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Grasping the impalpable: Critical appraisal of the role of public policy for intangibles[1]

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Abstract

Intangibles assets have long been an important component of the global economic systems, and have become more and more important in recent decades. Although, there are a number of policies to support the build-up and use of different components of intangible assets, policies for intangibles as a whole are often missing. Lacunae in policies are caused by a neglect of an inherent duality in the characteristics of intangibles that presents important challenges to policy making. On the one hand, intangible assets often play a central role in gaining competitive advantage. On the other hand, from a systemic point of view, individual ownership of intangible assets can limit the sharing and exchange of intangibles that is

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indispensable for what we call in this paper "intangibles commons". Policy makers must balance the tensions between supporting firm-specific intangibles and ensuring growing intangibles commons. This paper conceptualises the duality of intangible commons and subsequently explores the tensions arising, examines the gaps in our knowledge needed for effective policy making and presents a set of recommendations as to more appropriate policy making for intangibles.

Highlights

- Duality in the characteristics of intangibles
- Policies for intangibles overlook the duality leading to tensions
- Interdependencies between firm-specific intangibles and intangibles commons
- Balance required in policies to support interdependencies

Keywords

Intangibles; Policies; Firm-specific intangibles; Intangibles commons; Tensions

1 Introduction

Intangibles assets have long been an important component of the global economic systems, and have become more and more important in recent decades (Corrado et al., 2018). Consequently, there are numerous policies to support the build-up and use of this broader set of intangibles (Edler et al., 2015; Malcomson et al., 2003; Mason & Brown, 2013; OECD, 2019). However, in this article we argue that those policies are insufficient, and that this insufficiency is mainly due to a neglect of an inherent duality in the characteristics of intangibles that presents important challenges to policy making. On the one hand, intangible assets often play a central role in gaining competitive advantage (Marrocu et al., 2012; Teece, 1998). On the other hand, from a systemic point of view, individual ownership of intangible assets can limit the sharing and exchange of intangibles (Hurmelinna et al., 2007, 2008) that is indispensable for what we call in this paper "intangibles commons". Therefore, this paper conceptualises the intangible commons and subsequently explores the tensions arising, examines the gaps in our knowledge needed for effective policy making and presents a set of recommendations as to more appropriate policy making for intangibles.

Intangible assets are the collective term given to non-physical and non-financial resources. Corrado et al., (2005, 2009) term the non-physical resources, which can create value in the future as intangible investments and intangible assets as the accumulation of investments after accounting for the depreciation in the value of the investments. Beyond this basic characterisation, there is no consensus as to the precise definition and delineation of intangibles (Corrado et al., 2005; Edvinsson, 1997). The multiplicity of definitions makes it difficult to operationalise the concept of intangible assets leading to issues with measurement, and hence, evidence based policies (Lev, 2018). Intangibles are often conceived primarily in terms of knowledge and organisational skills giving rise to major intangible categories such as intellectual capital (Edvinsson, 1997; Nahapiet & Ghoshal, 1998; Subramaniam & Youndt, 2005), knowledge assets" (Bontis, 2001; Grant, 1996; Klein, 1997; Teece, 1998, 2000), and organisational capital (Bounfour, 2009). Authors also refer to intangibles such R&D, design and computerised information (Corrado et al., 2005), firm-specific human capital, social capital (Nahapiet & Ghoshal, 1998), customer loyalty (Agostini & Nosella, 2017) and reputation (Rindova et al., 2010).

A vast empirical literature has demonstrated that intangibles have always had enormous economic effects, and those effects are growing (Haskel & Westlake, 2017). From the 1990s there has been growing research interest in the contribution of intangibles to productivity, growth, and innovation (Chauvin & Hirschey, 1993; Montresor & Vezzani, 2022a; Tseng & James Goo, 2005; Webster, 2000). Research has shown that intangibles influence output and firm growth rate (Andersson & Saiz, 2018; Corrado et al., 2009; Marrano et al., 2009), underpin the competitive advantage of the firm (Teece, 2015; Villalonga, 2004), as well as provide for productivity and productivity growth at the macroeconomic level (R. Riley & Robinson, 2011).

However, there a number of qualities of intangibles and their utilisation in the economy that lead private firms to invest less in intangibles than would socially be desirable. While intangibles are highly scalable, their initial investment is often very high (C. I. Jones & Romer, 2010; Lev, 2000). Some intangibles, such as knowledge assets, are easy to copy and spill over to other firms, which reduces the ability of firms' to capture rents (Rayna, 2008). Some categories, such as training of employees are partially-excludable due to which firms cannot completely appropriate the rents from investments in intangibles (Eisenmann et al., 2011; Rayna, 2008; Spithoven & Teirlinck, 2015; Teece, 1998). Intangibles are also high-risk investments because of sunk costs, high frequency of failure, and no residual value for most categories of intangibles (Andrews & Serres, 2012; Demmou et al., 2019). The scalability, partial-excludability, non-rivalrous, spillovers, and low residual value characteristics are likely to lead to private sector under-investment in intangibles.

The recognition that intangibles are increasingly important for firms and for the economy as a whole, and the problem of underinvestment in intangible has fed into policy making in OECD countries, where encouraging investment and working to grow intangibles has become a feature of policy making (Thum-Thysen et al., 2017). However, it is the basic premise of this paper that policies for intangibles as a category are as yet ill-defined, and this paper wants to offer a conceptualisation of policies for intangibles and their tensions in order to support policy making.

We start from the observation that the ill-defined, idiosyncratic characteristics of intangibles confound policy-makers. They often do not recognise the diversity of the mechanisms through which intangibles influence innovation and productivity growth. Further, they are also, unable to take cognisance of the interdependencies and trade-offs inherent in the policies required to develop intangibles (Chiapini et al., 2018; Thum-Thysen et al., 2017). Therefore, while numerous policies have emerged that focus on individual intangibles in areas such as training and skills, research and development and intellectual property (Chiapini et al., 2018; Dar, 2004; Edler et al., 2015), there is far less effort devoted to coordinating these policies.

A second starting point has to do with the recognition that policy making for intangibles faces two major challenges which combine into a policy dilemma: First, there are limitations as to how policy can influence how firms internalise, build up and use different kinds of intangibles (Green & Hogarth, 2016). A number of intangibles within firms cannot be influenced directly by policy or the policy influence is very limited. The way firms build up the risk-taking spirit and grow entrepreneurial skills, for example, can be supported through general training or conducive framework conditions. However, in the end, the culture and strategies of firms and broader cultural and economic conditions in economies determine the build-up and use of the risk-taking spirit and entrepreneurial skills. The often cited limited risk-taking in countries like Germany as compared to UK or US would be an example of a very limited policy leverage to influence the intangible entrepreneurial spirit, which seems to be a manifestation of certain cultural traits in countries and within firms (Fuerlinger et al., 2015). Of course, the kinds of limitations shift constantly, as certain intangibles take on different levels of importance, as markets and technologies change and as the expectation of society changes as relates working conditions in firms.

A second key obstacle to developing policies that coordinate the build-up and use of intangibles is the tension between how intangibles are created and managed at the firm level, and the important role they perform as common resources at the regional, national and international levels. Thus, while policy makers are intent on assisting firms in the key strategic area of acquiring and controlling intangible assets (Menell, 2019), at the same time, from a systemic point of view, policy makers must contend with the fact that individual ownership of intangible assets can limit the sharing and exchange of intangibles (Murray & Stern, 2007) that is indispensable for growth and innovation for the economy as a whole. This duality in the nature of intangibles can be categorized at the firm level as *firm-specific intangibles* and at the level of regional and national level as *intangibles commons*.

As a result of those two obstacles, policy makers are faced with a dilemma. Firms may appropriate sufficient value from their intangibles to cover costs and obtain adequate returns, but they are usually unable to prevent spillovers that allow other firms to benefit from their investments (Teece, 2006). Firms therefore press governments to strengthen appropriability regimes (Boldrin & Levine, 2013; Patry, 1997). However, while firms may press policy makers to legislate for complete appropriation that excludes other firms from benefiting from their investments in intangibles, this may be counterproductive not only for the economy as a whole – but in the long-run for the firms that advocate such policy as well (Nelson, 2004). This is because there is a strong interdependence between the firm's ability to build up its stock of intangibles and sufficiently endowed intangibles commons. To craft policies that grow intangibles, policy makers must balance the tensions between supporting firm-specific intangibles and ensuring growing intangibles commons.

Against this background, this paper has three aims. First, it seeks to differentiate and explore the two types of intangibles and the role of policies for their development. Second, it outlines major policy tensions when it comes to the interplay of those two types of intangibles. Third, it addresses existing gaps both in terms of our knowledge on intangibles and policy and in terms of policy itself.

Our paper is based on a meta-narrative review of the literature on intangibles (Greenhalgh et al., 2005). Our starting point was a list of keywords using the taxonomy of policy instruments developed by (Edler & Fagerberg, 2017) and other widely used terminology for intangible assets. We conducted a structured search for literature in each of the journals in the category "Public Sector and Health Care" from the Association of Business Schools' Academic Journal Guide 2015. We searched the abstracts of the journals using various combinations of the keywords. We also conducted a similar exercise using the search function in EBSCO research databases. We then used snowballing technique by going through the literature that cited the papers in the search results as well as the key literature that was cited in the search results. Finally, we used Google search to download significant reports by organisations such as OECD to examine the policy discussions in the grey literature. The search process resulted in our examining more than 65 journals, 111 relevant articles, and 13 practitioner reports.

Our paper is structured as follows. In the subsequent section we explore in more detail the *firm specific intangibles* and *intangibles commons*, with some focus on the sources for the growth of various intangibles. In section 3 we then discuss the major policy tensions that arise from the interplay of intangible commons and firm specific intangibles. Section 4 then discusses the intelligence gaps we still face when it comes to understanding and measuring intangibles, which need to be addressed for a comprehensive approach to policy making on intangibles to be achieved. On that basis, section 5 summaries the major policy gaps that still exist both for intangibles as a category and for the two types of intangibles. In a last section we briefly zoom out again to draw wider conclusions as to how intangibles should be understood, analysed and supported in the future.

2 Firm specific intangibles vs. the intangibles commons: types, sources and policies

As intangibles have become more central to the economy, policy makers have become increasingly concerned that underinvestment in intangibles can stall higher productivity and limit the innovative growth of the economy. Devising policies for intangibles that span the firm as a site for the production and use of intangibles and the supply of intangibles for the economic system as a whole is challenging. To fully appreciate the challenge, we first classify intangibles along two dimensions: the degree to which their benefit can be appropriated by firms, in which case they can be described as *firm-specific intangibles,* and the extent to which they are part of a pool of intangibles that is available to all in the *intangibles commons*.

2.1 Firm specific intangibles

Intangibles can confer strategic advantages. Certain types of intangibles such as organisation structures, business models, and brands are often difficult to reverse-engineer because of time compression diseconomies (Dierickx & Cool, 1989). They cannot be easily separated from the firm that owns them, and the synergies between different dimensions of intangibles such as business models and managerial know-how and other tangible assets are difficult to imitate. They are often said to possess the valuable, rare, inimitable, and non-substitutable characteristics that result in competitive advantages for the firm (Barney, 1991). We term these assets or investments whose rents can be appropriated predominantly by the firm as *firm-specific intangibles*.

Appropriation is the primary mechanism through which certain intangibles become *firm-specific* intangibles. Appropriation is said to occur when the value generated through the use of an asset or investment is retained primarily by the firm, instead of competitors, suppliers, customers, employees, or other stakeholders (Bowman & Ambrosini, 2000, 2010). Important enabling conditions for appropriation include the presence of a favourable appropriability regime (the efficacy of legal instruments to protect the firm’s property rights and the extent to which the intangible cannot be codified), availability of complementary assets, extent of firm's control over the dominant design, and the bargaining power over stakeholders (Bowman & Ambrosini, 2000, 2010; Teece, 1986).

In this section we explore the various sources The main sources for the origin and growth of firm-specific intangibles are the entrepreneurial skills within the firm, managerial skills and capabilities, research, development and innovation processes, firm-specific training and development, alliances, partnerships, and joint ventures, and international trade and Foreign Direct Investment (FDI). Organisational processes, routines, systems, and structures also contribute to the growth of firm-specific intangibles directly, and indirectly as enablers of other sources of intangibles.

Entrepreneurial skills

Entrepreneurial skills are important for the introduction of new business models, technologies, products, and brands and contribute to the growth of the firm. Entrepreneurial skills result in the founding of new firms as well as new ventures or divisions within firms through corporate intrapreneurship (Hitt et al., 2011; Teece, 2015). Imprinting at the time of founding help in the development of organisational values and culture (Leung et al., 2013; Marquis & Qiao, 2020). Entrepreneurial skills can also be the key factor that differentiates the high-growth firms from other firms, at least in the cohort of knowledge intensive firms (Norkio & Piekkola 2022). While innovations may foster high growth for a few years, entrepreneurial talent is required for firms to persist on the high-growth path. New ventures indeed require new structures, processes and routines (Ambos & Birkinshaw, 2010), which together with the organisational values and culture, contribute to the organisational capital of the firm.

While entrepreneurial skills reside in individuals, they can be supported and they require enabling conditions. There are a range of policies and enabling regulatory framework conditions to support the build-up and application of entrepreneurial skills (European Commission, 2012). This starts with secondary and tertiary education that focuses on entrepreneurial knowledge and a culture of risk taking. Further, the state can improve and ensure availability of finance that can support risky ventures, an environment in which failure of an entrepreneurial venture is not viewed as a stigma, and robust bankruptcy and M&A processes that can facilitate quick reallocation of resources within the economy in cases of failure (Lee et al., 2007, 2011).

These policies and regulatory framework conditions, however, have limitations as to mobilise entrepreneurial skills, both within firms and for individuals to set up new ventures. The core of the intangible, the entrepreneurial attitude and skill, and in particular the way management in firms mobilise it, depends on a number of firm specific characteristics as well as cultural characteristics in a given system that are beyond the direct influence of the state. The way firms mobilise entrepreneurial skill, build it up internally, take risk and take products and services to the market cannot be mandated (Fuerlinger et al., 2015). Further, firms only have few incentives to support entrepreneurial activity that leads to spin outs. There are hence, limitations in mobilising the entrepreneurial potential residing within companies into the realm of intangible commons.

Managerial skills and capabilities

Managerial skills and capabilities are integral for the development of organisational processes and the routines and structures that enable the firm to pursue entrepreneurial opportunities, and successfully implement the new business models. These processes are idiosyncratic and usually difficult to imitate (Teece, 2015). Managerial skills and capabilities themselves constitute an important intangible asset of the firm and they also enable the development of other intangible assets. In market economies the managerial skills and capabilities within firms is a major distinguishing factor in market competition. Firms actively take steps such as managerial training, mentoring, poaching from competitors, non-compete agreements, and supporting career development to enable the growth of the intangible asset (Lazarova & Cerdin, 2007; Marx, 2011; Marx & Fleming, 2012; Moen & Rosén, 2004). However, these skillsets are unique, not all firms are likely to possess them to the extent required for survival and growth. This is especially true for young firms which need support to complement the knowledge and skills of their founders so that they can overcome the liability of newness (Boeker & Wiltbank, 2005) and for small and medium enterprises (SMEs), which might be constrained financially in recruiting managers with requisite skills.

As with entrepreneurial skills, there are limits as to the ways the state can support the build-up and application of necessary skills within companies (McKenzie & Woodruff, 2014). Further, it is of high importance to firms to try to assure they have the skills necessary and to prevent those skills from spilling over to other companies through employees changing firms or spill overs of skill related knowledge and practice (Marx, 2011). This stickiness may constrain the socially optimal use of skills, and its further improvement beyond the immediate needs of the company.

Research, Development, and Innovation

Firms generate and grow intangible assets that are essential to innovative processes and products by investing in R&D within their boundaries; by entering into cooperative agreements with other firms; and increasingly through open innovation processes (Chesbrough & Bogers, 2014) such as selective revealing (Alexy et al., 2013) - where the focus is not on internalising all knowledge, but to engage with the intangibles commons under less constrictive formal arrangements. R&D is an important component of firm innovation and growth, but it is only one aspect of the innovation process wherein “creative and systematic work” is undertaken to increase the stock of knowledge (OECD, 2015). According to (Edler & Fagerberg, 2017), innovation can be conceived as “the introduction of new solutions in response to problems, challenges, or opportunities that arise in the social and/or economic environment.”

R&D is an important activity for firms because it generates private returns for growth through the new products and processes introduced as an outcome of its innovation processes, as well as through the stock of accumulated knowledge resulting in absorptive capacity (Cohen & Levinthal, 1990). While many MNEs are looking to internationalise R&D and gain the advantages of the knowledge creation processes in other countries (Mudambi, 2008), firms are also increasingly evaluating and exploiting the knowledge created beyond their boundaries (Berchicci, 2013). This search for new knowledge occurs through R&D partnerships, participation in creative collaboration networks and open innovations (Chesbrough & Bogers, 2014; Hagedoorn et al., 2006).

States have provided significant support for R&D and innovation processes through many policy measures, including subsidies, tax incentives, and other interventions such as procurement, design competitions, IPRs and the like (Edler et al., 2016). Policy measures rest on the assumption that ownership of innovation outputs would incentivise firms to invest in R&D and innovation despite spillovers. Some of the policy support is in the form of greater opportunities to increase appropriation (e.g., IPRs) and some other in the form of monetary support and awards. However, these measures do not adequately account for the interdependencies between various innovations outputs for the advancement of science and technology.

Organisational processes, routines, systems, and structures

Entrepreneurial and managerial skills, when complemented by flexible and responsive organisational processes, routines and structures, can generate firm-specific intangible assets in a dynamic marketplace (Ahmed et al., 1996). The flexibility and responsiveness in organisational processes, routines, and structures are an outcome of decentralized decision-making and empowered teams. Flexibility and responsiveness are important attributes because they enable aggressive response to competition, facilitate speed in decision-making, quick information assimilation from markets, and increase the willingness of the firm to enter into alliances and joint ventures or outsourcing of activities (Teece, 2000). These structures and processes complement other intangibles and are important for their growth.

However, without timely intervention, and periodic reassessment, structure, processes, and shared knowledge can ossify, reducing the impact that these structures, processes and shared knowledge can have on the firm's performance (Berman et al., 2002). E.g., firms have elaborate structures and processes which vet their innovation ideas (Desouza et al., 2009). If these structures and the managers implementing the processes do not evolve with the market, firms are likely to lose out on many significant opportunities.

Since the structures, processes, and shared knowledge take time to develop, young firms might find it difficult to transition from the entrepreneurial stage to the mature firm, and mature firms sometimes lag behind their competitors (Judge et al., 2015). However, structures, processes, and routines are extremely firm-dependent (Quinn & Scur, 2021). There are limited opportunities for policy-makers to support the growth of firm-specific routines and structures, since their growth is highly firm-specific and hence, the costs of interventions are extremely high.

Firm specific training and development

Human capital affects firm investment in intangibles (Arrighetti et al., 2014). While organisations can hire people with the generic and specific knowledge required for a task, and employees might be willing to invest in skill development to improve their employment prospects, employers often have to train employees on the systems and processes that are specific to the organisation. The firm-specific training is important for employees to operate specialised equipment, process existing knowledge, and navigate existing systems, processes, structures, and routines. Firms undertake the costs of training because they expect to appropriate the benefits from such training in the form of higher productivity (Becker, 1994). Sometimes firms also get into non-compete agreements to ensure that they do not lose highly trained employees (Marx, 2011). Training programmes are also important from an employee retention and satisfaction perspective (Fletcher et al., 2018).

Several economies have used a variety of levies to fund firm-specific training along with economy-wide skills development. Although the efficacy of the funding varies across countries, in Asian countries such as Japan, Korea, and Singapore, and some of the European countries such as Germany and Netherlands, the funding schemes have established a training culture. The training funds are available for specific sectors in some instances, and in some cases, are available for firms of certain size (B. Jones & Grimshaw, 2012).

Alliances, partnerships, and joint ventures

Firms gain knowledge and technological know-how from supply chain relationships, licensing agreements, board interlocks, R&D partnerships, technological partners, and joint ventures (Pisano & Shih, 2009). While these forms of cooperation between firms exist regardless of tangible or intangible assets, there are significant considerations that need to be incorporated for intangible assets related cooperation mechanisms (Krause et al., 2019; Kumar, 2010). Mechanisms to exercise ownership, manage and maintain control of intangible assets are significantly different from mechanisms that perform the same function in the case of tangible assets, especially due to the ease of knowledge spillovers in the case of intangible assets (Lavie, 2007; Martinez-Noya et al., 2013).

At a first glance, negotiating these agreements seem to be within the purview of the private sector, with government action confined to providing the regulatory and legal infrastructure required to sanction and enforce these agreements. In many countries, however, governments also have policies to support new ventures. Policies related to incubation, R&D cooperation, networks and clusters actively seek to promote these inter-firm agreements, and these policies also encourage partnerships with universities and other research institutes – with a view to firms gaining from knowledge spillovers (Edquist & Zabala-Iturriagagoitia, 2012; Scillitoe & Chakrabarti, 2010).

International trade and FDI

Inward and outward FDI also helps organisations to develop and grow their intangible assets (Dunning, 2001). Firms enter foreign markets not only to seek new markets for their existing assets (market seeking motivation), but also to seek new technologies and know-how (asset and resource seeking motivations) (Nachum & Zaheer, 2005). MNEs that invest in a new country market through a joint venture or a partnership share technology, know-how and expertise, which the host country market firm can appropriate (Huang & Chiu, 2014). However, for such agreements to work as intended, policies have to be in place to ensure completeness of contracts and framework for sharing of technology and know-how (Wang et al., 2017). In many instances, firms also receive support from home governments to acquire intangible assets through FDI and increase the knowledge base of the home country (Lu et al., 2014).

2.2 Intangible Commons

In contrast to the firm-specific intangibles, intangibles commons are available to all social and economic actors. Intangibles commons is the aggregation of tacit and explicit knowledge, skills, and competencies related to a certain technology or industry. They are quasi-public goods that result both from public policy investments and from spillovers from the activities of firms to other firms and organisations. Firms contribute voluntarily and involuntarily to intangibles that enlarge the intangibles commons, through knowledge spillovers and other similar mechanisms such as joint ventures and consortia. Individuals in their roles as inventors and customers, not-for-profit agencies, and public agencies also contribute to the intangibles commons (Asheim et al., 2011).

Spillovers are the primary mechanism through which the *intangibles commons* takes shape. Spillovers represent incomplete appropriation. Firms are incentivized to invest in innovation capabilities by expectations of appropriation, expectations that are often based on the appropriation policies of the country in which they are located. Knowledge is inherently a non-excludable and non-rivalrous good (Romer, 1990).

Knowledge spillovers occur when it is legally difficult for firms to exclude rivals from imitating their products, technologies or ideas. Rivals learn from the innovative efforts of other firms by re-engineering products, technologies, and business models. Knowledge spillovers also occur when skilled employees, apprentices, and managers apply knowledge gained earlier in one firm when taking up employment in another firm. Contractually, this knowledge cannot be appropriated by a single firm, and its circulation as employees change jobs increases the intangibles commons, which in turn makes knowledge resources available for new ventures. Further, when intangibles are "embrained" in individuals, and therefore consisting of "knowledge that depends on conceptual skills and cognitive abilities" (Blackler, 1995): 1023), they can transfer in mobile labour markets. "On the hoof" transfer of knowledge enhances knowledge flows in the economy (Langrish et al., 1972), and allows firms to develop complementary and competing products.

There are a number of different sources for the development of intangible commons. These include public investment in research, education and training, open innovation, creativity through new ventures, demand from lead users, supply chains, and clusters. The important mechanism for the development of the intangibles commons from this variety of sources is spillovers.

Public investment in research, education and training

Research institutes and universities typically focus on "open science" where the emphasis is on rapid and complete release of information to support faster growth of new knowledge. Open dissemination of research output reduces duplication of efforts, improves cooperation between scientists, and reinforces institutionalised norms (Aghion et al., 2009). This public access to information complements private R&D efforts. Universities and public research institutes also play a key role in dissemination of knowledge through higher education, training, and skill development, thereby developing the skills related intangibles and the absorptive capacity of the economy as a whole (Nunes-Silva et al., 2019).

Next to firm specific support for research and development activities, government investments in research and funding especially of universities and public research organisations have been an important component of the development of the intangibles commons. Government support of research through public research institutes, universities and funding of research collaborations between public research institutes, universities, and the private sector increases the pool of knowledge available for further research and commercialisation (Sakakibara, 1997).

Open innovation

Open innovation is an important pathway for the development of the intangibles commons. When firms selectively reveal the issues for which they seek solutions from the external environment, they point to research areas that other firms can also exploit. Often supported by the wide reach of the internet, selective revealing allows also individuals and small firms to pursue small-scale low-cost research in these areas, thereby challenging innovation systems that are dominated by large well-funded organisations. These efforts link more closely the research community - which is decentralized and usually fragmented - with the needs of the industry (Alexy et al., 2013). These efforts also reduce the innovation costs for firms and increase the diversity of solutions that emerge. Although firms benefit from open innovation solutions that meet their specific needs, they cannot fully and exclusively appropriate these benefits. Researchers who develop these solutions often publish their work in journals, thereby denying firms quasi-monopolistic profits. Problem revelation thereby generates solutions that opens up new pathways for innovation and knowledge creation, with positive and significant impact on the development of intangibles commons (Monitor Deloitte et al., 2015; Terwiesch & Xu, 2008).

Public sector intangibles related to good governance, such as intellectual property rights and rule of law have an important role to play in open innovation processes. Literature suggests that firms active in open innovation prefer to govern the relationship through contracts and IPRs (Gambardella & Panico, 2014; Hagedoorn & Zobel, 2015). Strong mechanisms for dispute resolution will have a crucial role to play in firms initiating open innovation interactions.

New ventures dependence from and contribution to intangibles commons

New ventures contribute to the intangibles commons by providing creative solutions to latent and expressed demand for products and services. They do so by developing new skills in the workforce, introducing new ways of organising information, redesigning tasks, advancing technology, and pioneering new business models. Although, many production processes, technologies, organisational processes and structures are internal to the firm, and information is protected through trade secrets and confidentiality agreements, some of the activities of the new ventures are revealed through their actions in the marketplace. Products and technologies can be reverse engineered and some aspects of the business model such as sales practices, choice of channel partners, and pricing strategies can be retroactively understood from the startup's revealed actions (Casadesus-Masanell & Zhu, 2013). This knowledge adds to the intangibles commons through the novelty of ideas. Entrepreneurial firms and small and medium enterprises are a significant source of new employment. Employees acquire new skills especially in innovation-based startups, primarily through firm-specific training and learning-by-doing processes (Freel, 2005; Knockaert et al., 2011). These new skills are important contributors to the intangibles commons through mobility in the labour markets and knowledge spillovers.

Moreover, start-ups contribute to the intangibles commons through failure as well as success. Managers transfer what they learn by observation and experience from past failures to new projects, using knowledge gained to guide their decision-making (Carmeli, 2007). Failure also frees up intellectual capital, human capital and other financial resources for more productive uses through M&As and imitations (Andrews & Serres, 2012).

Demand from lead users

Lead users with sophisticated knowledge of technology and innovation that are willing to risk adoption of novel solutions can increase firm-specific intangibles (von Hippel, 1986). The lead users can be individual customers, large firms, or governments. Large firms and governments also use procurement and innovation contests to incentivize supply. Demand from large firms, and governments, for complex technological solutions, can increase firm-specific intangibles but can also encourages creation of an ecosystem of solution providers - thereby contributing to the development of the intangibles commons.

Because of the size and scale associated with large-scale public procurement, governments are particularly well positioned to take risks with costly changes in existing systems, and demonstrate the viability of complex technologies (Edler & Georghiou, 2007; Edquist et al., 2015; Landoni, 2017). Thus, large-scale public procurement can also lead to changes in the technology and production for suppliers of complex systems. Individual firms develop problem solving skills and novel technological solutions, creating firm-specific intangibles that result in improved products and service offerings. They also coordinate with other firms in the ecosystem for problem solving and inter-operability of technology and products thereby creating a pool of new knowledge on and around the new technology. This ecosystem forms a new *intangibles commons* for specific technologies and the socio-technological systems it supports, which can be used in other contexts and other products.

Supply chains as originators and transmission belts for intangibles commons

Suppliers and downstream partners are an extremely important source of market intelligence which firms transform and internalize into their knowledge base. Production partners, especially original equipment manufacturers (OEM), learn from the production processes of the lead firm in the supply chain to increase their technological sophistication, and can eventually emerge as competitors (Pisano & Shih, 2009). Suppliers and channel partners also participate in the technology development efforts of firms and increase the pathways through which knowledge flows across the economy, thus, growing the intangibles commons. They specialize in these production processes and subsequently develop the inbound and outbound logistics required to enter the same product markets as their competitors. Supply chain relationships are also a source for the diffusion of high-performance management practices in an economy (Fu, 2012).

The globalisation of supply chains throws up new challenges for policy makers. With many large firms outsourcing and offshoring production to partners in different countries, the possibility of the depletion of the intangibles commons becomes more real. Greater intervention is required from governments to ensure that production techniques and skills to execute the production processes and routines are not lost (Pisano & Shih, 2009).

3 Policy tensions

Policies for intangibles are complex to conceptualise and difficult to implement because of the interdependence between firm specific intangibles and intangibles commons. Although firms would like to completely internalise the benefits of their intangible investments, growth of intangibles within firm boundaries is strongly dependent on intangibles that exist outside the boundaries of the firm. Firms may try to minimize spillovers that contribute to the growth of network effects that in the long-run produce benefits for firms. Thus, there are contradictory demands placed on public policy to address the challenges of growth of intangibles in the economy. In this section, we investigate the tensions of policy making and the trade-offs that policy makers have to make to address these conflicting demands.

Policies that try to balance the tension between granting firms sufficient appropriability on the one hand and securing robust intangibles commons on the other hand must contend with the relationship between appropriability, competition, cooperation, and innovation. They also need to assess the training needs of the firm vis-à-vis the growth of the commons while keeping in mind the differential needs of the large and small firms. As we discussed in the previous section, firms' competitive strategies, cooperation strategies, and innovations contribute to the growth of the intangibles commons. Greater emphasis on appropriation results in reduced competition, restrictions on cooperation, and hence, places limits on innovation. In the following, we discuss the major tensions between firm specific intangibles and intangible commons.

3.1 Tensions between policies supporting appropriation and competition

Tensions between policies supporting appropriation and competition manifest in different forms. The Intellectual Property Rights Regime serves well to limit imitation (Veer et al., 2016), it extends the duration for which the firms can appropriate value from the intangibles and thus encourages greater appropriation. However, this appropriation regime at the same time reduces the incentives for inter-operability, whereby often dominant firms attempt to control the standards regime and ensuring that fewer alternative dominant designs emerge - impacting on the level of competition. Further, in the IT based economic domains the resultant network effects place greater data in the control of few firms, which in turn, has an impact on the number of firms competing for the next generation of technologies such as Artificial Intelligence and the internet-of-things (IoT) (Dubé et al., 2010; Mitomo, 2017).

Firms are also increasingly using mergers and acquisitions (M&A) to increase their intangibles assets base. The M&A activity is not only focusing on critical technologies, but often also seeks to gain control over competing brands, skilled workforce, and secure relationships with suppliers and distributors in case of new market entry. There are tensions between maintaining competition via anti-trust enforcement, and markets for corporate assets that tend to concentrate control through M&As. Although M&As are supposed to increase the dynamism of the economy by releasing intangibles and human capital trapped in inefficient processes and structures (Andrews & Serres, 2012), over time, M&As can lead to market consolidation and reduced competition. Ironically, lack of accounting standards for valuation and disclosure of intangible assets, means that currently M&As and bankruptcies may be the only time when information about the valuation of intangibles is more freely available (Bahadir et al., 2008).

Another tension arises from policies that encourage the growth and diffusion of intangibles through mobility of workforce and the vast safety nets that slow down or hinder mobility of the workforce which is a primary mechanism for knowledge spillovers. However, mobility is more likely to be high when there are flexible labour laws in place. When employment protection laws are strong, employers are more reluctant to let go of workers, and workers are less likely to be motivated to re-enter the labour market (Mitra & Jha, 2011; Warhurst, 2008). While these protections are beneficial for the growth of firm-specific intangibles, they reduce competition for workforce and the mobility an important source of intangibles commons.

3.2 Tensions between policies supporting appropriation and cooperation

As discussed in the previous sections, cooperation between firms can lead to the growth of firm-specific intangibles as well as the intangibles commons. The appropriation regime is extremely important for inter-firm cooperation, as the regime clarifies the control and claims of the different firms to their pre-existing as well as the jointly developed assets. However, the appropriation regime also allows firms to use defensive ploys to garner greater influence as compared to their cooperating partners and limit the future cooperation of the partners, thereby having the potential to limit the intangibles commons. An example of this strategic behaviour is standards setting. Standards setting impacts the development of the intangibles commons. The size of technological network effects depends on the standards by which the platform operates. Policies must avert a proliferation of standards that can stymie technological progress. This, however, may support the dominance of a few dominant players, and policies must at the same time, work to ensure that standards that result from IPR monopolies do not lock-in consumers to a limited set of technological standards. In contrast to regulations, standardisation is largely a bottom up, market driven activity, even if many standards are taken up by regulation (Blind et al., 2017). Thus, this tension between open and broad competition on the one hand and some control over the proliferation of standards on the other hand is exacerbated by the tension between top down and bottom-up dynamics. The challenge therefore is to still steer the technology development through laws that regulate competition and govern dispute resolution.

3.3 Tensions between policies supporting appropriation and innovation

A further tension exists *between the policy goal to enable appropriation through intellectual property and thus innovation in a particular firm on the one hand and the policy goal for innovation and new entries in the market place more generally*. (Gans & Persson, 2013) analytically demonstrate that due to the strong IP laws, new entrants are more likely to use cooperative strategies such as sale of innovations, M&As or long-term licensing of innovations instead of competing with incumbents directly. They argue that in light of the growing strength of the IP laws, competition regulators should offer more protections to new entrants when they enter into negotiations over the cooperative arrangements. Innovation policies also permit firms to use IPRs as aggressive and defensive competitive strategies. For example, competition regulators are increasingly concerned about "patents ambush", a process by which a firm that is part of the standards setting organisation (SSO) fails to disclose essential patent(s) during the standard setting, but extracts licensing fees after new products have been launched by competitors (Boldrin & Levine, 2013; Kang & Bekkers, 2015). There are ongoing debates on the extent to which firms have to disclose their IPRs portfolio to be eligible to be a part of any SSO, and what role should competition regulators adopt in enforcing those guidelines (Boldrin & Levine, 2013; Hemphill, 2005).

In view of the multiple strategic actions of firms to gain competitive advantages using IPRs, public policies for the development of the intangibles commons can design a role for innovation intermediaries that can support the markets for intangibles. Such a market would promote knowledge flows, prod firms to unlock the value of IP that sits on the shelf unused, and fuel development of business models that are more efficient in allocation of corporate resources as well as the resource allocation efficiency of markets.

3.4 Tensions between public and private investment in training

Furthermore, there is a *tension between private and public investment in training*. Governments invest in skill development through two main avenues. One is through educational policies pertaining to schooling, higher education, and vocational training. The other is through reskilling programs and training programs that are required to meet the challenges of changing technological and business landscape of the economy. Both the approaches are required for developing firm-specific intangibles as well as the intangibles commons. However, there is a need for distinct institutional foundations for professional education and training. Moreover, funding has to be evenly spread between the universities and other organisations providing short-term courses so that enrolment choices are not distorted by funding patterns (Green & Hogarth, 2016; Warhurst, 2008). Examples of organisations providing these facilities include the vocational colleges in Austria and community colleges in USA.

Governments also support firms by providing reskilling opportunities and training to employees who have been made redundant by firms. Such support carries challenges of providing redundant employees with unemployment benefits while they get trained and search for a new job, provide assistance in training and job search, and provide counselling during the challenging period (Green & Hogarth, 2016).

Governments take different approaches to fund their various skill development programs, including levies from firms, differentiated schemes to target specific categories of firms, and tuition fees; but governments cannot invest equally in all these approaches. Government priorities in terms of support of higher education, vocation training, and support for redundant workers will depend on many factors, including the degree of structural change in the economy (Silva et al., 2019). Involvement of the private sector in providing apprenticeships, incentives to hire workers with gaps in their employment history, and better feedback to ensure that curricula are updated to reflect the technological changes (Malcomson et al., 2003) are but some measures being increasingly undertaken to ensure that different sectors work together for skill development and reduce unemployment.

3.5 Tensions due to different needs of large and small firms

Finally, there are tensions *due to different needs of large vs small firms.* When it comes to developing intangibles there are distinct challenges facing large firms that are relatively mature as opposed to small firms, especially when they are new. Large firms often have substantial stock of intangibles (Bajgar et al., 2021). Their challenge is maintaining innovativeness while ensuring that its structures, process, and routines do not ossify with age (Loderer et al., 2017). For small and new firms, the main challenge is making the most of the intangibles that they have, and obtaining the complementary intangibles that are externally available at the lowest cost possible (Salavisa et al., 2012). A robust intangibles common can be vital for these firms, but is also useful for large firms. Government R&D support that is provided equally to small and large firms may benefit more large firms (Koga, 2003), thereby suppressing new venture formation and forcing small firms to exit. Since in many instances exit takes the form of acquisition by large firms, anti-trust policies have to strike a balance between industry concentration rising, thereby reducing intangibles commons, and providing entrepreneurs with exit opportunities.

4 Intelligence Gaps as Policy Challenges

4.1 Intelligence Gaps on Intangibles

The gaps in policies emerge partly from the knowledge gaps on intangibles. Since there is considerable progress yet to be made in the subject area, policy makers are reluctant to design policies that can be difficult to reverse when further knowledge emerges (Skinner, 2008).

First of all, there is a problematic lack of consensus when it comes to definition, principles, guidelines, measures, and measurement of intangibles in the firm's accounting systems (Lev, 2000, 2018; Massingham, 2016). The lack of consensus translates into incomplete reporting of the intangibles in the company public accounts. Hence, current financial reporting formats present an inaccurate picture of the financial health of the firm to its stakeholders. Such misrepresentation leads to increased information asymmetry between the managers and various stakeholders, making it difficult for investors to make informed investment decisions as well as making it difficult for managers to raise funding for different innovation and growth projects that rely on intangibles (Lev, 2018; Wen & Moehrle, 2016). Certain components of intangibles are slowly getting incorporated in the national accounting systems, but there is still little to no progress on their treatment in financial accounts of firms and their reporting (Lev, 2018). This focus on measurement and lack of consensus on measurement between the micro and the macro levels in the economy impacts policy making, which is unable to develop evidence-based policies for the growth of all types of intangibles.

Consensus also has to evolve on how information needs to flow between the macro and micro levels of the economy to improve the reliability of both macroeconomic data and company financial reports. In order to facilitate this, scholars need to reach an agreement on definitions and typologies that help to understand the components of intangibles (Corrado et al., 2005; Piekkola, 2018; Wall, 2005). This lack of operationalisation and measurement of intangibles is also one of the factors underlying the lack of evidence-based policy design and implementation, a growing concern, especially because there has been a growing focus on intangibles as a key explanatory factor in the so called "productivity puzzle" - a stagnant productivity despite an increasing output (Goodridge et al., 2013). Deeper understanding of the role of intangibles in productivity depends on improving measurement, and the use of these measurements in policy making (Corrado et al., 2005).

The divergence between national systems of accounting and financial accounts of firms impedes the measurement of firm-specific intangibles such as organisational capital that are extremely tacit (Lev, 2018; Zéghal & Maaloul, 2011; Zimmerman, 2015). Lack of measurements of organisational capital, and the consequent lack of policies relevant to these intangibles make it difficult to formulate future policies as well as study their impact.

There is also a dearth of empirically rigorous studies examining the relationships and interactions between various components of intangibles and firm growth and profitability. There are multiple studies in the strategic management and innovation literature with a theoretical foundation in resource-based view, knowledge-based view and dynamic capabilities that explore these themes (Arrighetti et al., 2014; Gómez & Vargas, 2012; S. M. Riley et al., 2017), but these studies have used broad constructs and proxies due to the difficulties in measurement related to intangibles (Molloy et al., 2011).

It is clear that we need to understand how firms develop the processes and structures that enable the growth of intangibles within the firm. There are multiple studies that examine the processes related to intangibles growth from the perspective of marketing (Joshi & Hanssens, 2010; Zhang et al., 2016), people management (Yang & Lin, 2009), training systems (Ballot et al., 2006), skill development (Petrick et al., 1999), and organisational development (Witt, 2000), but research that integrates or studies the underlying common processes has yet to evolve.

Another important knowledge gap that stands in the way of policy is a lack of understanding as to the variation in the strategies that firm use to develop intangible assets. Firms are increasingly relying on the intangibles commons to complement their innovation efforts through open innovation processes. However, firms have to navigate the “paradox of openness” (Laursen & Salter, 2014), the trade–off between opening up to collaborators and the declining power to appropriate knowledge from the collaboration. (Alexy et al., 2013) argue that firms participating in the open innovation processes should formulate their IP strategy based on the task environment and the concentration of knowledge between different firms in the competitive landscape. (Arora et al., 2016) contend that the choice between “spillover prevention” and “organisational openness” is contingent upon the technological and innovation leadership position of firms. However, with collaboration partners changing across different divisions in multidivisional firms, and variations in leadership position across divisions, we still do not know enough as to how firm strategies change with organisational complexity.

Our survey of literature (Busom & Fernández-Ribas, 2008; Herstad et al., 2010; Sakakibara, 1997; Singer, 2014; Teece, 2006; West et al., 2014; World Intellectual Property Organization, 2015) reveals the strides being made in developing the intangibles commons related to innovation property, but we do not know how the intangibles commons functions for certain types of intangibles such as brands and organisational processes. Brands and organisational processes are highly specific to the firm, and emerge from idiosyncratic conditions. Replication in the ecosystem is contingent on many factors and could easily transform the focal process or brand into something new. We need more conceptual and empirical studies on the functioning of the intangibles commons for some of these firm-specific intangibles.

Further, there is also a spatial element to the concept of intangibles commons that is poorly understood. The forces of globalisation and improvements in communications technology are making it easier to share information and knowledge across greater distances than before (Mudambi, 2008). It is hence of greater interest to understand the spatial effects and limits of the intangibles commons, and the implications of the differences in these spatial limits for different types of intangibles. Moreover, with the recent trends of increasing protectionism and nationalism (Evenett, 2019), it is also important to understand whether, and to what extent, these factors are going to influence the development of the intangibles commons.

Finally, and maybe most importantly, there is a lack of understanding of the tensions between different types of intangibles. In particular, the tensions we described above, the tensions between firm-specific commons and intangible commons, are insufficiently understood. This may very well be one of the reasons why policies that remedy those tensions are hard to find.

4.2 Intelligence Gaps on Policies for Intangibles

The other area that deserves a closer examination is related to the intelligence needed as to the impact of policies for individual intangibles and their relationship. More studies are required to systematically examine the relationship between public policies and components of organisational capital such as organisational structure, business models, branding, and marketing and advertising. While there are policies in place for certain aspects of the intangibles, such as software and innovation property (Edler et al., 2016; OECD, 2019), we do not know if, and how, these existing policies can be extended to other types of intangibles such as organisational capital. For example, although there are policies in place, such as those related to incubation centres and clusters (Aragon et al., 2014), which support inter-firm cooperation in order to develop innovative capabilities of firms, it is not clear whether similar policies can help firms to develop intangibles such as organisational capabilities and processes.

Further empirical studies are also required to examine the impact of public policies on the growth of the intangible assets per se. Research on cross-country variations in policies (OECD, 2019) and policy mixes and their impact on growth and productivity of intangibles are also needed to fill in the knowledge gaps on intangibles. These studies underscore the heterogeneity in policy formulation and response to differences in national systems. Studies are also predicting significant reallocation of labour resources in response to ongoing technological changes. Existing labour policies guide the scope of the reallocation process and the steps that can be taken to retrain and redeploy the labour force in response to mass layoffs (Silva et al., 2019). However, there are few studies on the efficacy of such responses. While there are policies on intangibles as output of the firm (e.g., film and music industry, software) (Lampel et al., 2006, 2007), more attention needs to be paid on intangibles as factors of production.

Despite a rather mature set of policies on intellectual property rights, the functioning and impact of organisations underpinning markets for ideas are not well understood. This is especially true for administrative response to challenges regarding patent thickets and granting of patents (Menell, 2019). Further research on these issues from a policy perspective not only can help address the challenges for the future, but also, understand the effectiveness of the current policy mix.

Finally, despite the growing interest in intangibles we still do not understand the processes by which policies that shape intangibles emerge. Nor do we have sufficient knowledge of how discussions between the various actors involved in the policy making process, whether political leaders, administrators, managers, or trade unions result in these policies. We also do not know whether and to what extent policy makers are aware of the need for policies on intangibles when policy makers consider how to increase growth. Although we distinguish between the intangibles commons and firm specific intangibles, the mechanisms through which policy makers address the balance between growth of the intangibles commons and growth of firm specific intangibles are largely unknown. We clearly have to make greater progress in developing knowledge on the effectiveness of policy making in creating intangibles.

5 Policy Gaps

The tensions arising from the interplay of firm specific intangibles and intangible commons discussed above and the intelligence gaps just described combine to create severe challenges for policy makers. Reflecting on the existing policies on intangibles, we can now derive at a set of policy gaps that would need attention by policy makers if we were to gain the total social benefits of intangibles to our economies.

The challenge of holistic policies for intangibles

First of all, our survey (Andrews & Serres, 2012; Capelleras et al., 2011; HM Treasury, 2018; Montresor & Vezzani, 2022b) of the literature indicates that there are few if any specific policies on *intangibles per se*. Most policies are directed toward individual components or at most a few complementarities between different components (Andrews & Serres, 2012; OECD, 2019). There are a few exceptions, such as the Irish Capital Allowances for Intangible Assets policy, which recognises growth in intangible assets such as, intellectual property, trade secrets, and software, as the target for public action (Donohoe, 2018). On the whole, however, there is no coherent attempt to strike a balance between firm specific policies that increase appropriability and policies that expand intangibles commons.

Further, and this is of critical importance, existing policies and policy mixes often do not recognise sufficiently the balance between ownership of intangibles on the one hand and the dependence on intangibles developed in other firms for the growth of firm-specific intangibles on the other hand. For instance, for more complex inter-firm relations such as R&D partnerships, patent pools, and joint ventures, the legal systems and frameworks have to evolve to protect and manage IPR. Policies related to intellectual property seek to reduce spillovers, reduce monitoring costs of transactions, and ensure that firms benefit from the network effects. However, such protections also increase the costs of inter-operability (Menell, 2019). Further, while policies related to IPRs and training seek to restrict the mobility of knowledge, growth of intangibles such as software, R&D, and skilled personnel are dependent on the extent to which firms can collaborate with each other, and build upon the knowledge bases of other firms (Berchicci, 2013; Hagedoorn et al., 2006). It still appears as a policy lacuna that this interplay is not fully reflected. Given the increasing importance of intangibles and in light of the policy tensions described above, this is a serious shortcoming.

One category of policies that can serve to enable simultaneous growth of firm-specific intangibles and the intangibles commons are policies to stimulate innovation related interaction. Policies for clusters, networks or multi-party research projects (Edler et al., 2016) in principle encourage two-way interactions between firms and their ecosystems such that firms can draw knowledge on technology, organisational processes, structures, and business models from the intangibles commons to develop their own specific intangibles and then share the updated knowledge with the pool to create a virtuous cycle of growth of intangibles.

Policies for firm specific intangibles

Our overview of individual firm specific intangibles indicates that currently public policies on firm-specific intangibles are extensively geared towards increasing the productivity of the economy by increasing the innovative output and capabilities of firms. The markets for intangibles are distorted due to the characteristics of the asset as well as the heterogeneity in the characteristics of the firms (Rayna, 2008). Policy interventions seek to address different types of systems and market failures including those due to increasing returns to scale, spillovers, information asymmetry and monitoring costs of transactions (Crouzet & Eberly, 2019). Public policy interventions range from developing entrepreneurial and managerial skills, FDI, training and development and enhancing the framework for intellectual property protections to well established R&D funding. The objectives of the policies are to enable the internalisation of intangibles by firms, and to maximize the rents that can be derived from them (Boldrin & Levine, 2013).

However, there is limited policy support available for firms to enhance their managerial skills, or invest and grow their brands and relationships with supply chain partners and distributors, or develop organisational processes, routines, or structures, which are especially important for firms to grow their organisational capital, or enable the development and use of software and databases within the firm (Leadership and Management Network Group, 2012; OECD, 2019; Quinn & Scur, 2021). Moreover, these policies largely neglect firm heterogeneity (other than firm size and age). This heterogeneity is important, because within the ambit of innovation strategies of firms, allocation of resources for different innovation processes will differ depending on internal and exogenous factors including complementary assets, embeddedness of the firms and their agents in a socio-political context.

A further shortcoming as for firm specific intangibles is the absence of policies or policy coordination for the development of organisational capital, which is linked with the lack of appropriate measurements of organisational capital. Organisational capital reflects not only the firm-specific skills of the employees, but also investments in brands and other marketing activities, as well as organisational structures and managerial capabilities, which are important for the firm's valuation (Osinski et al., 2017). Organisational capital also includes social capital - the accumulated history of the relationship between the firm and its customer base, and beyond that the firm's relationship with the ecosystem and its embeddedness in the wider socio-cultural-political context (Nahapiet & Ghoshal, 1998). Organisational capital is highly specific to the firm, and is an important marker of the difference between the firm and its competitors. Its policy support is both challenging because of this variety, but at the same time would have potential in particular for small and novel companies.

Policies for intangible commons

Policies for the intangibles commons seek to promote the growth, accessibility and flow of knowledge in the economy and its broad use to increase productivity and welfare. These policies have two aspects. One, they attempt to increase interactions between the various actors making knowledge and information sharing easier (Landoni, 2017; Monitor Deloitte et al., 2015; Su & Hung, 2009; Uyarra & Ramlogan, 2012). Second, they seek to set a limit on the extent to which actors in the ecosystem can appropriate benefits from the interactions at the expense of other actors (Baird, 2007; Hemphill, 2005). Those policies are a part of a complex landscape, where different elements such as firms, suppliers, academia, and governments are constantly collaborating and competing with each other and different policy instruments interact with each other to either mutually reinforce or dilute each other's impact. Policy mixes therefore have to be carefully crafted and implemented for benefits gained to both firms and the intangibles commons.

From the survey of literature (Andrews & Serres, 2012; Crouzet & Eberly, 2019; Da Rin et al., 2006; Edler et al., 2016; Landoni, 2017; Lee et al., 2011; Menell, 2019; R. Riley & Robinson, 2011; Silva et al., 2019) on the various agencies and avenues that develop the intangibles commons, we find that policies related to IPR, financing of risky ventures, especially through venture capital and angel investors, bankruptcy, competition, skill development, innovation systems, procurement, and social safety nets have a significant impact on the growth of the intangibles commons. Some of these policies while important for the growth of intangibles commons are also important for the growth of firm-specific intangibles. While there are significant ongoing discussions on strengthening policies related to these areas, the implications for the growth and development of intangibles are not explicitly considered.

Two examples for this limitation stand out. First, policies that encourage formation of venture capital are vital for financing new ventures and are therefore important for creation of firm-specific intangibles, but they also simultaneously grow the intangibles commons by creating knowledge resources, and evolving venture capital ecosystems. Venture capital firms not only provide finance but also provide advisory services to their clients (Peneder, 2010). They also provide networking opportunities to the new firms thereby encouraging technology collaboration, facilitating raising of additional finance, and brokering M&As. Thus, venture capitalists act as important disseminators of information and contribute to the intangibles commons both directly and indirectly (Da Rin et al., 2006; Scillitoe & Chakrabarti, 2010). Second, policies that shape bankruptcy laws are important because they provide a viable exit option. Well-designed bankruptcy laws ensure that investments in a new venture are not all sunk costs, that some can be recouped if the firm is dissolved (Andrews & Serres, 2012; Lee et al., 2011). Simultaneously, bankruptcy proceedings also provide an avenue for competitors and consortia to gain valuable firm-specific knowledge, thus indirectly adding to the intangibles commons.

To sum up, policies for intangibles are imbalanced, as is our knowledge about the relative meaning and effects of policies on intangibles. There are strong and highly differentiated policies for some firm specific intangibles, such as RDI, and a considerable knowledge base as regards policy effectiveness. For other firm specific intangibles, such as organisational capabilities or software investment, and for intangible commons, policies and our knowledge about policies are much more limited. Thus, there is a growing realisation that intangibles as a class of assets need to be studied in much more depth and breadth in order to develop appropriate and effective policy portfolios across the board of intangibles.

6 Conclusion

Intangible assets are a key component of the productive assets in the economy. Investments in intangible assets are outpacing investments in tangible assets in most developed countries. Estimates by (Corrado et al., 2018) suggest that in the period 2000-2013, compounded annual average rates of growth of investments in intangibles has been greater than that of investments in tangibles in key 18 countries belonging to the European Union and the US. These growth rates represent a fundamental change in how value is created in most developed economies. Firms increasingly owe their value not only to the greater sophistication and higher productivity of their production systems, but also to product and process innovations, and to assets such as brands, reputation, quality, and trained personnel (Teece, 2015).

Although there are is a growing literature on the measurement and productivity impact of intangibles (Corrado et al., 2018; Piekkola, 2018), policy research on this topic has lagged behind policy research on other areas. Summarizing the review of available literature, we find that there are no policies on intangibles as a category. Policies are fragmented and target one or two components of intangibles. Although policies may target areas where creation of intangibles is crucial, the motivation is rarely intangibles themselves.

A major obstacle for making progress on policies for intangibles is the fact that policies are often in conflict with each other, e.g., development of the intangibles commons may conflict with policies that ensure firm appropriation of benefits from intangibles. Conflicts in policies also arise due to the heterogeneity in firms due to age, size, and organisational complexity. In addition, the mechanisms linking creation of intangibles at the macro and micro levels are complex and poorly understood (Lev, 2018). Moreover, policies may focus on certain components of intangibles distorting creation of intangibles overall.

The accumulated literature thus far suggests that progress has been made in recognising the importance of intangibles for productivity and growth at the economy level, and likewise the importance of intangibles in creating competitive advantage at the firm level (Goodridge et al., 2013; Piekkola, 2018; Villalonga, 2004). Scholars have to build on this stock of knowledge and delve deeper into understanding the complex lifecycle of intangibles from generation to revitalisation of stocks of knowledge.

We hope that this article stimulates conversations on the policies for intangibles as an entirety. We conceive of three major research directions that can be derived from this report. One major research avenue can be the development of conceptual models and frameworks for the interactions between firm-specific intangibles and the intangibles commons under the different regimes of competition, cooperation, and coopetition. Another significant research avenue can be the study of policy instruments for intangibles, the interaction effects of bundling them in policy mixes and delineating the significant changes required in these instruments to implement them for various categories of intangible assets. The third is research on institutional framework on organisations needed to underpin a dynamic balance between firm-specific and the intangibles commons. The characteristics of intangibles lend themselves to contests over control, ownership, and appropriation. The contests emerge due to ambiguities in ownership, standards, measurement and valuation (Haskel & Westlake, 2017). The resolution of these ambiguities requires greater clarity from formal organisations as well as development of norms and values.

References

Aghion, P., David, P. A., & Foray, D. (2009). Science, technology and innovation for economic growth: Linking policy research and practice in "STIG Systems." *Research Policy*, *38*(4), 681–693.

Agostini, L., & Nosella, A. (2017). Interorganizational Relationships in Marketing: A Critical Review and Research Agenda. *International Journal of Management Reviews*, *19*(2), 131–150. https://doi.org/10.1111/ijmr.12084

Ahmed, P. K., Hardaker, G., & Carpenter, M. (1996). Integrated flexibility—Key to competition in a turbulent environment. *Long Range Planning*, *29*(4), 562–571. https://doi.org/10.1016/0024-6301(96)00048-9

Alexy, O., George, G., & Salter, A. J. (2013). Cui Bono? The Selective Revealing of Knowledge and Its Implications for Innovative Activity. *Academy of Management Review*, *38*(2), 270–291. https://doi.org/10.5465/amr.2011.0193

Ambos, T. C., & Birkinshaw, J. (2010). How Do New Ventures Evolve? An Inductive Study of Archetype Changes in Science-Based Ventures. *Organization Science*, *21*(6), 1125–1140. https://doi.org/10.1287/orsc.1090.0504

Andersson, M., & Saiz, L. (2018). *Investment in intangible assets in the Euro area*. ECB Economic Bulletin. https://www.ecb.europa.eu/pub/economic-bulletin/focus/2018/html/ecb.ebbox201807_03.en.html

Andrews, D., & Serres, A. de. (2012). *Intangible Assets, Resource Allocation and Growth: A Framework for Analysis*. OECD. https://doi.org/10.1787/5k92s63w14wb-en

Aragon, C., Aranguren, M. J., Diez, M.-A., Iturrioz, C., & Wilson, J. R. (2014). Participatory evaluation: A useful tool for contextualising cluster policy? *Policy Studies*, *35*(1), 1–21. https://doi.org/10.1080/01442872.2013.803532

Arora, A., Athreye, S., & Huang, C. (2016). The paradox of openness revisited: Collaborative innovation and patenting by UK innovators. *Research Policy*, *45*(7), 1352–1361. https://doi.org/10.1016/j.respol.2016.03.019

Arrighetti, A., Landini, F., & Lasagni, A. (2014). Intangible assets and firm heterogeneity: Evidence from Italy. *Research Policy*, *43*(1), 202–213. https://doi.org/10.1016/j.respol.2013.07.015

Asheim, B. T., Boschma, R., & Cooke, P. (2011). Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases. *Regional Studies*, *45*(7), 893–904. https://doi.org/10.1080/00343404.2010.543126

Bahadir, S. C., Bharadwaj, S. G., & Srivastava, R. K. (2008). Financial Value of Brands in Mergers and Acquisitions: Is Value in the Eye of the Beholder? *Journal of Marketing*, *72*(6), 49–64. https://doi.org/10.1509/jmkg.72.6.049

Baird, S. (2007). The Government at the Standards Bazaar. *Stanford Law & Policy Review*, *18*(35).

Bajgar, M., Criscuolo, C., & Timmis, J. (2021). *Intangibles and industry concentration: Supersize me* (No. 1806; p. 47). Center for Economic Performance, London School of Economics and Political Science. https://cep.lse.ac.uk/pubs/download/dp1806.pdf

Ballot, G., Fakhfakh, F., & Taymaz, E. (2006). Who Benefits from Training and R&D, the Firm or the Workers? *British Journal of Industrial Relations*, *44*(3), 473–495. https://doi.org/10.1111/j.1467-8543.2006.00509.x

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Becker, G. S. (1994). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education* (3d edition, Ed.). University of Chicago Press. https://press.uchicago.edu/ucp/books/book/chicago/H/bo3684031.html

Berchicci, L. (2013). Towards an open R&D system: Internal R&D investment, external knowledge acquisition and innovative performance. *Research Policy*, *42*(1), 117–127. https://doi.org/10.1016/j.respol.2012.04.017

Berman, S. L., Down, J., & Hill, C. W. L. (2002). Tacit Knowledge as a Source of Competitive Advantage in the National Basketball Association. *The Academy of Management Journal*, *45*(1), 13–31. https://doi.org/10.2307/3069282

Blackler, F. (1995). Knowledge, Knowledge Work and Organizations: An Overview and Interpretation. *Organization Studies*, *16*(6), 1021–1046. https://doi.org/10.1177/017084069501600605

Blind, K., Petersen, S. S., & Riillo, C. A. F. (2017). The impact of standards and regulation on innovation in uncertain markets. *Research Policy*, *46*(1), 249–264. https://doi.org/10.1016/j.respol.2016.11.003

Boeker, W., & Wiltbank, R. (2005). New Venture Evolution and Managerial Capabilities. *Organization Science*, *16*(2), 123–133. https://doi.org/10.1287/orsc.1050.0115

Boldrin, M., & Levine, D. K. (2013). The Case Against Patents. *Journal of Economic Perspectives*, *27*(1), 3–22. https://doi.org/10.1257/jep.27.1.3

Bontis, N. (2001). Assessing knowledge assets: A review of the models used to measure intellectual capital. *International Journal of Management Reviews*, *3*(1), 41–60. https://doi.org/10.1111/1468-2370.00053

Bounfour, A. (2009). *Organisational Capital: Modelling, Measuring and Contextualising*. Routledge. https://www.routledge.com/Organisational-Capital-Modelling-Measuring-and-Contextualising/Bounfour/p/book/9780415761901

Bowman, C., & Ambrosini, V. (2000). Value Creation Versus Value Capture: Towards a Coherent Definition of Value in Strategy. *British Journal of Management*, *11*(1), 1–15. https://doi.org/10.1111/1467-8551.00147

Bowman, C., & Ambrosini, V. (2010). How value is created, captured and destroyed. *European Business Review*, *22*(5), 479–495. https://doi.org/10.1108/09555341011068903

Busom, I., & Fernández-Ribas, A. (2008). The impact of firm participation in R&D programmes on R&D partnerships. *Research Policy*, *37*(2), 240–257. https://doi.org/10.1016/j.respol.2007.11.002

Capelleras, J.-L., Contín-Pilart, I., & Larraza-Kintana, M. (2011). Publicly Funded Prestart Support for New Firms: Who Demands it and How it Affects Their Employment Growth. *Environment and Planning C: Government and Policy*, *29*(5), 821–847. https://doi.org/10.1068/c10110b

Carmeli, A. (2007). Social Capital, Psychological Safety and Learning Behaviours from Failure in Organisations. *Long Range Planning*, *40*(1), 30–44. https://doi.org/10.1016/j.lrp.2006.12.002

Casadesus-Masanell, R., & Zhu, F. (2013). Business model innovation and competitive imitation: The case of sponsor-based business models. *Strategic Management Journal*, *34*(4), 464–482. https://doi.org/10.1002/smj.2022

Chauvin, K. W., & Hirschey, M. (1993). Advertising, R&D Expenditures and the Market Value of the Firm. *Financial Management*, *22*(4), 128–140. JSTOR. https://doi.org/10.2307/3665583

Chesbrough, H., & Bogers, M. (2014). Explicating Open Innovation: Clarifying an Emerging Paradigm for Understanding Innovation. In *New Frontiers in Open Innovation*.

Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199682461.003.0001

Chiapini, R., Gaffard, J.-L., Grebel, T., Guillou, S., Forero, M. L., Montmartin, B., Nesta, L., Saraceno, F., & Schiavo, S. (2018). *Structural Reforms in France, 2013-2017* (p. 226). European Union. https://ec.europa.eu/docsroom/documents/35841/attachments/1/translations/en/renditions/native

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, *35*(1), 128–152. https://doi.org/10.2307/2393553

Corrado, C., Haskel, J., Jona-Lasinio, C., & Iommi, M. (2018). Intangible investment in the EU and US before and since the Great Recession and its contribution to productivity growth. *Journal of Infrastructure, Policy and Development*, *2*(1), 11–36. https://doi.org/10.24294/jipd.v2i1.205

Corrado, C., Hulten, C., & Sichel, D. (2005). Measuring Capital and Technology: An Expanded Framework. In *Measuring Capital in the New Economy* (pp. 11–46). University of Chicago Press. https://www.nber.org/books-and-chapters/measuring-capital-new-economy/measuring-capital-and-technology-expanded-framework

Corrado, C., Hulten, C., & Sichel, D. (2009). INTANGIBLE CAPITAL AND U.S. ECONOMIC GROWTH. *Review of Income and Wealth*, *55*(3), 661–685. https://doi.org/10.1111/j.1475-4991.2009.00343.xCrouzet, N., & Eberly, J. C. (2019). Understanding Weak Capital Investment: The Role of Market Concentration and Intangibles. *National Bureau of Economic Research Working Paper Series*, *No. 25869*. https://doi.org/10.3386/w25869

Da Rin, M., Nicodano, G., & Sembenelli, A. (2006). Public policy and the creation of active venture capital markets. *Journal of Public Economics*, *90*(8), 1699–1723. https://doi.org/10.1016/j.jpubeco.2005.09.013

Dar, A. (2004). *Training Levies: Evidence from Evalualtions*. World Bank. https://openknowledge.worldbank.org/handle/10986/11810

Demmou, L., Stefanescu, I., & Arquie, A. (2019). *Productivity growth and finance: The role of intangible assets - a sector level analysis*. OECD. https://doi.org/10.1787/e26cae57-en

Desouza, K. C., Dombrowski, C., Awazu, Y., Baloh, P., Papagari, S., Jha, S., & Kim, J. Y. (2009). Crafting organizational innovation processes. *Innovation*, *11*(1), 6–33. https://doi.org/10.5172/impp.453.11.1.6

Dierickx, I., & Cool, K. (1989). Asset Stock Accumulation and Sustainability of Competitive Advantage. *Management Science*, *35*(12), 1504–1511. https://doi.org/10.1287/mnsc.35.12.1504

Donohoe, P. (2018). *The New, New Economy – A Speech by Minister Donohoe at Ibec*. https://www.gov.ie/en/speech/4b4461-p/

Dubé, J.-P. H., Hitsch, G. J., & Chintagunta, P. K. (2010). Tipping and Concentration in Markets with Indirect Network Effects. *Marketing Science*, *29*(2), 216–249.

Dunning, J. H. (2001). The Eclectic (OLI) Paradigm of International Production: Past, Present and Future. *International Journal of the Economics of Business*, *8*(2), 173–190. https://doi.org/10.1080/13571510110051441

Edler, J., Cameron, H., & Hajhashem, M. (2015). *The intersection of intellectual property rights and innovation policy making – A literature review* (p. 81). World Intellectual Property Organization (WIPO). https://www.wipo.int/edocs/pubdocs/en/wipo_report_ip_inn.pdf

Edler, J., Cunningham, P., Gök, A., & Shapira, P. (2016). *Handbook of Innovation Policy Impact*. Edward Elgar Publishing. https://www.elgaronline.com/view/edcoll/9781784711849/9781784711849.xml

Edler, J., & Fagerberg, J. (2017). Innovation policy: What, why, and how. *Oxford Review of Economic Policy*, *33*(1), 2–23. https://doi.org/10.1093/oxrep/grx001

Edler, J., & Georghiou, L. (2007). Public procurement and innovation—Resurrecting the demand side. *Research Policy*, *36*(7), 949–963. https://doi.org/10.1016/j.respol.2007.03.003

Edquist, C., Vonortas, N. S., & Zabala-Iturriagagoitia, J. M. (2015). Introduction. *Public Procurement for Innovation*. https://www.elgaronline.com/view/edcoll/9781783471881/9781783471881.00006.xml

Edquist, C., & Zabala-Iturriagagoitia, J. M. (2012). Public Procurement for Innovation as mission-oriented innovation policy. *Research Policy*, *41*(10), 1757–1769. https://doi.org/10.1016/j.respol.2012.04.022

Edvinsson, L. (1997). Developing intellectual capital at Skandia. *Long Range Planning*, *30*(3), 366–373. https://doi.org/10.1016/S0024-6301(97)90248-X

Eisenmann, T., Parker, G., & Van Alstyne, M. (2011). Platform envelopment. *Strategic Management Journal*, *32*(12), 1270–1285. https://doi.org/10.1002/smj.935

European Commission. (2012). *Building entrepreneurial mindsets and skills in the EU.* (Guidebook Series - How to Support SME Policy from Structural Funds). Publications Office, Directorate General for Enterprise and Industry. https://data.europa.eu/doi/10.2769/40659

Evenett, S. J. (2019). Protectionism, state discrimination, and international business since the onset of the Global Financial Crisis. *Journal of International Business Policy*, *2*(1), 9–36. https://doi.org/10.1057/s42214-019-00021-0

Fletcher, L., Alfes, K., & Robinson, D. (2018). The relationship between perceived training and development and employee retention: The mediating role of work attitudes. *The International Journal of Human Resource Management*, *29*(18), 2701–2728. https://doi.org/10.1080/09585192.2016.1262888

Freel, M. S. (2005). Patterns of innovation and skills in small firms. *Technovation*, *25*(2), 123–134. https://doi.org/10.1016/S0166-4972(03)00082-8

Fu, X. (2012). Foreign Direct Investment and Managerial Knowledge Spillovers through the Diffusion of Management Practices. *Journal of Management Studies*, *49*(5), 970–999. https://doi.org/10.1111/j.1467-6486.2011.01036.x

Fuerlinger, G., Fandl, U., & Funke, T. (2015). The role of the state in the entrepreneurship ecosystem: Insights from Germany. *Triple Helix*, *2*(1), 3. https://doi.org/10.1186/s40604-014-0015-9

Gambardella, A., & Panico, C. (2014). On the management of open innovation. *Research Policy*, *43*(5), 903–913. https://doi.org/10.1016/j.respol.2013.12.002

Gans, J. S., & Persson, L. (2013). Entrepreneurial commercialization choices and the interaction between IPR and competition policy. *Industrial and Corporate Change*, *22*(1), 131–151. https://doi.org/10.1093/icc/dts049

Gómez, J., & Vargas, P. (2012). Intangible resources and technology adoption in manufacturing firms. *Research Policy*, *41*(9), 1607–1619. https://doi.org/10.1016/j.respol.2012.04.

Goodridge, P., Haskel, J., & Wallis, G. (2013). Can Intangible Investment Explain the UK Productivity Puzzle? *National Institute Economic Review*, *224*(1), R48–R58. https://doi.org/10.1177/002795011322400104

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(S2), 109–122. https://doi.org/10.1002/smj.4250171110

Green, A., & Hogarth, T. (2016). *The UK skills system: How aligned are public policy and employer views of training provision?* (p. 24) [Foresight]. Government Office for Science, UK. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/571695/ER8_The_UK_skills_system_how_aligned_are_public_policy_and_employer_views_of_training_provision.pdf

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., Kyriakidou, O., & Peacock, R. (2005). Storylines of research in diffusion of innovation: A meta-narrative approach to systematic review. *Social Science & Medicine*, *61*(2), 417–430. https://doi.org/10.1016/j.socscimed.2004.12.001

Hagedoorn, J., Roijakkers, N., & Van Kranenburg, H. (2006). Inter-Firm R&D Networks: The Importance of Strategic Network Capabilities for High-Tech Partnership Formation1. *British Journal of Management*, *17*(1), 39–53. https://doi.org/10.1111/j.1467-8551.2005.00474.x

Hagedoorn, J., & Zobel, A.-K. (2015). The role of contracts and intellectual property rights in open innovation. *Technology Analysis & Strategic Management*, *27*(9), 1050–1067. https://doi.org/10.1080/09537325.2015.1056134

Haskel, J., & Westlake, S. (2017). *Capitalism without Capital*. Princeton University Press. https://press.princeton.edu/books/hardcover/9780691175034/capitalism-without-capital

Hemphill, T. A. (2005). Technology standards development, patent ambush, and US antitrust policy. *Technology in Society*, *27*(1), 55–67. https://doi.org/10.1016/j.techsoc.2004.10.006

Herstad, S. J., Bloch, C., Ebersberger, B., & van de Velde, E. (2010). National innovation policy and global open innovation: Exploring balances, tradeoffs and complementarities. *Science and Public Policy*, *37*(2), 113–124. https://doi.org/10.3152/030234210X489590

Hitt, M. A., Ireland, R. D., Sirmon, D. G., & Trahms, C. A. (2011). Strategic Entrepreneurship: Creating Value for Individuals, Organizations, and Society. *Academy of Management Perspectives*, *25*(2), 57–75. https://doi.org/10.5465/amp.25.2.57

HM Treasury. (2018). *Getting smart about intellectual property and other intangible assets in the public sector*. https://www.gov.uk/government/publications/getting-smart-about-intellectual-property-and-intangible-assets

Huang, M.-C., & Chiu, Y.-P. (2014). The antecedents and outcome of control in IJVs: A control gap framework. *Asia Pacific Journal of Management*, *31*(1), 245–269. https://doi.org/10.1007/s10490-012-9304-x

Hurmelinna, P., Kyläheiko, K., & Jauhiainen, T. (2007). The Janus face of the appropriability regime in the protection of innovations: Theoretical re-appraisal and empirical analysis. *Technovation*, *27*(3), 133–144. https://doi.org/10.1016/j.technovation.2005.09.011

Hurmelinna, P., Sainio, L.-M., & Jauhiainen, T. (2008). Appropriability Regime for Radical and Incremental Innovations. *R and D Management*, *38*. https://doi.org/10.1111/j.1467-9310.2008.00513.x

Jones, B., & Grimshaw, D. (2012). *The Effects of Policies for Training and Skills on Improving Innovation Capabilities in Firms* (Compendium of Evidence on the Effectiveness of Innovation Policy Intervention). Nesta. https://www.research.manchester.ac.uk/portal/en/publications/the-effects-of-policies-

for-training-and-skills-on-improving-innovation-capabilities-in-firms(73641b7c-ff1b-4266-ae2a-3534a44e87ad)/export.html
Jones, C. I., & Romer, P. M. (2010). The New Kaldor Facts: Ideas, Institutions, Population, and Human Capital. *American Economic Journal: Macroeconomics*, *2*(1), 224–245. https://doi.org/10.1257/mac.2.1.224
Joshi, A., & Hanssens, D. M. (2010). The Direct and Indirect Effects of Advertising Spending on Firm Value. *Journal of Marketing*, *74*(1), 20–33. https://doi.org/10.1509/jmkg.74.1.20
Judge, W. Q., Hu, H. W., Gabrielsson, J., Talaulicar, T., Witt, M. A., Zattoni, A., López-Iturriaga, F., Chen, J. J., Shukla, D., Quttainah, M., Adegbite, E., Luis Rivas, J., & Kibler, B. (2015). Configurations of Capacity for Change in Entrepreneurial Threshold Firms: Imprinting and Strategic Choice Perspectives. *Journal of Management Studies*, *52*(4), 506–530. https://doi.org/10.1111/joms.12121
Kang, B., & Bekkers, R. (2015). Just-in-time patents and the development of standards. *Research Policy*, *44*(10), 1948–1961. https://doi.org/10.1016/j.respol.2015.07.001
Klein, D. A. (1997). Knowledge and Competence as Strategic Assets: Sidney G. Winter. In *The Strategic Management of Intellectual Capital*. Routledge.
Knockaert, M., Ucbasaran, D., Wright, M., & Clarysse, B. (2011). The Relationship Between Knowledge Transfer, Top Management Team Composition, and Performance: The Case of Science–Based Entrepreneurial Firms. *Entrepreneurship Theory and Practice*, *35*(4), 777–803. https://doi.org/10.1111/j.1540-6520.2010.00405.x
Koga, T. (2003). Firm size and R&D tax incentives. *Technovation*, *23*(7), 643–648. https://doi.org/10.1016/S0166-4972(02)00010-X
Krause, R., Wu, Z., Bruton, G. D., & Carter, S. M. (2019). The Coercive Isomorphism Ripple Effect: An Investigation of Nonprofit Interlocks on Corporate Boards. *Academy of Management Journal*, *62*(1), 283–308. https://doi.org/10.5465/amj.2017.0064
Kumar, M. V. S. (2010). Differential Gains Between Partners in Joint Ventures: Role of Resource Appropriation and Private Benefits. *Organization Science*, *21*(1), 232–248.
Lampel, J., Bhalla, A., & Jha, P. (2006). *Back to the Digital Future: The Role of Copyrights in Sustaining Creativity and Diversity in the Music Industry*.
Lampel, J., Bhalla, A., & Jha, P. (2007). *The BASCAP Global Survey on Counterfeiting and Piracy and the Survey Findings Report*.
Landoni, M. (2017). Innovation policy in progress. Institutional intermediation in public procurement of innovation: Satellite telecommunications in Italy. *R&D Management*, *47*(4), 583–594. https://doi.org/10.1111/radm.12246
Langrish, J., Gibbons, M., Evans, W. G., & Jevons, F. R. (1972). *Wealth from Knowledge*. Palgrave Macmillan UK.
Laursen, K., & Salter, A. J. (2014). The paradox of openness: Appropriability, external search and collaboration. *Research Policy*, *43*(5), 867–878. https://doi.org/10.1016/j.respol.2013.10.004
Lavie, D. (2007). Alliance portfolios and firm performance: A study of value creation and appropriation in the U.S. software industry. *Strategic Management Journal*, *28*(12), 1187–1212. https://doi.org/10.1002/smj.637
Lazarova, M. B., & Cerdin, J.-L. (2007). Revisiting repatriation concerns: Organizational support versus career and contextual influences. *Journal of International Business Studies*, *38*(3), 404–429. https://doi.org/10.1057/palgrave.jibs.8400273
Leadership and Management Network Group. (2012). *Leadership and Management in the UK - The key to sustainable growth*. Department for Business Innovation and Skills. http://www.employment-studies.co.uk/resource/leadership-and-management-uk-key-sustainable-growth

Lee, S.-H., Peng, M. W., & Barney, J. B. (2007). Bankruptcy Law and Entrepreneurship Development: A Real Options Perspective. *Academy of Management Review*, *32*(1), 257–272. https://doi.org/10.5465/amr.2007.23464070

Lee, S.-H., Yamakawa, Y., Peng, M. W., & Barney, J. B. (2011). How do bankruptcy laws affect entrepreneurship development around the world? *Journal of Business Venturing*, *26*(5), 505–520. https://doi.org/10.1016/j.jbusvent.2010.05.001

Leung, A., Der Foo, M., & Chaturvedi, S. (2013). Imprinting Effects of Founding Core Teams on HR Values in New Ventures. *Entrepreneurship Theory and Practice*, *37*(1), 87–106. https://doi.org/10.1111/j.1540-6520.2012.00532.x

Lev, B. (2000). *Intangibles: Management, Measurement, and Reporting*. Brookings Institution Press. https://books.google.co.uk/books?id=TzyIDwAAQBAJ

Lev, B. (2018). The deteriorating usefulness of financial report information and how to reverse it. *Accounting and Business Research*, *48*(5), 465–493. https://doi.org/10.1080/00014788.2018.1470138

Loderer, C., Stulz, R., & Waelchli, U. (2017). Firm Rigidities and the Decline in Growth Opportunities. *Management Science*, *63*(9), 3000–3020. https://doi.org/10.1287/mnsc.2016.2478

Lu, J., Liu, X., Wright, M., & Filatotchev, I. (2014). International experience and FDI location choices of Chinese firms: The moderating effects of home country government support and host country institutions. *Journal of International Business Studies*, *45*(4), 428–449.

Malcomson, J. M., Maw, J. W., & McCormick, B. (2003). General training by firms, apprentice contracts, and public policy. *European Economic Review*, *47*(2), 197–227. https://doi.org/10.1016/S0014-2921(02)00207-6

Marquis, C., & Qiao, K. (2020). Waking from Mao’s Dream: Communist Ideological Imprinting and the Internationalization of Entrepreneurial Ventures in China. *Administrative Science Quarterly*, *65*(3), 795–830. https://doi.org/10.1177/0001839218792837

Marrano, M. G., Haskel, J., & Wallis, G. (2009). WHAT HAPPENED TO THE KNOWLEDGE ECONOMY? ICT, INTANGIBLE INVESTMENT, AND BRITAIN’S PRODUCTIVITY RECORD REVISITED. *Review of Income and Wealth*, *55*(3), 686–716. https://doi.org/10.1111/j.1475-4991.2009.00344.x

Marrocu, E., Paci, R., & Pontis, M. (2012). Intangible capital and firms’ productivity. *Industrial and Corporate Change*, *21*(2), 377–402. https://doi.org/10.1093/icc/dtr042

Martinez-Noya, A., Garcia-Canal, E., & Guillen, M. F. (2013). R&D Outsourcing and the Effectiveness of Intangible Investments: Is Proprietary Core Knowledge Walking out of the Door? *Journal of Management Studies*, *50*(1), 67–91. https://doi.org/10.1111/j.1467-6486.2012.01086.x

Marx, M. (2011). The Firm Strikes Back: Non-compete Agreements and the Mobility of Technical Professionals. *American Sociological Review*, *76*(5), 695–712. https://doi.org/10.1177/0003122411414822

Marx, M., & Fleming, L. (2012). Non-compete Agreements: Barriers to Entry … and Exit? In *Innovation Policy and the Economy* (Vol. 12, pp. 39–64).

Mason, C., & Brown, R. (2013). Creating good public policy to support high-growth firms. *Small Business Economics*, *40*(2), 211–225. https://doi.org/10.1007/s11187-011-9369-9

Massingham, P. (2016). Knowledge Accounts. *Long Range Planning*, *49*(3), 409–425. https://doi.org/10.1016/j.lrp.2015.02.003

McKenzie, D., & Woodruff, C. (2014). What Are We Learning from Business Training and Entrepreneurship Evaluations around the Developing World? *The World Bank Research Observer*, *29*(1), 48–82. https://doi.org/10.1093/wbro/lkt007

Menell, P. S. (2019). Economic Analysis of Network Effects and Intellectual Property. *Berkeley Tech. L.J.. Berkeley Technology Law Journal*, *34*(IR), 219.

Mitomo, H. (2017). Data Network Effects: Implications for Data Business. *Competition and Regulation in the Information Age*, 11. https://www.econstor.eu/bitstream/10419/169484/1/Mitomo.pdf

Mitra, D., & Jha, P. (2011). *Social protection in labour markets exposed to external shocks* (pp. 199–231). https://doi.org/10.30875/352a7cef-en

Moen, E. R., & Rosén, Å. (2004). Does Poaching Distort Training? *The Review of Economic Studies*, *71*(4), 1143–1162. https://doi.org/10.1111/0034-6527.00317

Molloy, J. C., Chadwick, C., Ployhart, R. E., & Golden, S. J. (2011). Making Intangibles "Tangible" in Tests of Resource-Based Theory: A Multidisciplinary Construct Validation Approach. *Journal of Management*, *37*(5), 1496–1518. https://doi.org/10.1177/0149206310394185

Monitor Deloitte, Centre for Challenge Prizes, & Nesta. (2015). *The Renaissance of Public Sector Prize Competitions* (p. 5).

Montresor, S., & Vezzani, A. (2022a). Financial constraints to investing in intangibles: Do innovative and non-innovative firms differ? *The Journal of Technology Transfer*, *47*(1), 1–32. https://doi.org/10.1007/s10961-020-09842-1

Montresor, S., & Vezzani, A. (2022b). Financial constraints to investing in intangibles: Do innovative and non-innovative firms differ? *The Journal of Technology Transfer*, *47*(1), 1–32. https://doi.org/10.1007/s10961-020-09842-1

Mudambi, R. (2008). Location, control and innovation in knowledge-intensive industries. *Journal of Economic Geography*, *8*(5), 699–725. https://doi.org/10.1093/jeg/lbn024

Murray, F., & Stern, S. (2007). Do formal intellectual property rights hinder the free flow of scientific knowledge?: An empirical test of the anti-commons hypothesis. *Journal of Economic Behavior & Organization*, *63*(4), 648–687. https://doi.org/10.1016/j.jebo.2006.05.017

Nachum, L., & Zaheer, S. (2005). The persistence of distance? The impact of technology on MNE motivations for foreign investment. *Strategic Management Journal*, *26*(8), 747–767. https://doi.org/10.1002/smj.472

Nahapiet, J., & Ghoshal, S. (1998). Social Capital, Intellectual Capital, and the Organizational Advantage. *The Academy of Management Review*, *23*(2), 242–266. JSTOR. https://doi.org/10.2307/259373

Nelson, R. R. (2004). The market economy, and the scientific commons. *Research Policy*, *33*(3), 455–471. https://doi.org/10.1016/j.respol.2003.09.008

Norkio, Antti, & Piekkola, Hannu (2022). Entrepreneurial Talent and Intangibles Explaining High-Growth Firms. University of Vaasa unpublished paper as part of Globalinto EU 2020 horizon project.

Nunes-Silva, L., Malacarne, A., Macedo, R. F., & De-Bortoli, R. (2019). Generation of intangible assets in higher education institutions. *Scientometrics*, *121*(2), 957–975. https://doi.org/10.1007/s11192-019-03226-5

OECD. (2015). *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development*. OECD. https://doi.org/10.1787/9789264239012-en

OECD. (2019). *ICT investments in OECD countries and partner economies: Trends, policies and evaluation*. OECD. https://doi.org/10.1787/bcb82cff-en

Osinski, M., Selig, P. M., Matos, F., & Roman, D. J. (2017). Methods of evaluation of intangible assets and intellectual capital. *Journal of Intellectual Capital*, *18*(3), 470–485. https://doi.org/10.1108/JIC-12-2016-0138

Patry, W. (1997). The Failure of the American Copyright System: Protecting the Idle Rich. *Notre Dame Law Review*, *72*(4), 29.

Peneder, M. (2010). The impact of venture capital on innovation behaviour and firm growth. *Venture Capital*, *12*(2), 83–107. https://doi.org/10.1080/13691061003643250

Petrick, J. A., Scherer, R. F., Brodzinski, J. D., Quinn, J. F., & Ainina, M. F. (1999). Global leadership skills and reputational capital: Intangible resources for sustainable competitive advantage. *Academy of Management Perspectives*, *13*(1), 58–69. https://doi.org/10.5465/ame.1999.1567322

Piekkola, H. (2018). Broad-based intangibles as generators of growth in Europe. *Economics of Innovation and New Technology*, *27*(4), 377–400. https://doi.org/10.1080/10438599.2017.1376170

Pisano, G. P., & Shih, W. C. (2009, July 1). Restoring American Competitiveness. *Harvard Business Review*. https://hbr.org/2009/07/restoring-american-competitiveness

Quinn, S., & Scur, D. (2021). Management practices and public policy: An overview. *Oxford Review of Economic Policy*, *37*(2), 221–230. https://doi.org/10.1093/oxrep/grab007

Rayna, T. (2008). Understanding the Challenges of the Digital Economy: The Nature of Digital Goods. *Communications & Strategies*, *71*, 24.

Riley, R., & Robinson, C. (2011). Skills and Economic Performance: The Impact of Intangible Assets on UK Productivity Growth. *UK Commission for Employment and Skills*, 110.

Riley, S. M., Michael, S. C., & Mahoney, J. T. (2017). Human capital matters: Market valuation of firm investments in training and the role of complementary assets. *Strategic Management Journal*, *38*(9), 1895–1914. https://doi.org/10.1002/smj.2631

Rindova, V. P., Williamson, I. O., & Petkova, A. P. (2010). Reputation as an Intangible Asset: Reflections on Theory and Methods in Two Empirical Studies of Business School Reputations. *Journal of Management*, *36*(3), 610–619. https://doi.org/10.1177/0149206309343208

Romer, P. M. (1990). Endogenous Technological Change. *Journal of Political Economy*, *98*(5), S71–S102.

Sakakibara, M. (1997). Evaluating government-sponsored R&D consortia in Japan: Who benefits and how? *Research Policy*, *26*(4), 447–473. https://doi.org/10.1016/S0048-7333(97)00018-8

Salavisa, I., Sousa, C., & Fontes, M. (2012). Topologies of innovation networks in knowledge-intensive sectors: Sectoral differences in the access to knowledge and complementary assets through formal and informal ties. *Technovation*, *32*(6), 380–399. https://doi.org/10.1016/j.technovation.2012.02.003

Scillitoe, J. L., & Chakrabarti, A. K. (2010). The role of incubator interactions in assisting new ventures. *Technovation*, *30*(3), 155–167. https://doi.org/10.1016/j.technovation.2009.12.002

Silva, F., Menon, C., Falco, P., & MacDonald, D. (2019). *Structural adjustment, mass lay-offs and employment reallocation*. OCDE. https://doi.org/10.1787/90b572f3-en

Singer, P. L. (2014). *Federally Supported Innovations*. Information Technology and Innovation Foundation. https://itif.org/publications/2014/02/03/federally-supported-innovations

Spithoven, A., & Teirlinck, P. (2015). Internal capabilities, network resources and appropriation mechanisms as determinants of R&D outsourcing. *Research Policy*, *44*(3), 711–725. https://doi.org/10.1016/j.respol.2014.10.013

Su, Y.-S., & Hung, L.-C. (2009). Spontaneous vs. policy-driven: The origin and evolution of the biotechnology cluster. *Technological Forecasting and Social Change*, *76*(5), 608–619. https://doi.org/10.1016/j.techfore.2008.08.008

Subramaniam, M., & Youndt, M. A. (2005). The Influence of Intellectual Capital on the Types of Innovative Capabilities. *The Academy of Management Journal*, *48*(3), 450–463. JSTOR. https://doi.org/10.2307/20159670

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, *15*(6), 285–305. https://doi.org/10.1016/0048-7333(86)90027-2

Teece, D. J. (1998). Capturing Value from Knowledge Assets: The New Economy, Markets for Know-How, and Intangible Assets. *California Management Review*, *40*(3), 55–79. https://doi.org/10.2307/41165943

Teece, D. J. (2000). Strategies for Managing Knowledge Assets: The Role of Firm Structure and Industrial Context. *Long Range Planning*, *33*(1), 35–54. https://doi.org/10.1016/S0024-6301(99)00117-X

Teece, D. J. (2006). Reflections on "Profiting from Innovation." *Research Policy*, *35*(8), 1131–1146. https://doi.org/10.1016/j.respol.2006.09.009

Teece, D. J. (2015). Intangible Assets and a Theory of Heterogeneous Firms. In A. Bounfour & T. Miyagawa (Eds.), *Intangibles, Market Failure and Innovation Performance* (pp. 217–239). Springer International Publishing. https://doi.org/10.1007/978-3-319-07533-4_9

Terwiesch, C., & Xu, Y. (2008). Innovation Contests, Open Innovation, and Multiagent Problem Solving. *Management Science*, *54*(9), 1529–1543.

Thum-Thysen, A., Voigt, P., Bilbao-Osorio, B., & Maier, C. (2017). *Unlocking Investment in Intangible Assets* (Discussion Paper No. 047; p. 60). European Commission. https://ec.europa.eu/info/sites/default/files/economy-finance/dp047_en.pdf

Tseng, C.-Y., & James Goo, Y.-J. (2005). Intellectual capital and corporate value in an emerging economy: Empirical study of Taiwanese manufacturers. *R&D Management*, *35*(2), 187–201. https://doi.org/10.1111/j.1467-9310.2005.00382.x

Uyarra, E., & Ramlogan, R. (2012). *The Effects of Cluster Policy on Innovation*. University of Manchester. https://doi.org/10.22163/fteval.2012.88

Veer, T., Lorenz, A., & Blind, K. (2016). How open is too open? The mitigating role of appropriation mechanisms in R&D cooperation settings. *R&D Management*, *46*(S3), 1113–1128. https://doi.org/10.1111/radm.12232

Villalonga, B. (2004). Intangible resources, Tobin's q, and sustainability of performance differences. *Journal of Economic Behavior & Organization*, *54*(2), 205–230. https://doi.org/10.1016/j.jebo.2003.07.001

von Hippel, E. (1986). Lead Users: A Source of Novel Product Concepts. *Management Science*, *32*(7), 791–805. https://doi.org/10.1287/mnsc.32.7.791

Wall, A. (2005). The measurement and management of intellectual capital in the public sector. *Public Management Review*, *7*(2), 289–303. https://doi.org/10.1080/14719030500091723

Wang, L., Sheng, S., Wu, S., & Zhou, K. Z. (2017). Government role, governance mechanisms, and foreign partner opportunism in IJVs. *Journal of Business Research*, *76*, 98–107. https://doi.org/10.1016/j.jbusres.2017.03.009

Warhurst, C. (2008). The knowledge economy, skills and government labour market intervention. *Policy Studies*, *29*(1), 71–86. https://doi.org/10.1080/01442870701848053

Webster, E. (2000). The growth of enterprise intangible investment in Australia. *Information Economics and Policy*, *12*(1), 1–25. https://doi.org/10.1016/S0167-6245(99)00024-4

Wen, H., & Moehrle, S. R. (2016). Accounting for goodwill: An academic literature review and analysis to inform the debate. *Research in Accounting Regulation*, *28*(1), 11–21. https://doi.org/10.1016/j.racreg.2016.03.002
West, J., Salter, A., Vanhaverbeke, W., & Chesbrough, H. (2014). Open innovation: The next decade. *Research Policy*, *43*(5), 805–811. https://doi.org/10.1016/j.respol.2014.03.001
Witt, U. (2000). Changing cognitive frames - changing organizational forms: An entrepreneurial theory of organizational development. *Industrial and Corporate Change*, *9*(4), 733–755. https://doi.org/10.1093/icc/9.4.733
World Intellectual Property Organization (Ed.). (2015). *The Intersection of Intellectual Property Rights and Innovation Policy Making—A Literature Review*. World Intellectual Property Organization (WIPO). https://doi.org/10.34667/tind.28863
Yang, C.-C., & Lin, C. Y.-Y. (2009). Does intellectual capital mediate the relationship between HRM and organizational performance? Perspective of a healthcare industry in Taiwan. *The International Journal of Human Resource Management*, *20*(9), 1965–1984. https://doi.org/10.1080/09585190903142415
Zéghal, D., & Maaloul, A. (2011). The accounting treatment of intangibles – A critical review of the literature. *Accounting Forum*, *35*(4), 262–274. https://doi.org/10.1016/j.accfor.2011.04.003
Zhang, H., Liang, X., & Wang, S. (2016). Customer value anticipation, product innovativeness, and customer lifetime value: The moderating role of advertising strategy. *Journal of Business Research*, *69*(9), 3725–3730. https://doi.org/10.1016/j.jbusres.2015.09.018
Zimmerman, J. L. (2015). The role of accounting in the twenty-first century firm. *Accounting and Business Research*, *45*(4), 485–509. https://doi.org/10.1080/00014788.2015.1035549