0.007)	0.025*** (0.007)
<i>Motivation profit</i>	0.045 (0.251)	0.482*** (0.150)	0.528*** (0.159)
<i>Motivation innovation</i>	-0.154 (0.301)	0.240 (0.185)	0.182 (0.198)
<i>Motivation research implement.</i>	-0.127 (0.342)	0.155 (0.188)	-0.119 (0.204)
<i>R&D expenditures</i>	0.200 (0.424)	0.661*** (0.246)	0.912*** (0.256)
<i>In-house R&D</i>	0.450* (0.255)	0.528*** (0.151)	0.596*** (0.159)
<i>Product innovation</i>	0.409 (0.275)	0.315** (0.153)	1.170*** (0.182)
<i>Process innovation</i>	-0.154 (0.257)	0.102 (0.145)	0.123 (0.154)
<i>International</i>	0.185 (0.238)	0.379*** (0.140)	1.100*** (0.152)
<i>Externally funded</i>	0.285 (0.250)	0.191 (0.148)	0.206 (0.157)
<i>Incubated</i>	-0.281 (0.271)	-0.093 (0.152)	-0.226 (0.161)
<i>Appropriability regime</i>	0.707*** (0.264)	-0.179 (0.184)	0.203 (0.180)
<i>Constant</i>	-2.572*** (0.575)	-1.993*** (0.348)	-3.575*** (0.389)
Regional controls		Included	
Observations		1,608	
Log. likelihood		-1764.356	
Pseudo R²		0.127	

Notes: Regional (Nuts 1 level) controls are included in all models. Standard errors are reported in parenthesis. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 9 - Panel b. Marginal effects of policy measures (from multinomial logit estimates of Panel a)

Analysis type	Multinomial logit			
	<i>No protection strategy</i>	<i>Only formal IP protection strategy</i>	<i>Only informal IP protection strategy</i>	<i>Both formal and informal IP protection strategies</i>
<i>Equity instrument</i>	-0.051* (0.031)	-0.013 (0.018)	0.041 (0.031)	0.023 (0.029)
<i>Debt instrument</i>	-0.053 (0.034)	-0.010 (0.018)	-0.064* (0.035)	0.126*** (0.030)
<i>Flexible contracts instrument</i>	-0.094** (0.044)	0.037* (0.020)	0.001 (0.044)	0.058 (0.039)
<i>Dynamic salary instrument</i>	0.064 (0.069)	-0.023 (0.043)	-0.017 (0.074)	-0.024 (0.066)
<i>Stock option instrument</i>	0.030 (0.059)	-0.033 (0.042)	-0.128* (0.066)	0.131** (0.054)
<i>Low tax high skills instrument</i>	-0.012 (0.046)	-0.034 (0.030)	0.038 (0.046)	0.008 (0.041)

Table 10. Multivariate probit on IP informal protection strategies: additional evidence

Analysis type					
Column	(10a)	(10b)	(10c)	(10d)	(10e)
Dep. variable	<i>Formal IP protection</i>	<i>Secrecy</i>	<i>Lead time</i>	<i>Complementary assets: commercial</i>	<i>Complementary assets: production</i>
<i>Equity instrument</i>	0.020 (0.090)	0.187** (0.089)	0.126 (0.093)	0.177* (0.099)	0.096 (0.118)
<i>Debt instrument</i>	0.355*** (0.095)	0.157* (0.094)	0.235** (0.097)	0.090 (0.103)	0.099 (0.121)
<i>Flexible contracts instrument</i>	0.257** (0.120)	-0.118 (0.120)	0.101 (0.126)	0.138 (0.132)	0.271* (0.155)
<i>Dynamic salary instrument</i>	-0.107 (0.201)	-0.467** (0.208)	0.077 (0.209)	0.263 (0.213)	-0.251 (0.287)
<i>Stock option instrument</i>	0.319* (0.168)	0.121 (0.170)	0.235 (0.169)	-0.213 (0.194)	-0.251 (0.249)
<i>Low tax high skills instrument</i>	-0.060 (0.128)	0.028 (0.128)	-0.085 (0.136)	-0.036 (0.142)	-0.130 (0.175)
<i>No. of founders</i>	-0.016 (0.019)	0.007 (0.019)	-0.003 (0.021)	0.015 (0.023)	-0.016 (0.027)
<i>No. of permanent employees</i>	-0.020* (0.011)	-0.010 (0.011)	0.025** (0.012)	0.027*** (0.012)	0.027* (0.014)
<i>No. of temporary employees</i>	0.015 (0.040)	0.049 (0.039)	0.005 (0.043)	-0.056 (0.058)	-0.039 (0.067)
<i>Firm age</i>	0.081*** (0.030)	0.054* (0.030)	-0.087** (0.034)	-0.034 (0.036)	-0.007 (0.043)
<i>Human capital of founders</i>	0.011*** (0.003)	0.012*** (0.003)	-0.002 (0.004)	0.007* (0.004)	0.012** (0.005)
<i>Motivation profit</i>	0.100 (0.075)	0.217*** (0.073)	0.230*** (0.082)	0.118 (0.088)	0.087 (0.108)
<i>Motivation innovation</i>	0.001 (0.093)	0.073 (0.091)	0.227** (0.104)	0.267*** (0.113)	0.283* (0.146)
<i>Motivation research implement.</i>	-0.148 (0.095)	0.267*** (0.092)	-0.079 (0.103)	-0.339*** (0.120)	-0.073 (0.137)
<i>R&D expenditures</i>	0.233** (0.117)	0.461*** (0.115)	0.262** (0.127)	0.174 (0.138)	0.315* (0.164)
<i>In-house R&D</i>	0.172** (0.075)	0.264*** (0.073)	0.142* (0.080)	0.249*** (0.088)	0.279** (0.110)
<i>Product innovation</i>	0.505*** (0.084)	0.444*** (0.081)	0.290*** (0.092)	-0.044 (0.094)	0.127 (0.126)
<i>Process innovation</i>	0.006 (0.071)	0.174** (0.070)	0.102 (0.077)	0.066 (0.082)	0.198** (0.100)
<i>International</i>	0.426*** (0.071)	0.313*** (0.069)	0.041 (0.077)	0.087 (0.083)	0.514*** (0.113)
<i>Externally funded</i>	0.062 (0.072)	-0.052 (0.071)	0.183** (0.077)	0.303*** (0.083)	0.263*** (0.101)
<i>Incubated</i>	-0.097 (0.075)	-0.022 (0.073)	-0.042 (0.080)	-0.050 (0.087)	-0.036 (0.105)
<i>Appropriability regime</i>	0.245*** (0.082)	0.007 (0.081)	-0.152* (0.091)	-0.066 (0.097)	0.382*** (0.105)
<i>Constant</i>	-1.537*** (0.164)	-1.635*** (0.161)	-1.563*** (0.177)	-1.832*** (0.191)	-2.962*** (0.260)

Notes: Regional controls are omitted to ease convergence of the model. Standard errors are reported in parenthesis. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. Number of observations: 1,608. Log-likelihood: -3771.47. Likelihood ratio test of all rho = 0: chi-squared (10) = 219.563.

Figure 1. The relationship between the flexibility of resources associated to the underlying policy mechanisms and the type of IP protection strategy.

