Best Practices as to How to Support Investment in Intangible Assets

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Abstract

Intangible investment is an indispensable factor in the projected socio-ecological transition towards a new European path of economic growth. Its concern with knowledge-based intangible assets highlights the innovation-driven formation of a knowledge-based economy, which is at the heart of current EU strategies for the promotion of sustainable growth. The policy report will summarise best practices of supporting investments in intangible assets in the EU member states at the level of firms, industries and countries as a whole. In proceeding with this work, the policy report will draw on insights that were developed in preceding FP7 projects, in particular COINVEST. This allows for an understanding of intangible investment as investment in intangible assets that provide firm-specific flows of knowledge services. These involve both formal and tacit knowledge in diverse areas such as firm-funded investment in R&D, education and training, software and databases as well as design and branding, accompanied by mechanisms of inter-firm cooperation in the management of knowledge assets. The diverse strategies and policies in support of intangible investment across the EU are going to be assessed on the basis of available cases and data about best practices. The resulting policy report is set to sort out those strategies and policies that provide the most effective support of intangible investment in the formation of a socio-ecologically sustainble knowledge-based economy.

Contribution to the Project

The planned work will contribute to the central question how technological, organisational and social innovations may be supported in a manner that shifts the focus of innovation in line with the socio-ecological transition towards a new European path of economic growth. In so doing, the planned work focuses on best practices in support of investment in intangible assets, perceived in terms of firm-specific assets that reflect flows of productive services from both formal and tacit knowledge. Intangible investment is subject to national, regional as well as sectoral and industrial variations that stimulate diverse trajectories of innovation. Therefore, the identification of best practices in support of intangible investment is crucial for the formulation of a new European growth strategy that combines knowledge-based intangibles with sustainable patterns of innovation.

Keywords:

Economic growth path, High road strategy, Innovation, Intangible assets, Social capital as growth driver, Socio-ecological transition

Jel codes:

D22, D83, M19

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Tables and Figures

Executive Summary

The current transition towards a knowledge-based economy goes hand in hand with the shift of strategic investment from tangible to intangible assets. These intangibles define the knowledge base of firms and industries. They emerge as major factors in the shaping of competitive advantages and innovativeness, including a wide range of investment in domains such as computerised databases, R&D, intellectual property rights, and workforce training schemes. Empirical evidence hints at a positive correlation between investment in intangible assets and productivity change across firms and industries. Therefore, viewed in the context of the evolving European economic model, intangible assets may play an important role in the attainment of a new path of economic growth that focuses on environmental and social sustainability while maintaining international competitiveness. In this manner, policies in support of investment in intangible assets are set to provide key incentives in the transition of the European economies towards a knowledge-based path of sustainable growth.

This policy report addresses intangible assets in terms of three basic components that constitute the knowledge base of the firm while upholding a focus on technological and organisational innovation as driving force of economic growth. These components of intangible assets are:

- Computerised information.
- Innovative property.
- Economic competencies.

The policy report sets out to collect best-practice policy measures that successfully support investment in intangible assets. These measures reflect a new type of comprehensive industrial policy that aims at cooperative efforts of public and private sector while combining policy fields in industry, technology, science, education and training in order to provide an adequate framework for innovation.

Policy mechanisms in support of investment in intangible assets cover a broad range of initiatives and schemes that are meant to advance the knowledge base of firms by means of tackling investment in computerised information, innovative property and economic competencies. In more detail, the assessment of policy support of investment in computerised information addresses primarily the provision of information and communication technologies infrastructures. Policy support of investment in innovative property copes with a broader range of policy practices involving fiscal incentives for R&D investment, the promotion of intermediate research and technology organisations as well as collaborative public-private research networks, the provision of information on intellectual property rights, and support of entrepreneurial start-ups. Policy support of investment in economic competencies then addresses financial and fiscal incentives for workforce training as well as the provision of information and consulting for management.

The provision of infrastructures is a key rationale of public policy. When it comes to intangible assets, these infrastructures include those associated with information and communication technologies, yet they also include infrastructures in science, education and training. In effect, most of the surveyed policy fields are concerned with issues such as the promotion of research collaborations and knowledge transfer involving business firms, universities, and research institutes, and aiming at a sustained commercialisation of the results of R&D by means of product and process innovations. Innovative property thus stands for the actual strategic business challenges posed by technological innovation. Yet also the knowledge related to the human capital accumulated in firms is in need of persistent renovation. This is the subject matter of policies that are meant to stimulate investment in economic competencies. Most prominent policy instruments for supporting investment in all of these intangible assets highlight financial and fiscal incentives that directly address the investment decision of firms. The reduction of tax burdens stands for a policy mechanism that directly feeds into the cost calculations of firms as it affects expected returns on investments. In this setting, support for entrepreneurial start-ups and competitive small and medium-sized enterprises matters as a domain in its own right, because these firms play an important role in the creation of employment opportunities and they also provide a promising organisational terrain of innovation. It is in particular with regard to these firms that policy initiatives provide services for coping with intellectual property rights, which become a key issue in the ever more complex technological setting of the knowledge-based economy.

The surveyed European economies – Finland, Germany and the United Kingdom – each stand for a particular institutional type of market economy with distinct governance patterns, industrial structures, and modes of innovation:

- The Finnish innovation system exhibits major advances in building a knowledge-based and service-oriented economy by means of combined infrastructural and institutional provisions that highlight information and communication technologies as key technologies for the evolving knowledge-based economy. Accordingly, the survey puts an emphasis on policy efforts for intangible investment in computerised information.
- The national innovation system of the United Kingdom comes together with a liberal type of service-oriented market economy, which serves as institutional and industrial backbone for major policy thrusts that draw on the utilisation of university-industry relations in science-based industries such as biotechnology. The analytical focus of the survey thus focuses on policies supporting intangible investment in innovative property.
- Germany's innovation system is embedded in the institutional setting of a coordinated market economy that combines market and relational modes of governance with an industrial specialisation in medium-tech manufacturing industries such as automotive. Efforts in applied R&D draw on intermediate research and technology organisations and regional clusters of industries. In this

regard, the survey highlights policies supporting intangible investment in economic competences.

In summary, polices in support of investment in intangible assets are a key aspect in the transition of the European economies towards a sustainable path of economic growth that combines employment and innovation in a socially inclusive manner. Governments on various policy levels play an important role in the design, coordination, and implementation of these efforts in the formation of a new growth path. The following analysis of Europe’s best practice policies in support of investment in intangible assets accounts for the institutional complexity that stems from the underlying cooperation between science, research and industry in both public and private sector. The outline of a proactive action plan, which concludes this report, takes these aspects into account and formulates key concerns for European policy-makers.

1. Approaching intangible assets

1.1 Intangible assets and economic growth

During recent decades, and in particular following the financial crisis of 2008-2009, policy makers across the European Union and beyond have been increasingly concerned with fostering a sustainable path of economic growth that provides new employment opportunities and a socially inclusive mode of operation while maintaining the international competitiveness of firms and industries. This strategic target brings economic areas like knowledge-intensive business activities to the fore (Warwick, 2013: 7). The corresponding transition drive towards a knowledge-based economy, which puts the knowledge base of firms in the centre of innovation and competition strategies, actually goes hand in hand with the shift of investment patterns from tangible to intangible assets. Indeed, this shift of investment activities has been identified as a striking trend that appeared in the mid-1990s and persists ever since (Corrado et al., 2012; Buigues, Jacquemin and Marchipont, 2000; Webster, 1999). Current structural changes in the high-performing industrialised economies seem to point at the vision of such a knowledge-based economy that is built on the application of intangible information technology with inputs and outputs increasingly becoming intangible (Arthur, 2011).

Intangible assets thus depict a new empirically valid tendency regarding the spending of firms on their knowledge base as means to further their competitive advantages. Intangible capital emerges as a form of business investment that exhibits a remarkable increase while it serves the economic growth of advanced high-performing economies as a key contributor to the innovativeness and competitiveness of firms and industries, which becomes manifest in productivity increases over time. When highly developed industrialised economies evolve into knowledge economies, therefore, intangible capital emerges as a key factor in maintaining international competitiveness of firms and industries, thus determining the competitive position of regional and national economies (Corrado, Haltiwanger and Sichel, 2005; Subramaniam and Youndt, 2005; Teece, 1998).

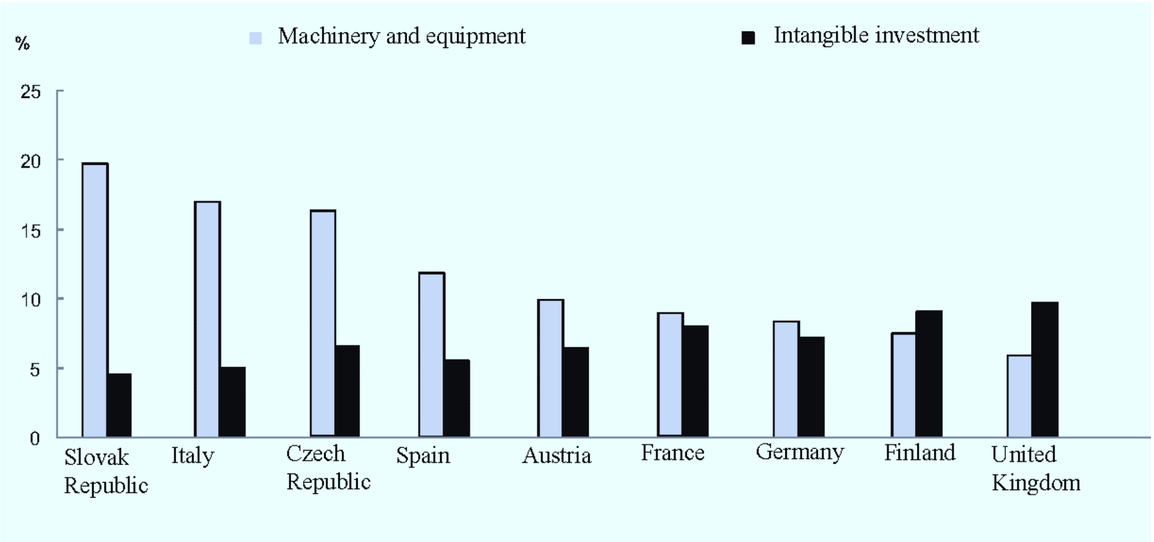
The process of creating and applying knowledge in the shape of technological innovation becomes ever more crucial for firms that need to sustain competitive advantages in an economic environment that puts a premium on knowledge-based business operations. Indeed, the knowledge-base of firms and industries is the decisive platform for proceeding with the evolution of a learning economy that faces new economic and ecological as well as social challenges in a globalised market setting (Lundvall et al., 2002: 227). As the intangible nature of an asset refers to its essentially knowledge-based character, so the terms “knowledge based capital” and “intangible assets” are commonly used interchangeably (Hulten, 2013). This growth promoting nature of intangible assets is intrinsically linked to the impact of increasing returns of knowledge, for the initial costs in the promotion of certain types of knowledge are not incurred again when this knowledge is re-used during the productive process. Knowledge resembles a semi-public good. The latter aspect is a key insight of recent theorizing on technological innovation, industrial change and economic growth, as discussed in diverse strands of economic reasoning (Nelson and Romer, 1996).

A key indicator of the intangibles-productivity-growth nexus seems to be the actual performance of labour productivity. OECD data suggest that intangible assets contribute to labour productivity growth and possibly serve as an explanation for large shares of multifactor productivity growth (OECD 2010a: 21). In corresponding terms, a positive and significant relationship between business investments in intangibles and overall economic labour productivity growth has been confirmed in empirical analyses, which suggest that intangible capital investment can explain a significant portion of the unexplained international variance in labour productivity growth, and thus markedly diminishes the unexplained part of labour productivity growth (Roth and Thum, 2010). In line with these findings, it has been estimated that intangibles account for up to 75% of the average growth of market sector labour productivity in the European economies (Corrado et al., 2012: 38).

When it comes to patterns of investment in intangible assets, however, intra- and international differences in investment levels and areas prevail, quite in line with different economic structures, institutional settings and related developmental paths to the knowledge-based economy. Indeed, a plausible explanation for persistent productivity differentials across plants and firms operating in the same region is provided by differences in the prevailing investment in intangible assets; the same line of interpretation applies to international performance profiles (OECD, 2013a: 24). In some Scandinavian and Anglo-Saxon countries, investment in intangible assets is already equal or even superior to investment in tangibles such as machinery and equipment. Moreover, in many OECD countries, investment in intangible assets has actually grown as a share of GDP while investment in tangibles has stagnated or even declined. Of course, these diverse patterns of investment in intangibles reflect differences in industrial as well as technological and organisational structures, which stand for distinct pathways of specialisation in the formation of competitive advantages (OECD, 2010b).

Figure 1 depicts the relations in volume between the types of investment dedicated to fixed and intangible assets across selected European economies in the year 2006. Clearly, high performing service-oriented economies such as the United Kingdom and Finland stand out with regard to the prevalence of investment in intangibles. Yet also the more manufacturing-oriented economies of Germany and France show a considerably high level of investment in intangible assets. Economies with a dedicatedly more traditional industrial outlook, however, such as the Slovak Republic, the Czech Republic, Italy, Spain and even Austria still exhibit a dominant pattern of investment in tangibles. Thus, while positive correlations between investment in intangible capital and economic outcomes might suggest that the facilitation of investment in intangibles should be part of an overall growth strategy, it still needs to be considered that the outreach of these kinds of investment need to reflect the actual industrial structure under consideration. Thus, there may be multiple options and opportunities in the formation of a knowledge-based economy by means of promoting investment in intangible assets.

Figure 1 **Investment in fixed and intangible assets as a share of GDP, 2006**



Source: Adapted from OECD (2010b: 32, Figure 2.1).

The strategic role of intangibles in the European path of economic growth is factually recognised in the Lisbon strategy and has been adopted by the "Europe 2020" strategy for smart, sustainable and inclusive growth by the European Commission (2010). In effect, intangibles are identified as major determinants of efforts in the carrying out of technological innovation and the enhancement of economic growth, employment and competitiveness in the European Union (Roth and Thum, 2012). At this point, the comparatively poor performance of the European economies regarding the generation of economic growth before and after the recent financial crisis at the end of the 2000s emphasizes the urgency of policies that are meant to combine ongoing concerns with economic growth and international competitiveness by pushing for improvements in factor productivity that adequately account for the role of intangibles. As investment in intangible assets is set to boost labour productivity across the European economies, which suggests that policies in support of these productivity-enhancing intangibles becomes a new priority domain in the European Union.

Such a workable policy approach targets tangible assets as factors in promoting the competitiveness of firms and industries. Right at the outset, it needs to be kept in mind that the term "competitiveness" has been repeatedly misused in the narrow sense of price and cost competitiveness, which has led to the notion that reducing wages or taxes would be the single way of promoting competitive efforts. Instead of such a "low road" to competitiveness, however, a more promising strategy entails an enhancement of the knowledge-based capabilities of firms which are said to determine productivity and thus the long-term economic success of high-income countries. A productivity-enhancing policy-approach that accounts for the role of intangibles can support the transition to a new path of sustainable growth and development in line with a socially inclusive and ecologically less resource-intensive "high road" to competitiveness (Aiginger et al., 2013). Moreover, a key aspect with regard to boosting the competitiveness of firms and industries lies in their ability to innovate, whereby the creation, diffusion and application of technological knowledge play a decisive role. In order to foster innovation processes, policies should reach beyond the dimension of science and technology in recognition of the fact that innovation involves a wider range of knowledge investment with complex implications for the innovation performance of the involved firms (OECD, 2010b). A broad understanding of technological innovation thus needs to reconsider the link between the knowledge base of the firm and its overall competitive performance. Recent research findings thus emphasise the link between the organisational capability of a business firm to innovate and its ability to strategically utilise its available knowledge resources, which may be explored in terms of intangible assets (Subramaniam and Youndt, 2005).

While it is actually quite commonly sensed that intangible assets play a major role in achieving future growth and competitiveness, still the question as to how to measure them raises comprehensive theoretical and methodological problems that are also highly relevant for the design of policies that target investment in intangibles (Van Ark et al., 2009). The inherent nature of intangible assets makes them difficult to measure physically and to evaluate them in monetary terms. Consequently, it is hard to design policies aimed at exploiting such investments by outlining distinct policy instruments and targets. The evaluation of the effectiveness of such policies in support of investment in intangibles is a related problem (DSTI et al., 2011; DSTI et al., 2012). All of this pinpoints the need for a further scrutiny of the conceptualisation of intangibles assets.

1.2 Conceptualisation of intangible assets

In outlining a workable approach to intangible assets, it is useful to differentiate between the micro-level of the firm level and the macro-level of the economy as a whole. As a point of departure, one may stress that the knowledge resources of the firm, which altogether provide the economic substance of its intangible assets, actually constitute a mixture of explicit and tacit knowledge, codified information and intrinsic know-how that is rooted in the experience and expertise of the individuals who are part of an organisation. This knowledge base of the firm can be specifically documented and communicated, or it may be based on the intuition of individual decision makers (Carayannis, 2004). The question is, however, how the corresponding set of intangible assets is to be measured and evaluated. The international accounting standard defines intangible assets as non-monetary assets, which are identifiable and without physical substance (International Accounting Standard Committee, 1998). This definition provides a first approximation to the problem of calculation, yet current attempts in accounting to determine the value of these kinds of intangibles are not proceeding in a satisfactory manner (Zégal and Maaloul, 2011). In fact, a professional consensus regarding the exact composition and measurement of intangible assets does not exist. The combination of formal and tacit knowledge in the formation of intangible assets remains problematic by itself, for it hints at methodological problems concerning the valuation of knowledge in both its objective and subjective dimensions that are difficult to overcome in a consistent manner.

The macro-perspective on intangible assets addresses their role for economic growth at large. In fact, the corresponding problems of accounting for intangibles as genuine factors of economic growth have been addressed at an early stage of the debate on intangibles. The System of National Accounts originally employed by the United Nations, which is intended for international use as a statistical framework for macroeconomic accounts has actually contributed to the methodological discussion in a most relevant manner. In this view, the first step is to determine whether or not an outlay can be accounted for as an investment into intangibles. Therewith, a differentiation between current production costs and expenditures that expand future productive capacity is made. If the expected service life of an outlay exceeds one year, national accountants usually treat the expenditures as an investment. With regard to intangibles, the System of National Accounts recommends treating the costs of producing artistic originals, computer software, and the expense of mineral exploration as fixed investments. More recently, the conduct of R&D activities was added to this international accounting standard (Corrado et al., 2012: 11).

Complementing these efforts, the OECD has been taking on a pioneering position in outlining diverse national systems and practices in accounting on intangibles. In a pioneering effort, a workshop on the measurement of intangible investment investigated the corresponding efforts of six countries, namely Finland, Sweden and Norway accompanied by the United Kingdom, France, and the Netherlands. Finland and Norway conducted special surveys using a tailor-made questionnaire, Sweden added additional questions on software, R&D and marketing to a regular industrial survey, and the studies put together in France, the Netherlands and the United Kingdom combined data from existing sources in a new format (OECD, 1998). Subsequent analytical contributions have tried to combine theoretical and empirical advances by outlining both the prospects and limits of these kinds of macroeconomic accounting efforts (Nakamura, 2001; Corrado, Haltiwanger and Sichel, 2005; Corrado, Hulten and Sichel, 2009). Nonetheless, although national accounting standards across the OECD world and beyond have begun to account for investments into intangibles such as software and R&D in recent decades, many aspects of intangible investment still remain ignored in the actually employed accounting standards (OECD, 2010b).

An essential contribution to a broader understanding of investment in intangibles has been delivered by Corrado, Haltiwanger and Sichel (2005), who address the relevance of intangible asset measures for the analysis of economic growth as well as for national accounting practices. By means of a reconsideration of a wider concept of innovation and in view of a practical revision of the national accounting framework, they have grouped the various items that constitute intangible assets into three basic categories. These categories are:

- computerised information,
- innovative property,
- economic competencies.

In fact, this classification has emerged as the conceptual basis for most of the subsequent discussions on empirical approaches to the exploration of the knowledge base of firms and industries (Hulten, 2013: 6). It is also used in the following exposition of policies in support of investment in intangible assets.

These three categories of intangibles can be further differentiated in terms of asset types, whereby the resulting list of categories addresses issues such as the valuing of assets for a company under scrutiny, or tax guidelines for reporting the value of financial assets following a corporate merger or acquisition (Corrado et al., 2013: 271n.). These categories indicate that the potential of intangibles for stimulating productivity growth lies in the provision of knowledge to be utilised within the involved firms, involving the generation and transfer of knowledge as well as its legal protection and the appropriability of its returns in terms of property rights. All of this is meant to practically promote competitive effects such as an increase in the market penetration of a product or an improvement of the productive environment for the actual physical production of a product or service (Roth and Thum, 2010: 2). Therefore, the actual knowledge dimension of products and services informs the qualities of intangible assets and their role in the competitive dynamism of the firm and its business environment (Van Ark et al., 2009). This is confirmed by complementary conceptual frameworks such as the notion of knowledge-based capital that is currently put to use by the OECD, among others (OECD, 2013a). This concept basically reiterates the three categories of intangibles as suggested by Corrado, Haltiwanger and Sichel (2005), as it differentiates even more kinds of asset types in order to further elaborate on the concept of intangibles.

Table 1 shows the different types of intangible assets together with their projected effects on the investors of the assets. The first category of computerised information reflects knowledge embedded in computerised information. Sub-categories that grasp this aspect are computer software and databases. The category of software can be further divided into purchased and own-account software, which illustrates the distinction between knowledge generated inside the firm and external knowledge transfer that requires internal adaptation (Corrado et al., 2013: 272). Crucially, reflecting current trends in the domain of computing, the importance of databases is likely to grow with the increased interest in so-called big data that allow for the computation of ever increasing data volumes (McKinsey Global Institute, 2011). The corresponding mechanisms of positive effects for firms investing in intangible assets are as follows. In the case of software, these effects may include improved process efficiency, accompanied by the ability to spread process innovations more quickly based on potentially improved communication structures in vertical and horizontal integration. In the case of databases, investors may benefit from an improved understanding of consumer needs and an increased ability to tailor products and services to meet them. Also, databases may contribute to optimised governance structures in vertical and horizontal integration.

Table 1 **Classification of intangible assets and effects on investors**

Type of intangible asset	Positive effect on investors performance
Computerised information	
Software	• Improved process efficiency. • Capability to diffuse process innovation more quickly. • Improved vertical and horizontal integration.
Databases	• Improved understanding of consumer needs and ability to tailor products and services to meet them. • Optimised vertical and horizontal integration.
Innovative property	
Research and development	• New products, services and business processes, and quality improvements to existing ones. • New technologies. • Improved capabilities for technology transfer. • New scientific knowledge.
Mineral explorations	• Information on location and access of new resource inputs.
Copyright and creative assets	• Artistic originals, designs and other creative assets for future licensing, reproduction or performance. • Diffusion of new ideas with commercial applications.
New product development in financial services	• More accessible capital markets. • Reduced information asymmetry and monitoring costs.
New architectural and engineering designs	• New designs with commercial applications. • Product and service quality improvements • Improved business processes.
Economic competencies	
Brand-building advertisement	• Improved consumer trust by communication of quality. • Consumer identification in product innovation.

Market research	• Improved understanding of consumer needs and ability to tailor products and services accordingly.
Workforce Training	• Improved productive capability and skill levels. • Improved adaptation to innovations.
Management consulting	• Externally acquired improvement in internal decision-making and business processes.
Own organisational investment	• Internal improvement in decision-making and business processes.

Source: Adapted from OECD (2013a: 12, Table 1) and Corrado, Haltiwanger and Sichel (2005).

The second category of intangible assets depicted in Table 1 comprises of innovative property. The essential part of the concept is the differentiation between scientific and non-scientific R&D. Scientific R&D involves industrial knowledge that becomes protected by means of intellectual property rights in patents or licenses. Such science-based R&D operations are prominently covered in empirical research efforts on R&D. The definition of the corresponding data commonly includes expenditures on design and development of new products and processes as well on the enhancement of existing products and processes, carried out by persons formally trained or experienced in related types of science, ranging from physical sciences, via biological sciences to engineering and computer science. However, apart from this emphasis on science-based R&D, also more applied types of research and actual modes of process and product development need to be taken into account, although they are more difficult to measure and asses due to the particularly high degrees of tacit knowledge going into these innovations. At the same time, R&D affects the knowledge base of the firm in two distinct knowledge segments. It may improve organizational capabilities for technology transfer in general, while it can also add new scientific knowledge that flows into the corresponding science and research system.

When it comes to the investor effects of R&D, then, it is useful to distinguish new products, services and business processes as well as quality improvements to existing ones as a more gradual contribution of intangibles to economic performance, while the introduction of new technologies emanating from R&D may come together with a more disruptive impact for the innovating firm. This amounts to a differentiation of incremental and radical innovative capabilities in terms of capabilities to refine and reinforce existing products and services as distinct from capabilities significantly transform existing products and services (Subramaniam and Youndt, 2005: 452). Obviously, the effects of these different forms of innovative capabilities differ markedly. Radical innovations can cause established technologies to become obsolete, which may imply a short-term loss of employment opportunities, but they also have the potential to generate new markets and employment opportunities that can pave the way for further improvements in existing technologies.

Yet the innovative property of intangible assets is not to be reduced to the domain of R&D proper. Indeed, following the outline of intangible assets proposed by Corrado, Haltiwanger and Sichel (2005), further sub-categories are to be added to the domain of innovative property. They include mineral explorations as an input device, copyright and creative assets like innovative and artistic content in commercial designs, new products in financial services, and new architectural and engineering designs. In this way, a broader conception of intangible assets illustrates the different sources of the knowledge base of firms and industries as it is utilised in the competitive endeavours of the market process. Investment in mineral explorations is said to promote information on access to new resource inputs. In this vain, an innovative restructuring of supply-chains may be feasible. The matter of intellectual property rights comes to the fore once again when it comes to investment in copyright and creative assets, which may result in artistic originals, designs and other creative assets that can be utilised for future licensing, reproduction or performance. Also, they may contribute to the diffusion of new ideas with commercial applications. In a similar manner, investment in new architectural and engineering designs may yield new designs with commercial applications as well as actual product and service quality improvements, which can inform basic improvements of business processes. Finally, investment in new product development in financial services also adds to the domain of innovative property. It may promote more accessible capital markets, accompanied by reduced information asymmetry and monitoring costs for investors.

The third category of intangible assets denotes economic competencies of the firm. It comprises of a wider range of knowledge assets that firms invest in, in order to run their businesses in a competitive market setting. The notion of economic competencies thus refers to a meaning of intangibles that goes beyond the idea of human capital and involves broader concerns with internal and external knowledge flows that are internalised in the organisational routines of the firm (Corrado et al., 2012: 27). In this vain, intangible assets of economic competencies highlight the broader knowledge base of the firm in terms of workforce training, management consulting and the general upgrading of organisational capabilities, paralleled by capabilities in improving market knowledge as well as consumer and customer relations. Workforce training stands out as a key domain of investment in intangible assets in general. It addresses the skills and capabilities of the workforce, which can be augmented by investment in corresponding training programmes that enhance firm-specific human capital and thus add to the knowledge base of the firm in its distinct competitive environment (Corrado et al., 2013: 273). Crucially, the range of this intangible asset reaches beyond the productive domain of the traditional shop-floor. In fact, also the quality of management may be affected by targeted measures in education and training that are meant to upgrade a firm’s endowment with human capital (Bloom and Van Reenen, 2006). Expected returns on these investments in workforce training may include improved productive capabilities and skill levels, which then also allow for an improved adaptation to innovations in a potentially volatile technological and market context.

Further modes of enhancing the knowledge base of the firm relate to investment in management consulting, which may result in the improvement of decision-making and business processes by knowledge transfer from external sources. This externally mobilised and purchased knowledge component is measured by the management consultant fee. Adding to this particular kind of intangible asset, also internal organisational investment matters, for it also improves capabilities in decision-making and governing business processes. The own-account component of this category is represented by the value of executive time spent on improving the effectiveness of business organisations. Examples are the managerial development of business models or corporate cultures. Market research also adds to the knowledge base of the firm as it allows for an improved understanding of consumer needs and enriches the ability to tailor products and services accordingly. A further component of economic competencies that relates to the market setting is brand-building advertisement, which can improve consumer trust and attachment to established as well as new products of the firm. In accounting terms, it encompasses the costs of launching new products, developing customer lists and maintaining brand equity (Corrado, Haltiwanger and Sichel, 2005: 28). The effects of these kinds of intangible assets on the market performance of firms are illustrated by empirical evidence which suggests that an increase of 10% in design expenditures results in an increase of 3.5% in the sale of a firm’s new products. An increase of 10% in marketing expenditures boosts innovative sales by 7%. All of this confirms the positive effects design and marketing on the competitive position of innovative firms, which need to introduce customers and consumers to product novelty (Ciriaci and Hervas, 2012).

In view of this array of components, it is fair to suggest that intangible assets contribute to economic growth in a complex manner. Indeed, investment in intangible assets is set to entail spill-over effects across firms and industries that may be viewed as source of positive externalities with growth-enhancing effects. As knowledge generated in one firm or industry may spill over into other parts of the economy, so it is evident that even those firms that do not invest in intangible assets by themselves may benefit from the knowledge originally created by other firms – while they do not need to share the original costs incurred by the creation of this particular knowledge. In spite of ubiquitous methodological difficulties in estimating these kinds of knowledge spill-over effects, recent empirical studies have shown that they are quite common in the OECD economies, among others in the fields of R&D, workforce training, design, and brand equity, all of which stand for main areas of intangible assets (OECD, 2013a: 21). Accordingly, it has become common to address spill-over effects as major factors of a knowledge-based type of economic growth that utilises the intangible assets of firms in order to expand production possibilities by introducing innovations (Aiginger, 2007: 314).

These issues also involve a most relevant spatial dimension. Knowledge spill-over effects are usually facilitated in localised agglomerations of firms that share a similar knowledge base. Concerning the effects of the underlying intangible assets, then, it is empirically evident that significant spill-over effects exist that can be associated with the spatial agglomeration of regional human capital and complementary organizational capabilities. These agglomerations remain relevant for most European economies and serve as locational advantages in an international market context. Yet they are also increasingly relevant in other domains of the world economy, in particular in the high-performing economies of East Asia (Ebner, 2013). A geographical concentration of firms with distinct knowledge bases also facilitates knowledge spill-over effects from research institutes and universities. Academic spin-off firms are likely to have local university advisers and related investors. Areas where universities are actively promoting research develop specialized expertise that may be translated into industrial specialization (Smith and Bagchi-Sen, 2006: 374). Both the cumulative character and local specificity of knowledge imply that intangible assets are partially very difficult if not at all impossible to replicate. Particularly, the replication of economic competencies such as firm-specific skills and capabilities is a strategic challenge for competitors and partners alike. Economic competencies are usually firm-specific, non-tradable and built up through in-house accumulation over time (OECD, 2013a: 24). However, the same does not apply to all kinds of intangible assets. In the case of computerised information, it is obvious that the transfer and replication of knowledge are constitutive for this intangible asset. This quality refers to the fact that computerised information draws on formalised and codified knowledge that is easier to transfer than the comparatively high degree of tacit knowledge implicit in other intangibles (Castaldi et al., 2009: 67).

By strategically investing in the kinds of intangible assets that are difficult to transfer and replicate it is therefore possible for companies to strengthen competitive advantages, which are difficult to emulate by competitors. Indeed, a firm’s unique history of investment in economic competencies leads to a sort of path dependency that makes it almost impossible for competitors with different histories to completely imitate the range of intangible assets employed by the firm (Ciriaci and Hervas, 2012). On the other hand, however, globalization has unleashed the international mobility of key segments of the intangible assets of the firm. This applies to formalized knowledge in the format of software and databases, among others, but it also relates to the mobility of specialist workforce in R&D departments or the offshoring of R&D in general. In this manner, a global competition for intangible assets has been ensuing in recent decades, which strives for their transfer and adaptation in an ever more extensive manner (OECD, 2014: 39).

The latter aspect points to the concern with complementary effects that possibly result from investment in intangibles. In order to successfully maintain their competitiveness, firms may benefit from a range of complementary activities that include, for example, organisational changes, firm-level workforce training, marketing and design as crucial elements. This matter of complementarity boils down to the relationship between new technologies and their institutional adaptation. It should be kept in mind that the attention to complementary investments of intangibles arose during the mid-1990s when the rapid diffusion of information and communication technologies turned the focus of attention onto the possibilities of how to develop appropriate co-investments in knowledge-based business activities that would complemented each other in the utilisation of these technologies (Hulten, 2013: 6). Of course, different institutional environments would promote distinct competitive strategies in coping with the corresponding investment in intangibles. At this point, the role of the institutional environment of firms becomes a crucial aspect in the analysis of the accumulation of intangible assets. When it comes to the matter of knowledge, innovation and learning, this institutional environment is appropriately approached in terms of the national, regional or sectoral innovation systems in which firms are strategically embedded.

1.3 Varieties of innovation systems

The institutional environment of firms and industries plays a key role for understanding the way in which government policies can be designed effectively in order to support investment in intangible assets. Multiple strategies exist for the purpose of supporting and exploiting the knowledge base of a region or country and enhancing its competitive advantage. Thus, there exist significant differences in the deployment of intangibles by different countries (Corrado et al., 2012). But how are these different support strategies and policy patterns among countries to be explained? It is generally difficult to relate clearly one particular institutional form to superior economic performance when it comes to empirical testing. This fact is explained with the complementary interrelations between institutions, which lead to a composite of influences that evolves over time. Thus, an appropriate approach to the institutional embeddedness of firms and industries relates to the evolution of governance structures, which adds to the difficulty to exactly identify those institutional rules and norms that shape a particular economic outcome (Crouch, 2005). In a similar manner, when it comes to intangible assets as a manifestation of the knowledge base of a firm, it is difficult to rigorously outline those causal relations that drive the innovativeness and competitiveness of a firm. Innovation should be conceived as a collective process that involves multiple interactions and collaborations which are subject to likewise complex institutional influences. In this way, institutional frameworks are key variables when it comes to explaining the role of knowledge in the competitive performance of firms, industries and whole economies (Lundvall et al, 2002).

National specificities of institutional frameworks may relate to historical path dependencies in the evolution of cultural settings, industrial structures and political-economic governance mechanisms, all of which impact on styles of innovation that define the competitive position of firms. This involves national idiosyncrasies in the mode of knowledge generation and dissemination in particular when it comes to the strategic behaviour of firms in the accumulation and utilisation of knowledge; an aspect that is massively influenced by national patterns in the structuration of the education and the systems of workforce training, but also in the regulation and enforcement of intellectual property rights. These national specificities need to be viewed as evolving components in a multi-level structure that combines national aspects with local and regional as well as international and supranational conditions. However, the persistence of nation-states and national settings of cultural proximity underline the continuous relevance of national styles of economic life (Ebner, 1999).

Focussing the analysis of the institutional foundations of the competitive advantages of nations on a firm-centred analysis then may allow for outlining distinctive national types of capitalist market economies. The strategic relationships of firms with their institutional environment involve complementary sub-systems of corporate governance, industrial relations, workforce training and education, and inter-firm relations in technology transfer. Based on these patterns, two varieties of capitalism can be differentiated ideal typically: liberal market economies such as the United States and the United Kingdom with a dominant pattern of market coordination through investment in transferable assets as compared with coordinated market economies such as Germany and France with a dominant pattern of strategic coordination through investment in specific assets. Liberal economies share the market-based characteristics of short-term orientated company finance, deregulated labour markets, general education, and strong inter-company competition. In coordinated economies the strategic behaviour of firms is coordinated to a much larger extent through nonmarket mechanisms, basically characterized by long-term company finance, cooperative industrial relations, high levels of firm-specific vocational training, and inter-firm cooperation in technology and standardization, framed by industry associations. In effect, the flexibility of liberal market economies supports advantages in radical innovations, while coordinated market economies tend to specialize in incremental innovations within stable organizational settings. As there is no single-best model achievable, the diversity of institutional patterns and modes of economic growth prevails (Hall and Soskice, 2001).

The underlying notion of the path dependence of institutional change implies that certain institutional options may be blocked due to “lock-in” effects. This means that policies have to fit in with existing institutional patterns by providing incentive-compatible policy targets and mechanisms in addressing the strategic behaviour of firms (Jackson and Deeg, 2006: 36). Possible tensions in strategic interactions between economy and polity may result in tensions between the sub-systems that drive an ongoing hybridisation of institutional frameworks beyond the established modes of economic growth (Crouch, 2005). In theoretical terms, the reconsideration of this hybridisation has been a driving motive behind debates on more complex typologies and methods in the comparative institutional analysis of capitalist market economies (Hancké et al., 2008). Accounting for distinctive patterns of economic organization that vary in their degree and mode of coordination of economic activities still provides a promising outline of further analyses that address the institutional determinants of the competitive advantages of business firms (Whitley, 2002: 33). In line with these concerns, it may be useful to consider the evolutionary character of institutional change as a major quality of capitalist market economies; a quality that involves the matter of knowledge and innovation as prominent issues – and with government-business relations as focal point of comparative analyses (Ebner, 2008). Indeed, an evolutionary viewpoint may provide useful insights on the hybrid character of national institutional frameworks and the related limits of policy-driven change, as illustrated for instance by the case of Germany's coordinated market economy, which has been going through diverse institutional reforms in key domains of economic life during the recent decades (Ebner, 2010).

In fact, this concern with the institutional evolution of the national specification of innovative activities of firms and industries is a most relevant analytical topic in the systems of innovation perspective. This approach takes on a systemic view on innovation as an economy-wide affair that integrates diverse actors and networks in a particular territorial setting. In addition to business firms as a principal terrain for innovation, further elements in the interactive promotion of innovation and collective learning such as the national settings of R&D, science and education are taken to the fore as components of institutional networks in the private and public sector. Government, law and culture delineate an institutional arena on the national level, which affects the intensity and direction of technological innovation (Lundvall et al., 2002). The corresponding analysis of innovation systems highlights the evolution of knowledge in processes of learning and innovation that are subject to the strategic efforts of firms and framed by distinct policy regulations (Lundvall, 2007: 106). The innovative capacity of a national innovation system then reflects specialization patterns and related competitive advantages that are based on variations in interlinked factor conditions such as skilled human resources and efficient R&D endowments (Furman, Porter and Stern, 2002). Accordingly, it is fair to suggest that intangible assets stand for the key resources of innovation systems, which determine the innovation performance and learning capacities of firms.

A reconsideration of these aspects allows for stylizing distinct types of national innovation systems in a manner that resembles the dichotomies of the literature on varieties of capitalism, as discussed above. One option is to distinguish "myopic" innovation systems such as the United States with a short-term market orientation regarding investment in new technology as distinct from "dynamic" innovation systems such as Germany that have been historically standing for a rather long-range oriented type of coordination and governance that combines market and non-market components in a peculiar manner. In this view, learning processes based on intangible assets are considered as key arguments in investment decisions (Patel and Pavitt, 1994). This kind of differentiation of national styles of innovation and related patterns of investment in intangible assets is actually reaffirmed when the finance-innovation nexus is taken to the fore more explicitly. Market based financial systems such as those that are observable in the United States, the United Kingdom and other national variations of liberal market economies tend to provide extensive resources from financial markets for financing innovation and learning processes of firms. Thus, these processes, which involve the accumulation of intangible assets, are organised with a view on short-term market success that yields adequate returns for the investors. Bank-based financial systems typically provide credit facilities as financial means for technological innovations and organisational learning. In Europe, they have been historically predominant in coordinated market economies such as Germany and France. Typically, investment behaviour in these types of economies is more long-term oriented although international pressure for a market-oriented financialization of the finance-innovation nexus prevail (Tylecote and Visintin, 2008, Tylecote, 1996). Effective policies in support of investment in intangible assets have to respond to these institutional idiosyncrasies of various national innovation systems. Indeed, viable policies must be compatible with existing institutional patterns, that is, they must be 'incentive compatible' with the coordination mechanisms of the prevailing political-economic system and its particular bent towards market- or non-market coordination (Hall and Soskice, 2003). Corresponding efforts inform the design of new types of industrial policies that aim at facilitating the formation of new skills and capabilities, which are meant to enhance the knowledge base of the economy at large.

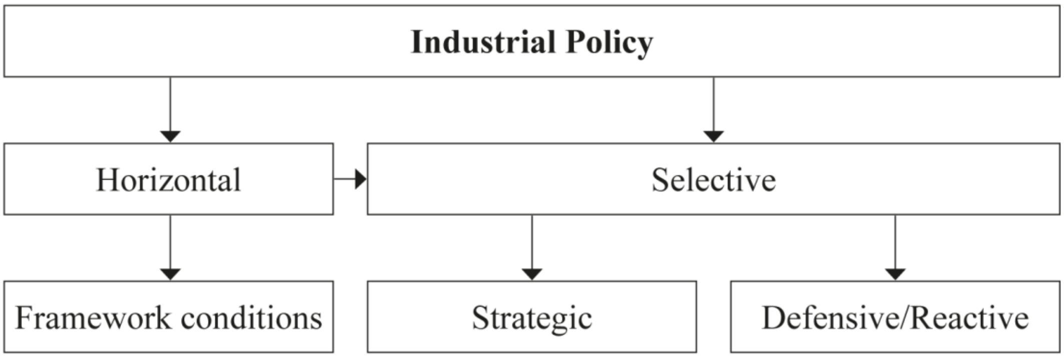
1.4 Towards a new type of industrial policy

A common definition of industrial policy refers to "any type of selective government intervention or policy that attempts to alter the structure of production in favour of sectors that are expected to offer better prospects for economic growth in a way that would occur in the absence of such intervention" (Pack and Saggi, 2006: 267n.). This policy perspective has been quite controversial due to the potentially interventionist standing of government. In particular, it has been confronted with problems of distorted market structures and rent-seeking, among others, all of them resembling the problematic areas of protectionist market regulation and intervention. The pervasiveness of market failure, however, remains a key issue in reasoning on the logic of industrial policy and even more so when it comes to the evolution of a knowledge-based economy. Therefore, the concerns of industrial policy are experiencing a world-wide renaissance in current research, advice and practice on policies in support of technological innovation and international competitiveness (Warwick, 2013; Wade, 2012; Rodrik, 2007). In particular, recent efforts in thinking about industrial policy highlight the strategic issue of innovation as an economy-wide concern that is crucially related with both the knowledge base of firms and industries as well as the path of economic growth of regions and nations (Aghion, Boulanger and Cohen, 2011; Ciuriak, 2013). While traditional approaches to industrial policy have been concerned with often misguided efforts in support of politically selected strategic industries, more recent efforts pinpoint the relevance of forward-looking coordination efforts in promoting the knowledge base of firms and industries in line with the requirements of international competitiveness. In effect, maintaining employment and income opportunities in view of sustained economic growth remains the key concerns of this policy perspective (Aiginger, 2007).

In confronting the risks of the selective support of strategic industries that are associated with the traditional form of industrial policy, which has usually suspended the market mechanisms by interventionist policy measures based on the pretence of superior governmental guidance in industrial and technological affairs, a new type of industrial policy is set to be based on a facilitative role of institutional coordination exercised by government in cooperation with the private sector. Indeed, in this new approach, industrial policy is based on the persistent cooperation between the private and the public sector for neither have access to complete information and therefore they require an experimental approach to the design and implementation of policy strategies (Rodrik, 2007: 100n). When this kind of cooperation takes on the challenges of introducing novelty into an established economic setting, it is adequate to identify government as an entrepreneurial actor in Schumpeterian terms; that is, a functional configuration which may be grasped in terms of the notion of an “entrepreneurial state” whose modes of coordination and governance constitute the institutional terrain for the design and implementation of industrial policy (Ebner, 2009: 370).

However, the relationship between generalized rules of competition and sectoral specificities of policy measures remains a key issue in the design and implementation of these policies. The type of industrial policy promoted by the European Commission follows a horizontal approach, which implies a concentration on framework conditions in support of technological innovation, entrepreneurship and competitiveness. However, the actual impact of horizontal measures depends on sectoral characteristics and their specific requirements. This entails that a horizontal policy approach has to be applied differently and in consideration of the industry it is actually designed for (European Commission, 2002: 30). This kind of industrial policy combines a horizontal basis with sectoral applications and specifications, as illustrated in Figure 2. On the one hand, this approach of industrial policy maintains its horizontal nature and aims at the facilitation of industrial competitiveness through appropriate framework conditions. On the other hand, specific needs of the individual industries and sectors are taken into account, too (Aiginger, 2007: 307). As complementary policy measures might differ across firms and industries, it may be useful to reconsider these policies in terms of a matrix approach with horizontal components depicting the industries while vertical components illustrate policy instruments (Aiginger and Sieber, 2005; Aiginger and Sieber, 2006). This matrix approach stands for a more pro-active policy approach that aims at structural change as compared to an approach that simply concentrates on framework conditions with no further policy goals regarding the facilitation of structural and technological change (Aiginger, 2007: 311n.).

Figure 2 **Typology of industrial policies**



Source: Adapted from Warwick (2013: 29, Figure 3).

Such a new type of industrial policy should aim at the support of intangible assets in order to enhance the knowledge base of the economy as a whole. It should encourage the implementation of supporting institutions and knowledge spill-over effects as a means to promote economic growth. The Lisbon agenda of the European Union has fuelled renewed interest in a European framework for such a kind of industrial policy in combination with the goal of furthering dynamic competitiveness that refers to the idea of quality- or technology-driven competitiveness based on an economic structure with knowledge-based high-skill industries. Particularly in industrialised countries, the knowledge base of the economic structure comes to the fore as a strategic aspect that is meant to increase the structural shares of sophisticated industries with high income perspectives (Aiginger et al., 2013). This is why intangible assets play a key role in such a new type of industrial policy, which is highly relevant for the strategic perspectives of the making of European industrial policy. In addition to the classical domains of industrial policy, thus, the envisioned new type of industrial policy tackles the current transition towards a knowledge-based economy, which involves the recognition of the decisive role of intangibles in economic affairs (Tomer, 2008). These comprehensive industrial policies supporting investment in intangible assets need to reach across traditional policy domains that have exhibited an orientation towards the R&D sector. Instead, it follows a broadly conceived approach that tackles both formal and tacit knowledge in all domains of the economy (Jensen et al., 2007).

At this point, the relevance of education and training as a policy concern for the support of intangibles assets becomes most obvious. Indeed, policies in support of intangible assets need to combine a new type of industrial policy with related efforts in the science and education sectors. Generally speaking, education stands for institutional structures of individual and collective learning that provides professional knowledge and expertise, both of which translate into various formats and types of intangible assets. For example, software is a primary outcome of human expertise translated into a digital code. High shares of R&D expenditures are spent on the wages of researchers and technical engineers. Patents stand for intellectual property rights that relate to ideas, which derive from the recombination of professional knowledge (OECD, 2013b: 49). At the same time, the rapidly increasing relevance of intangible assets may probably lead to a shortage of available skills in the workforce. For instance, it has been claimed that 1.5 million additional data-savvy managers are needed to capture all business benefits of digitalised data in the United States in the near future (McKinsey Global Institute, 2011: 10).

As innovation is based on the capacity of creating, exchanging, and exploiting knowledge, so education and training of the workforce become ever more important with all of their economy-wide implications that derive from the improved skills and capabilities of the workforce (Ciricai and Hervas, 2012). This is why the OECD suggests that the facilitation of innovation processes is based on “broad and relevant education as well as on the development of wide-ranging skills that complement formal education” (OECD, 2010b: 11). In effect, education and training aim to raise the productivity of the workforce and in doing so pave the way for a high-skill and high-wage constellation of employment that feeds into a knowledge-based mode of economic growth. Crucially, the development of the education system has to be linked to the coordination of education in consideration with the situation of the labour markets. The supply of skills has to match the corresponding demand of firms (Hulten, 2013: 24). Yet strategic capabilities are also enhanced through training activities within firms. Indeed, evidence suggests that firms which are capable of providing extensive in-house training of the workforce may exhibit sustained advantages regarding their innovative capacity. This insight informs policy approaches in support of workforce training as an inherent component of industrial policy (Ciricai and Hervas, 2012). Yet the national varieties of education and training systems, which are intimately connected to the overarching systems of innovation, also have a major impact on the outlook of workforce training. Indeed, in coordinated market economies like Germany with their bias towards investment in firm-specific intangible assets, vocational training systems for the workforce are a stand-out quality that combines cooperative industrial relations with a long-term perspective on skills development (Thelen, 2004).

However, the formative role of the education system for promoting productive skills and capabilities already begins with the actual spending on primary and secondary education, but the expansion of these efforts to the tertiary sector is of acute importance as the quality of universities and colleges stands out in the formation of a knowledge-based economy. Indeed, the endowment with universities that are part of industrial networks of knowledge exchange needs to be regarded as the backbone of a new type of international competitiveness (Janger et al., 2010: 3). The interconnections between universities and industries thus play an increasingly important role for policy makers. Knowledge flows between research institutions and business firms are regarded as vital elements in the formation of globalised knowledge and innovation networks. They require support both with regard to the formation of institutional networks as well as concerning intellectual property rights that allow for the appropriability of returns on innovation (Kitagawa, 2004: 846). Given this rather complex picture of support requirements, policy instruments in support of investment in intangible assets need to provide a comprehensive set of measures in diverse but interrelated policy domains.

1.5 Policy instruments in support of investment in intangible assets

A wide range of policy instruments is available in order to support investment in intangible assets. Indeed, the corresponding policies run across traditional policy areas as they need to integrate the goal, instruments and actors of industrial and technology policy with aspects of science and education policy. First of all, in order to proceed with stimulating investment in intangibles in the aforementioned manner it is important to focus both on the resource efficiency and instrumental efficacy of the implemented policies (OECD, 2013b: 29). This reference hints at problems in the making of policies that are set to address genuinely uncertain aspects of technological innovation and structural change, whose manipulation by governmental measures may lead to unintended and in this way also counterproductive consequences. Even more fundamentally, despite their legitimisation in terms of market failures, they may obstruct market processes and contradict the competitive logic of markets. Nonetheless, these policies are part of the repertoire of all industrialised market economies, regardless of their attachment to liberal or coordinated types or models. This is well exemplified in more detail by the European Commission’s policy framework on the General Block Exemption Regulation, which addresses the compatibility of state aid for R&D and innovation with the requirements of the European common market (ECISP, 2013: 23).

As depicted in Table 2, policy instruments for investment in intangible assets combine various efforts in stimulating private sector investment in the knowledge base of firms. The list of options highlights the common understanding of the targeted provision of physical and legal infrastructures that serve as backbones for the investment operations of private sector firms. Yet a more nuanced viewpoint hints at financial and fiscal support measures ranging from loans and grants to various schemes that are meant to conditionally reduce the tax burden of firms. Then again, also further service functions of government matter, as exemplified by the proviso of market and business information. All of these instruments may be related to the three distinct areas of intangible assets outlined above, namely computerised information, innovative property and economic competencies. The following exposition tackles all of these areas by highlighting the associated policy measures as well as the strategic effects that are to be expected by implementing them.

Table 2 **Policies supporting investment in intangible assets**

Type of intangible asset	Selected policies supporting investment in intangible assets
Computerised information	
Software	• Provision of ICT infrastructures. • Regulatory frameworks for intellectual property rights. • Information on safeguarding intellectual property rights. • Public procurement. • Grants, loans and related funding schemes. • Fiscal incentives for business digitalisation. • Public venture capital and funds for entrepreneurial start-ups.
Databases	• Provision of ICT infrastructures. • Regulatory frameworks for data access, data security and protection of data privacy. • Regulatory frameworks for intellectual property rights. • Information on safeguarding intellectual property rights. • Public procurement. • Grants, loans and related funding schemes. • Fiscal incentives for business digitalisation. • Public venture capital and funds for entrepreneurial start-ups.
Innovative property	
Research and development	• Provision of complementary research infrastructures. • Regulatory frameworks for intellectual property rights. • Information on safeguarding intellectual property rights. • Public procurement. • Research grants, loans and funding schemes. • Fiscal incentives in taxation and transfer payments. • Public procurement. • Collaborative public-private research networks. • Acquisition of foreign direct investment. • Public venture capital and funds for entrepreneurial start-ups.
Mineral explorations	• Fiscal incentives. • Provision of information on new markets and business opportunities.
Copyright and creative assets	• Regulatory frameworks for intellectual property rights. • Information on safeguarding intellectual property rights. • Grants, loans and related funding schemes. • Fiscal incentives for creative business processes. • Public venture capital and funds for entrepreneurial start-ups.
New product development in financial services	• Regulatory frameworks for market entry, transparency, accountability and good corporate governance.
New architectural and engineering designs	• Regulatory frameworks for intellectual property rights. • Information on safeguarding intellectual property rights.

	• Grants, loans and related funding schemes. • Fiscal incentives. • Public venture capital and funds for entrepreneurial start-ups.
Economic competencies	
Brand-building advertisement	• Regulatory frameworks for intellectual property rights and product information transparency. • Information on safeguarding intellectual property rights. •
Market research	• Provision of information on new markets and business opportunities.
Workforce Training	• Provision of education and training infrastructures. • Grants, loans and funding schemes for training programmes. • Fiscal incentives for training programmes. • Information on training programmes. • Promotion of inter-firm training networks.
Management consulting	• Provision of information on new markets and business opportunities.
Own organisational investment	• Provision of information on new markets and business opportunities.

Source: Own illustration.

A first set of policy instruments targets computerised information. This domain is a key area of policies in support of investment in intangibles, which also transcends traditional policy areas. It is related to the digitalisation of the knowledge base of the firm and in doing so echoes technology trends such as the "internet revolution" and the emergence of digital technologies like mobile networks and smart grids. The prevalence of skilful data analytics that work with big data also offers new prospects of value creation and productivity enhancement in firms and industries. In this vain, computerised information stands for the technology backbone of the evolving knowledge-based economy (OECD, 2013b: 48). The provision of ICT infrastructures is expected to have a positive impact on investment in intangible assets while financial incentives and fiscal measures may provide incentives in promoting related business operations. Broadband networks exhibit a particularly high potential for supporting the knowledge base of firms and industries when the open, free, decentralised and dynamic nature of the Internet is preserved. The provision of these kinds of high-quality ICT infrastructures needs to account for these aspects (OECD, 2010b: 13).Yet, policy makers also encounter new challenges in this field, in particular with regard to issues of software and data privacy protection and security, and open data access. Indeed, the provision of physical ICT infrastructures needs to be framed by legal infrastructures in terms of adequately designed regulatory frameworks for intellectual property rights, which balance data security and open access options. Also, policies in support of investment in computerised information may provide financial means such as grants, loans and related funding schemes as well as fiscal incentives for business digitalisation, which are usefully complemented by public procurement policies. Also, in marked terms, public venture capital for entrepreneurial start-ups in the corresponding ICT industries is set to provide incentives for complementary private sector investment.

The second bundle of policy instruments that targets the support of intangible assets concerns the promotion of innovative property. This domain of intangibles first of all pinpoints the strategic contribution of R&D. Both the level and dynamics of R&D expenditures and the associated returns have to be taken into account in the design of related policies; an aspect that pinpoints the information problems policy-makers face in the design of these kinds of support schemes (OECD, 2013b: 37). In this context, it is noteworthy that recent developments of policies that are meant to stimulate private sector R&D have witnessed a shirt of emphasis away from direct administrative funding in favour of competitive funding schemes, debt financing as promoted by loans, and equity finance as promoted by venture capital (OECD, 2014: 16). In a more comprehensive view, however, the provision of complementary research and education infrastructures which allow for matching institutional orientations in the private and public sector stands out with regard to supportive policies for R&D investment by means of institutional infrastructures and related financial as well as fiscal incentives. The former involve information on legal safeguards of intellectual property rights, latter aspects point to grants, loans and related funding schemes that are meant to boost R&D operations. Also, they include the design and implementation of tax policies and related fiscal measures, which exercise effects on investment in the knowledge base of firms. Across the OECD, the granting of R&D tax allowances as well as tax credits is a widely used instrument in this regard, which is applied regularly among others to corporate income or payroll taxes (OECD, 2014: 165n.). Again, public procurement becomes an increasingly relevant policy device in the support of private sector R&D investment. It fits the demand-oriented segment of policy-making that strives for the use of market signals in promoting investment in intangibles. These efforts are also potentially furthered by means of public-private ventures and research networks. Indeed, a prominent way of public support is the provision of financial incentives for joint or collaborative projects, including collaborative R&D that supports a specified innovation project (OECD, 2011a: 50). The policy support of collaborative mechanisms which pinpoint the interaction of science and industry seeks to encourage the exchange of knowledge and thus adds value to intangible assets (OECD 2010b: 13). The underlying idea of knowledge networks is consistent with the promotion of local and regional innovation hubs, which have become a prominent spatial issue in industrial policies all over the industrialised world.

Yet this focus on local and regional knowledge agglomerations with intense university-industry relations also involves the tapping of globalised knowledge and production networks. High-performing international firms and research institutes become locally agglomerated yet globally interacting players in R&D. This means that corresponding policies need to account for the attraction of foreign direct investment in order to advance investment in the knowledge base of firms and industries (Ebner, 2013). Therefore, investment in R&D and other intangibles is persistently supported by policies that strive for the acquisition of foreign direct investment. The flow of foreign direct investment is of course affected by the actual framework conditions of the host country, which go way beyond distinct policies and fiscal incentives. These framework conditions involve the legal protection of investors in terms of the enforcement of their property rights, the current levels and sophistication of R&D, the prevalence of highly skilled labour in the workforce, the level of labour costs, and the costs that incur for starting a new business. The selective moulding of these conditions is a key policy concern as foreign direct investment may add to the knowledge base of an economy, especially when it comes to knowledge-intensive segments of production and services. In this vain, investment in intangible assets needs to be viewed as an open economy affair that requires adequate policy-based incentives (Falk, 2013: 26).

A particularly relevant aspect of the internationalisation of business operations is the geographic fragmentation of production chains. In view of this phenomenon, policies supporting investment in intangible assets can aim at the promotion of high-value activities in global value chains, which are linked to international firms and markets. High levels of value creation are found in activities such as R&D, branding, design or the integration of software within an organisation, all of which relate to intangible assets. As the role of global competition taking place in the format of these value chains increases, policies have to account for the fact that knowledge-intensive business operations tend to cluster in certain localities and remain concentrated in certain national economies. Thus, a global competition for high-value adding intangibles prevails (OECD, 2013b: 47). The underlying fragmentation of organisational structures, involving R&D operations, all across the global economy adds to the complexity of the new type of industrial policies in support of intangible investment as aspects such as transnational governance become increasingly relevant in the policy process (OECD, 2014: 36).

However, these aspects of strategic collaboration and international investment in R&D need to account for questions of the appropriability of the returns of investment, which highlight the prevailing regulatory frameworks for intellectual property rights. Indeed, the protection of intellectual property rights is a fundamental issue in view of international investment, as it relates to various types of intangible assets that are affected by the need to define and enforce the right of appropriating returns on investment. Particularly, patents of new products and processes stand out in this regard, for the definition and enforcement of the corresponding rights defines a most crucial domain of policies in support of R&D investment (OECD, 2013b: 40). These issues have gained an ever-increasing attention recently as the protection of intellectual property rights comes together with the marketization of research efforts as an issue of high relevance for universities and public research institutes alike (Smith and Bagchi-Sen, 2006: 373). Of course, it can be argued that this legal constellation leads to a situation in which the protection of intellectual property rights conflicts with the idea of open knowledge. Therefore, a trade-off has to be made between the pro-growth effects of widely available knowledge with a public good character and the protection of intellectual property rights that entails the incentive for investment in intangibles by strengthening the market dimension of knowledge (Hulten, 2013: 20).

The question of open versus limited access to new knowledge hints at the matter of policy support of entrepreneurial start-ups in the domain of R&D as a facet of policies in support of investment in intangible assets. The recognition of various modes of innovation points at the heterogeneity of firms as a crucial argument in the design of supportive policies. Entrepreneurial firms that enter the market and exhibit relatively high growth rates in their market performance are disproportionally responsible for the creation of employment opportunities. According to empirical evidence, small, young and innovative firms in the United States represent less than 1% of all the companies but generate about 10% of new employment (Stangler, 2010). An OECD study that investigated firms younger than five years which would extensively use intangible assets in their market performance claimed that these firms accounted for 18% of total employment but created 47% of new jobs across the OECD world (OECD, 2013a: 7). Also, when it comes to the inducement of radical innovation, the segment of newly established entrepreneurial ventures comes to the fore as a strategic target area of policy design and implementation. Incumbent firms are more inclined to concentrate on processes of incremental innovation while building on existing competences. They tend to be less concerned with radical innovations because of their potential to make existing competences – and thus also existing market positions – obsolete. In contrast to that, entrepreneurial start-ups are less concerned with the maintenance of prevalent skills and market positions. Therefore, radical innovations are more likely to occur in these entrepreneurial firms. The most promising of these firms have the potential to achieve a strong market position in a rather short span of time, which implies that their knowledge base soon becomes relevant for other market participants as well (Schneider and Veugelers, 2010: 970).

Indeed, the recently revised aid rules for innovation support of the European Union allow for a more favourable treatment of young, innovative firms that combine a promising technological profile with a positive growth potential (Schneider and Veugelers, 2010: 970n.; Veugelers and Cincera, 2010). Crucial for these types of new innovative firms are efforts in the reduction of financial burdens as action points for supportive policies. Entrepreneurial firms facing a financial gap may bridge it by access to specialised financial intermediaries such as venture capitalists, who provide early-stage finance. Business angels scrutinise firms before they provide capital and continue to monitor them after the start-up phase (OECD, 2013b: 31). Yet this kind of financial support may also originate in the public sector. Indeed, public venture capital for high-technology based entrepreneurial start-ups has emerged as a major policy instrument across the OECD economies in recent years. Direct support for these young entrepreneurial firms has the advantage that it can be focused on activities and actors of greatest interest and directly meet public policy goals with a broader range of positive externalities (OECD, 2011a: 17). Still, it needs to be taken into account that these kinds of financial infrastructures are subject to national, sectoral and technological specificities that reflect complementary influences in the prevailing national innovation systems (O'Sullivan, 2005).

Beyond the domain of R&D, however, supportive policies need to address further components of intangible innovative property. They include the domain of new products and designs, as exemplified by artistic originals, brand trademarks, and design rights. Corresponding policy instruments address first of all adequate legal frameworks for intellectual property rights that enforce returns on investment when it comes to issues such as copyrights and registered trademarks, which are increasingly important in a globalising world economy. Furthermore, in complementing these legal issues in support of the appropriability of product innovations, both targeted funding schemes as well as fiscal incentives in support of the creative dimension of innovative property matter. They may include the support of investment in creative business processes by means of taxation-related incentives, but they also hint at the persistent relevance of financial support for entrepreneurial starts in this domain, as exemplified by public venture capital designated to the creative industries. All of these policy propositions also apply to the fields of new architectural and engineering designs. However, more specific measures are required when it comes to the domain of policy support for investment in new financial products. This domain requires well adapted regulatory frameworks for market entry, transparency, accountability. Also, it relies on the policy-based prevalence of good corporate governance, which builds on an adequate legal framework. Finally, policies for investment in mineral explorations that restructure supply chains of firms may utilise fiscal incentives, but even more so the public provision of information on new business and market opportunities proves to be promising – with government as a knowledge broker among producers and other market participants.

Likewise, a diverse set of policy instruments supports investment in economic competencies, which constitutes the third categories of intangible assets. Workforce training is a key issue in this domain, for it contributes decisively to the evolution of skills and capabilities that largely determine the knowledge base of the firm. Policy instruments in this domain relate first of all to the provision of education and training infrastructures, which can be supplied as governmentally provided public goods or as private-public partnership ventures amounting to a pattern of co-investment in these kinds of infrastructures. Furthermore, grants and funding schemes in support of workforce training provide incentives for complementary private sector investment on this domain of intangible assets. The same holds for fiscal incentives in support of training programmes as well as to the policy-based promotion of inter-firm training networks, which can be based on public forms of consulting and information brokering. The latter aspect of knowledge coordination and dissemination points to policies that support investment in management consulting. Also in this case, the provision of information on new markets and business opportunities matters a lot. Yet again, also governmental or government-related agencies may contribute to these consulting processes. In particular, specific policy programmes can facilitate business access to research or technology-related advice and thus disseminate information from universities and public research organisations (OECD, 2013a: 30).

Further support measures for investment in economic competencies address the mobilisation of external and internal knowledge. Market research is a first domain of investment in this category. Its policy support involves the provision of public information on new markets and business opportunities that can feed into further market research operations. The same set of measures applies to policy support for own organisational investment within a firm. In this case, the public provision of information on new markets and business opportunities may inform further investment strategies on the improvement of internal business processes. In both cases, government may enhance the knowledge base of the firm and the value of intangible assets by contributing to the dissemination of knowledge. Policies in support of investment in brand-building advertisement, however, need to rely much more on the legal framework of the market process. In this case, promising policy measures may address the establishment of regulatory frameworks for intellectual property rights and product information transparency.

In summary, it may be argued that policies in support of investment in intangible assets are best approached in terms of a new type of industrial policy that transcends traditional policy fields by combining policy concerns for industry evolution and technological innovation with complementary efforts in the domains of science, education, and training. However, in such a systemic perspective, the support of the corresponding investment decisions in the private sector also needs to account for complementary policy areas that influence the framework conditions for business firms. For example, country-specific regulations on labour market affairs are set to affect investment strategies, for the latter involves aspects such as labour market rigidity and the costs that are needed to start a business. Also, the overall business climate of a country, which is persistently shaped by a range of factors involving taxation, bureaucracy and government-business relations at large, adds to actual business concerns with investment in intangible assets. Finally, the information infrastructure matters both with regard to its physical and legal features. In particular, the openness of communication networks facilitates collective learning effects in key domains of intangible assets such as R&D and workforce training (OECD, 2011a: 52). Accordingly, policies in support of investment in intangible assets need to account for institutional and technological complementarities across firms, industries and policy fields.

2. Policies in support of investment in intangible assets: Best practices

In order to explore best practices as to how to support investment in intangible assets, the following chapter explores the national innovation systems and policy efforts of selected member states of the European Union. In fact, when it comes to the international comparison of these kinds of policies that are directly related to the knowledge bases of firms and industries with their diverse national and regional idiosyncrasies, it is most relevant to reconsider the underlying institutional varieties of market economies, which shape the national institutional frameworks that are relevant for the investment behaviour of business firms regarding the advancement of their intangible assets. Indeed, while positive correlations between investment in intangible assets and economic growth might suggest that the facilitation of investment in intangibles should be part of an overall growth strategy, it still needs to be considered that the outreach of these kinds of investment support measures need to reflect the actual industrial structure under consideration with its local specificities and specialisations.

A first glance at the available data on fixed and intangible investment across the European economies, as provided in Figure 1 above, has already indicated that high performing service-oriented economies such as the United Kingdom and economies undergoing a transformation from a primary goods producer to a knowledge-based service economy such as Finland stand out with regard to the prevalence of investment in intangible assets. Also manufacturing-oriented economies such as Germany and France exhibit high levels of investment in intangible assets, although these are not surpassing the relative levels of fixed investment. Economies with a more traditional industrial outlook such as Italy, Spain and Austria still exhibit a much more dominant pattern of investment in tangibles (OECD, 2010b: 32). Table 3 provides further insights into this subject matter. Data on total intangible investment as percentage of GDP for the mid-2000s provide evidence for the varied performance of the European economies. The most active economies in that regard seem to have been the United Kingdom as well as Sweden and Finland, while the Netherlands, France, and Germany have tended to follow suit in the context of their particular production models and institutional frameworks (BIS, 2012: 61).

Table 3 **Intangible investment as percentage of GDP, cross-country comparison**

Country (Year) / Intangible Assets	UK (2004)	Nether-lands (2005)	Germany (2006)	France (2006)	Italy (2006)	Spain (2006)	Finland (2005)	Sweden (2004)
Computerised Information	***1.70***	***1.40***	***0.73***	***1.42***	***0.64***	***0.79***	***1.02***	***1.83***
Computer software	1.70	1.40	0.71	1.37	0.63	0.76	.	.
Computerised databases	.	.	0.02	0.05	0.01	0.03	.	.

Innovative property	***3.23***	***1.80***	***3.59***	***3.18***	***2.21***	***2.78***	***4.01***	***5.39***
Scientific R&D	1.06	1.00	1.72	1.30	0.58	0.63	2.73	2.59
Mineral exploration	0.04	0	0.01	0.04	0.09	0.04	0.04	0.01
Copyright and license cost	0.21	0.20	0.21	0.31	0.10	0.18	0.14	0.11
Other product development	1.92	0.60	1.65	1.53	1.44	1.93	1.10	2.68
New architect./ engin. designs	1.20	0.60	0.9	0.93	0.86	1.41	1.10	2.42
Economic competencies	***5.95***	***5.20***	***2.84***	***3.3***	***2.19***	***1.90***	***4.07***	***3.32***
Brand equity	1.59	2.30	0.56	0.99	0.71	0.42	1.74	1.61
Advertising expenditure	1.20	2.10	0.41	0.73	0.47	0.19	.	1.43
Market research	0.39	0.30	0.15	0.26	0.24	0.23	.	0.18
Firm-specific human capital	2.45	1.20	1.29	1.51	1.02	0.81	1.18	1.05
Organisational structure	1.92	1.80	1.00	0.81	0.45	0.68	1.15	0.66
Purchased	0.60	1.30	0.54	0.32	0.15	0.27	0.41	0.20
Own account	1.31	0.40	0.46	0.49	0.3	0.41	0.73	0.47
Total	***10.88***	***8.40***	***7.16***	***7.9***	***5.04***	***5.47***	***9.10***	***10.55***

Source: Adapted from BIS (2012: 61, Table 2).

In surveying best policy practices in support of investment in intangible assets across the member states of the European Union, the following chapter thus selects countries that are not only relevant with regard to the level of intangible as compared with fixed investment, but also with regard to their representation of specific types of market economies with their particular institutional frameworks for business investment in intangible assets. In this vain, it is useful to consider the distinct transition paths to a knowledge-based economy all the European economies are passing through. It is not appropriate to design a one-size-fits-all kind of policy in support of intangible investment. Instead, these policies need to respond to the diverse patterns of industrial specialisation and the comparative institutional advantages that govern the strategic outlook of business firms with regard to the assessment of their intangible assets. Also, it is useful to find all three main categories of intangible assets represented in the survey of best practice policies in their support. In view of these concerns, then, the selected European economies which are subject to an in-depth scrutiny of best practice policies in support of investment in intangible assets are the United Kingdom, Finland and Germany. This selection is motivated by the coincidence of a particularly high-ranking share of investment in intangible assets in relation to the share of investment in tangible assets. This viewpoint in the selection of countries is paralleled by considering the prevalence of a particular type of market economy, which stands for a distinct pattern of transition towards the knowledge-based economy.

The survey of best practices as to how support investment in intangible assets commences with Finland's type of coordinated market economy, which has been going through rapid structural changes from a primary goods producer to a knowledge-based economy with a strong standing of high-technology producers and service providers, based on an outstanding specialisation in the information and communication technologies. International comparisons of performance indicators on innovativeness and competitiveness commonly position Finland in the top ranks, while the Finnish innovation system is said to be effectively performing on the basis of collective learning in a technologically vibrant economic setting as comprehensively arranged industrial policies pinpoint the strategic transition towards a knowledge-based economy (Sabel and Saxenian, 2008: 5; Aiginger, Okko and Ylä-Anttila, 2009: 103; Oy, 2009: 11). During the 2000s, Finland has emerged as the world's most ICT-specialised economy concerning the shares of information and communication technologies in production and R&D operations, framed by rapidly upgrading ICT infrastructures (Aiginger et al., 2009: 130; Technopolis, 2010b; WSA, 2010). Thus, specifically, the Finnish innovation system stands out as a model of policies in support of computerised information (Halme et al., 2014: 1-3; Salminen and Lamminmäki, 2014). Therefore, in the following survey, the analytical focus is going to be on Finland's ability to support investment in intangible assets associated with computerised information.

The analysis of best practices concerning the support of investment in intangible assets proceeds with a related survey of the United Kingdom. The United Kingdom stands for the type of a liberal market economy that exhibits major advantages in the domain of radical technological changes based on considerable efforts in the organisation of R&D and the facilitation of knowledge flows in science-based industries such as biotechnology and pharmaceuticals in the domain of the life sciences. International benchmarking reports dealing with the national innovation system of the United Kingdom refer to its persistent strength in the generation of new knowledge as supported by a highly productive research base comprising of world-class universities and research institutions that are part of high-level networks of international research collaborations (BIS, 2014a: 23). Corresponding policies are widely regarded as effective means in advancing the knowledge base of the British economy. In particular, these policies address the second dimension of intangibles assets, as outlined above, namely the domain of innovative property (Mason and Nathan, 2014; BIS, 2011a). In this regard, the competitive funding system is said to drive excellence in research and innovation. In fact, according to an OECD assessment, financial and fiscal incentives as well as supportive organisational structures have led to the formation of strong formal and informal knowledge networks and clusters that are indispensable for industrial competitiveness in science-based industries (OECD, 2010b: 23). Recent efforts in the restructuring the intermediate research and technology sector and the promotion of public-private research collaborations on a broader scale of business operations underline the strong role of higher education and international research for the growth path of the British economy (PACEC, 2011; TSB, 2014a; TSB, 2014b). All of this underlines the strategic character of intangible assets associated with innovative property –and the relevance of policies in support of these kinds of intangibles. The following survey of the United Kingdom will therefore focus on best practices in the support investment in intangible assets associated with innovative property.

Germany, the third economy to be surveyed in the following sections, is the economically most potent economy in the European Union. It stands for the model of a coordinated market economy with governance mechanisms that include labour unions and business associations next to firms and government as key actors in the combination of market and non-market coordination. Industrial structures involve both large multinational enterprises and networks of small- and medium-sized enterprises, which are regarded as indispensable backbone of employment and economic growth (BMBF, 2012: 19n.). Competitive advantages in export-oriented manufacturing industries such as automotive go hand in hand with a focus on incremental innovations that build on the integrative use of the productive knowledge of the workforce (EFI, 2012; Ebner and Täube, 2009). Corresponding policies that promote investment in research and education reserve a key role for intermediate organisations. This consideration of the applied industrial relevance of scientific research contributes to the long-term strategy for economic growth that has recently become ever more enhanced by the issue of sustainability (BMBF, 2012: 21).

Particularly successful policy fields in this strategic outlook relate to best practices in support of small- and medium-sized enterprises, the successful promotion of start-ups and entrepreneurship and the promotion of knowledge clusters. In this manner, German policies in support of workforce training are deemed to be best practice model for policies in support of economic competencies, which are an additional sub-category of the set of intangible assets outlined above (Lenske and Werner, 2009; BMWi, 2009).

Based on available evaluations of the related policy measures, examples of best practices in Finland, the United Kingdom and Germany are taken to the fore. In view of the sequence of presentation, this is in line with national advantages in the key dimensions of intangible assets as outlined above. The following sections thus highlight best practice cases of policies in support of intangible investment in these countries.

2.1 Finnish policies for investment in intangible assets

2.1.1 Intangible assets in the Finnish innovation system

The economic development of the Finnish economy during the last 20 years is characterised by massive increases in intangible investments in the fields of R&D as well as education and work organisation, all of this framed by persistent concerns with the expansion of the national information and communication technology infrastructures. During the same period, comprehensive structural changes across the traditional, resource-based Finnish industries have contributed to a rise of unemployment, which still poses a major policy challenge. In view of the latter, the corresponding shifts in patterns of competitive industries point at the prevalence of the information and communication sector, which shapes the overall characterisation of the Finnish economy as an evolving knowledge-based economy with persistent advantages in the domain of high-value added manufacturing, in particular electronics, as well as information and communication technology-related services (Halme et al., 2014: 4). In this manner, Finland successfully built an extensive national knowledge based that is well connected with knowledge networks across Europe and beyond. This path of economic growth has been promoted in a most sustained manner by diverse government initiatives in collaboration with the corporatist organisations of labour unions and employer associations also involving key business firms such as Nokia, all of them pushing for a shift of specialisation patterns from a resource-based economy focussing on the primary goods sector to a service-oriented knowledge-based economy with a focus on information and communication technologies. Thus, the historically rooted corporatist governance structures of Finland’s coordinated market economy were reshaped and hybridised, in particular with regard to the expansion of the role of financial markets, as to fit the new mode of knowledge-based economic growth (Lindgren, 2011: 57n; Moen and Lilja, 2005).

In fact, in 2014 Finland has been portrayed as an outstandingly strong performer in the domain of information and communication technology (ICT). Its digital ICT infrastructure is viewed as the best in the world. It is ranked among the top-listed countries when it comes to the usage of information and communication technologies with more than 90 percent of the population using the internet. Also, the impact of the ICT industries is exemplified by the comparatively high degrees of innovativeness in this domain, which is well documented in patenting activity (Bilbao-Osorio et al., 2014: 15). This pattern of industrial, technological and institutional specialisation needs to be understood in the context of the economic crisis in the early 1990s that stimulated the shift towards knowledge-based economic growth with an emphasis on high-value adding innovative industries and services. The corresponding measures in the comprehensive policy strategy that was implemented in a collaborative mode of public-private interaction actually came to highlight a sustained boost in R&D expenditures, which actually rose to a GDP share above 3%, framed by concerted efforts in strengthening of the linkages between the diverse firms and other organisations in the national innovation system (Moen and Lilja, 2005: 368n). In effect, these efforts would contribute to the formation of the outstanding features of the Finnish innovation system ever since the 1990s, namely a high rate of tertiary degrees in the population, high percentages of public and private investment in R&D with high rates of high-technology patenting (Georghiou et al., 2003: 55). In 2012, the Finnish share of gross expenditures on R&D per GDP amounted to 3,55%, with public share of 0.95%, well above OECD average level and thus exposing Finland once again as a top spender on R&D operations in international comparison (OECD, 2014: 315).

The OECD's comparative performance of national innovation systems currently ranks Finland as a top 5 performer regarding the following items (OECD, 2014: 260n):

- wireless broadband subscribers per population,
- public expenditures on R&D per GDP,
- industry-financed public R&D expenditure per GDP,
- business R&D expenditures per GDP,
- top 500 corporate R&D investors per GDP,
- triadic patent families per GDP,
- young patenting firms per GDP
- venture capital per GDP,
- tertiary education expenditure per GDP,
- top 500 universities per GDP,
- doctoral graduate rate in science and engineering,
- top adult performers in technology problem solving,
- top 15 year-old performers in science.

All of these characteristics of the Finnish innovation system underline the exposed role of intangible assets in the Finnish economy, involving all of the three dimensions of computerised information, innovative property and economic competencies. Indeed, in the European and OECD contexts as outlined in Table 3 above, Finland has emerged as a high-performing economy in spending on intangible assets. As illustrated in Figure 1, this implies that investment in intangibles by far exceeds investment in tangible assets, which is also a stand-out quality in the international context. Table 4 once again depicts the comparative profile of this Finnish performance of investment in intangibles. In 2005, investment in computerised information has amounted to a GDP share of 1.02%, while investment in innovative property held a share of 4.01% with scientific R&D as largest sub-category holding a share of 2.73%. Investment in economic competencies then actually held a share of 4.07% with investment in brand equity as strongest field. All together, these investment activities in the domain of intangible assets would amount to a GDP share of 9,1%, which has been among the highest shares in the European context all the way during the 2000s. Until the mid-2010s, Finland has even expanded this top position in spending on intangibles.

Table 4 **Intangible investment as percentage of GDP in Finland, 2005**

Investment in Intangible Assets	Percentage of GDP
Computerised Information	***1.02***
Computer software	.
Computerised databases	.
Innovative property	***4.01***
Scientific R&D	2.73
Mineral exploration	0.04
Copyright and license cost	0.14
Other product development	1.10
New architect./ engin. designs	1.10
Economic competencies	***4.07***
Brand equity	1.74
Advertising expenditure	.
Market research	.
Firm-specific human capital	1.18
Organisational structure	1.15
Purchased	0.41
Own account	0.73
Total	***9.10***

Source: Adapted from BIS (2012: 61, Table 2).

In view of this performance, it is fair to suggest that the Finnish innovation system provides a most telling example of an institutional environment that matches the requirements of a new techno-economic paradigm based on information and communication technologies, which are set to serve as carrier technologies of economic growth in the knowledge-based economy (Freeman, 2002).

2.1.2 Actors and Policies in the Finnish innovation system

In policy terms, then, the Finnish National Innovation Strategy as officially promoted by government targets the support of investment in intangible assets through the definition of two main policy goals. The first goal is to improve productivity in new and established firms, the second goal seeks to facilitate technological and organisation innovation in promising industries. In both of these strategic thrusts, the actual focus is on the promotion of information and communication technologies. Pillars of the underlying strategy are an outspoken demand focus and user orientation that seeks to interactively involve users in the innovation process, framed by a systemic and broad-based policy approach that highlights the interdependence of diverse institutional factors of innovativeness across economy and society at large (Oy, 2009: 21). Accordingly, it may be argued that Finnish policies underlying the evolution of the national innovation system policy represent an ambitious strategy for long-run growth that seeks to create a balance between supply and demand-side policy measures while accounting for their inherent complementarity (Edquist et al., 2009: 50).

Supply-side policy measures in the support of the Finnish innovation system may be distinguished in terms of the provision of financial means and services. Both involve a complex array of policy components that are largely targeting the intangible assets of firms. The provision of financial means involves grants for industrial R&D in the private sector. Particular formats are grants for collaborative R&D, reimbursable loans, and competitive R&D funding mechanisms. Corresponding funds for public sector R&D highlight the funding of universities and research laboratories, grants for public-private research collaborations, and the funding of contract research. Entrepreneurial perspectives inform the policy measures of equity support. They involve public ventures capital, mixed public-private venture capital as well as performance-based tax incentives. These financial instruments are complemented by fiscal measures such as tax grants for R&D operations and personal tax incentives for R&D personnel. Also, the financial support for workforce training and mobility matters. It includes the funding of firm-specific training courses, tailored training programmes for entrepreneurial management, funded research studentships, and the funding of the recruitment of scientists and engineers. Furthermore, services that are meant to enhance the competitive performance of firms and industries include services for public information brokerage, involving the provision of patent and contact databases, brokerage platforms and events, as well as advisory consulting services. All of this is complemented by networking measures such as collaborative foresight projects as well as the organisational establishment of science parks and business incubators. These supply-side measures, which relate to an exposed role of intangible assets as target objects are paralleled by demand-side measures which supplement the supply-side enhancement of the knowledge base of firms by addressing the systemic character of innovation. Systemic policies on the demand-side take on the domains of clusters and supply- chains, which are moulded by governmental frameworks. Corresponding regulations and standards are meant to set incentives for innovation while public procurement policies shape market processes in favour of certain industries and technologies. These efforts are completed by the policy support of private demand, in particular by means of information delivery and tax incentives in support of consumer awareness and customer training regarding new technologies (Edler and Georghiou, 2007: 953).

The policy actors of the Finnish innovation system, which design and implement the set of policy measures outlined above, have mostly come into existence since the 1980s and 1990s, that is, during the decades when the Finnish economy went through a phase of rapid modernisation and sectoral reorientation towards new and innovative industries. The Finnish Research and Innovation Council is the political organisation that is actually responsible for the strategic setting of the Finnish innovation policy. It defines the overall priorities, analyses systemic problems and formulates rationales for new policies. It is chaired by the Prime Minister and comprises of expert members from the highest political levels. Its power and influence is the basis for the successful coordination of industry and technology policies with an innovative orientation as the basis for the promotion of investment in intangible assets (Edquist et al., 2009: 22).

An overview of the key policy actors of the Finnish innovation system yields that most of their activities contribute to the support of investment into intangible assets. Relevant ministries that are concerned with policies in support of intangibles are the Ministry of Employment and the Economy – formerly titled Ministry of Trade and Industry – as well as the Ministry of Education and Culture, and the Ministry of Finance. Together with the Research and Innovation Council they are all together responsible for the general strategy and policy setting as they supervise several funding and support agencies. The Sitra innovation funding agency is supervised by the Finnish Parliament while Tekes – Finland's primary organ in support of R&D and innovation – is governed by the Ministry of Employment and the Economy which also supervises industry-specific funding agencies such as Finnvera. A further major agency that relates to the support of investment in intangible assets is the Academy of Finland, which promotes academic research funding under the auspices of the Ministry of Education and Culture. All of these agencies in turn aim to foster and support specific organisations and programmes in the research and education sectors, in particular universities and polytechnics, as well as targeted knowledge-based firms and industries as well as their organised interest groups (Halme et al., 2014: 13n).

Also, the Finnish innovation system exhibits an extended network pattern of university-industry relations, which contribute to the utilisation of intangible assets across public and private sector. For instance, Finland's systemic strategy of building a knowledge-based economy directs specific attention to various complementary forms of economic competencies such as design and management practices. Finnish universities contribute to these efforts by revamping their research and teaching profiles in line with the articulated needs of the business sector (Montonen and Eriksson, 2013: 111). At the same time, organisations in the science and education sectors are subject to adaptive pressure for competitive performance themselves. Thus, universities are facing organisational mergers while there are plans for reducing the number of governmental research institutes from 17 to 9 by 2016 in order to combine cost-efficiency with a focus on new demands of business firms in the evolving knowledge-based economy (Lemola, 2014: 37).

In this process of the institutional renewal of the national knowledge base, Finnish polytechnics stand out as important actors. This is also due to their impact on regional development and their strengths in applied sciences that benefit the actual competence requirements of the business sector. This division of knowledge-related affairs between universities and polytechnics is regarded as a major strength of the Finnish innovation system (Oy, 2009: 10). Yet, of course, also universities may take on policy-relevant and applied topics. The University of Eastern Finland makes the case for teaching innovation-related knowledge. It was established in 2010 as a merger of two neighbouring universities. The university plays an important role in the regional innovation system of Eastern Finland and facilitates local learning processes that benefit business by involving private sector firms and other extra-academic organisations as course co-operators in its curricula. For instance, the newly introduced subject of innovation management was planned in view of the needs of local SMEs in its emphasis on practical learning. The corresponding teaching profile seems to have encouraged students in launching new start-up companies (Montonen and Eriksson, 2013: 111-116). A similar initiative in the transfer of knowledge is carried out by Demola, a publicly funded open innovation platform that brings together university students with companies and research institutes. The platform aims to facilitate the development of product and service concepts and their practical implementation. The key idea is that students obtain working experience while companies gain new ideas. Students may receive intellectual property rights in the course of their work while the participating companies can purchase these rights or the students may further develop them and create new enterprises themselves (Salminen and Lamminmäki, 2014: 52).

These university-industry relations, which add to the accumulation and utilisation of intangible assets, are complemented by the likewise highly relevant knowledge transfer between public research institutes and private sector firms. The system of Strategic Centres for Science, Technology and Innovation has been set up to foster close cooperation in this domain. In particular, SHOK represent a demand-oriented and user-driven innovation policy approach that allows firms, business associations and other groups to participate in the decision-making process. The centres are coordinated by non-profit companies and are jointly owned by its shareholders (OECD, 2011b: 78). Public funding organisations are committed to the SHOKs as they safeguard the means of long-term public financial funds that serve as stakeholder devices in the operations of the related projects (Piirainen, 2014: 112). This approach with its long-run commitments has enabled some SHOK organisations to experiment with a variety of business concepts in order to elaborate and promote them in the wider system of innovation. In this context, a key quality of the structure of the SHOKs is their encompassing and integrative outlook that seeks to enrich the capabilities of all committed actors and organisations while maintaining the logic of innovation as a collective process (Halme et al., 2014: 14n.). Assessments of the SHOK system endorse their experimental procedures that play a major in the strategic renewal of existing business domains, in particular when it comes to their capacity to contribute to the restructuring of large incumbent firms in more traditional industries (Edquist et al., 2009: 331n.; Oy, 2009: 10). A distinctly spatial approach adds to these efforts by promoting the advance of industrial clusters in certain locations. From 2014 onwards, the Innovative Cities Programme supports 12 selected urban regions in which to strengthen internationally attractive innovation clusters, based on collaborative projects between business firms, research organisations and political-administrative players (OECD, 2014: 318).

Crucially, policy evaluation is an important issue concerning the redesign of policies and corresponding modes of policy learning. Indeed, a well-positioned network of evaluating organisations and programmes exists in the Finnish innovation system. In 2003, the Ministry of Trade and Industry, predecessor of the Ministry of Employment and the Economy, commissioned a comprehensive report that evaluated the Finnish innovation support system and its role for the evolution of a knowledge-based economy (Georghiou et al., 2003). The Ministry then based its policy measures on the recommendations of the evaluation results. The underlying evaluation practices serve as a consulting device for the management of Finnish funding agencies and research institutions alike, thus underlining collective processes of institutional learning and policy adaptation (Oy, 2009: 32n). This mode of the evaluation of outcomes may be viewed as a key to the formation of institutions that are able to facilitate investment in intangible assets in an efficient as well as effective manner. Indeed, the Finnish case refers to the necessity of accountable and independent evaluation practices, which implies that a third party commissions the evaluation in order to further common practices of learning and adaptation. The Finnish Higher Education Evaluation Council is such an independent expert body that assists universities and the Ministry of Education and Culture in its evaluation efforts (Edquist et al., 2009: 51).

2.1.3 Information and communication technologies as lead sector

The sector of information and communication technologies has played a vital role in Finland's transformation to a knowledge-based economy. As outlined above, Finland's digital information and communication infrastructure is viewed as the best in the world, serving as the material basis of internationally competitive and innovative ICT industries (Bilbao-Osorio et al., 2014: 15). Indeed, Finland has made significant progress in this field. In terms of R&D, output and exports, the Finnish ICT industry has become one of the most specialised industries on a global scale ever since the late 1990s and early 2000s (Georghiou et al., 2003: 46). The Finnish innovation system has maintained the basic patterns of specialisation in this domain even during the massive restructuring of the ICT sector in the late 2000s. A large amount of Finnish R&D expenditure is spent in the ICT industry. The underlying specialisation has been accompanied by a general transition of the governmental emphasis of a structural shift towards high-tech industries. This reorientation has also shaped related measures that are visible in the domains of science and education. Thus, the rapid technological development and economic expansion of Finnish ICT industries is also based on increasing levels of productive specialisation and workforce education. The ensuing evolution of higher education institutions that have been venturing into the domain of information and communication technologies has facilitated the rapid emergence of Finnish ICT clusters that have become a competitive environment for innovative firms in this sector generating positive externalities for the Finnish economy at large (Boschma and Sotarauta, 2007: 165).

With regard to the nation-wide ICT cluster that concentrates on the manufacturing of telecommunication devices and associated services it is actually Nokia, Finland's prime corporation in the domain of ICT, which has played an important role as a leading company of that cluster. During the 2000s, it has assembled a highly educated workforce and professional researchers contributing to the overall development of the Finnish ICT sector (Aiginger, Okko and Ylä-Anttila, 2009: 119-120). The attraction and availability of specialised skills and human resources have had a major impact on Nokia's international market success. Moreover, the shortage of an adequately skilled labour force initiated high-technology firms like Nokia to substantially invest in their economic competencies by means of training programmes and cooperation programmes with universities. This mobilisation of intangible assets on behalf of Nokia has been a common feature of its competitive strategy until recently, when Nokia underwent a lasting phase of restructuring since the late 2000s. Management failures in product development and ill-conceived projects of alliance formation accompanied by cost and pricing pressures from new competitors in Asia such as Samsung would induce a shift from mobile phones to telephone networks, all of this reducing the overwhelmingly dominant role of Nokia in the employment and market volumes of the Finnish ICT sector to a more competition-friendly level. In 2013, at last, Nokia's mobile phone business was sold to Microsoft. Indeed, the case of Nokia illustrates that even huge enterprises are vulnerable if they do not constantly reinvent themselves (Lemola, 2014: 48). Still, promising businesses opportunities prevail even in the aftermath of Nokia's restructuring as exemplified by the further development of Nokia's mobile phone operating system by other firms. Also, creative industries are progressing in the Finnish ICT sector – with game industry growing quickly. In effect, the Finnish ICT sector has moved from the manufacturing of products to the supply of services and software. Thus, while the production of hardware components has been outsourced to low-cost countries, knowledge intensive business activities that require high educational input persist within the country. Thus, for instance, the structural change within the ICT sector has led to an increase of employment in software firms (Salminen and Lamminmäki, 2014: 54n.).

At this point, it is fair to suggest that public infrastructures in support of the intangible assets of economic competencies have provided the skills and capabilities of the workforce, which were necessary for coping with the recent reshuffling of the ICT sector and which provided sound knowledge foundations for a sectoral innovation regime that would be able to cope with the decline of a big business player like Nokia in favour of a more diversified structure with new market entrants. This sectoral push for an improved portfolio of intangible assets took off with the expansion of university programmes in information and communication technologies, accompanied by public procurement with a focus on technologically sophisticated domestic companies (Sabel and Saxenian 2008, 55). Between 1993 and 1998 alone, the number of students in the polytechnics tripled while doctoral education was expanded and dozens of new postgraduate schools were established in the field of information and communication technologies all over Finland (Boschma and Sotarauta, 2007: 167). All of this would contribute to sustaining the strategic relationship between higher education policies and the development of an effective knowledge base for the ICT industry. On the one hand, government engaged in targeted industrial and technology policies by providing funding and fiscal incentives for private sector investment in the development and application of information and communication technologies. On the other hand, it created a supporting framework by setting up appropriate physical and legal infrastructures (Halme et al., 2014: 3n.).

Yet these efforts are currently subject to further evaluation as Finnish policies have adapted to the recent change in the domestic and international profile of the ICT sector at large. As suggested by the ICT 2015 Working Group, current policies aim at the support of the service sector as a new source of economic growth and societal welfare, thus striving to elevate the information and communication technologies to the actual backbones of a high value-adding service sector in Finland's knowledge-based economy (MEE, 2013). The ICT 2015 Working Group recognises that new opportunities in public and private services will arise during this reorientation. In fact knowledge-intensive business services are among the fastest growing service domains in Finland (Lemola, 2014: 37). In this setting, Finnish firms maintain a technological advantage in key areas of the ICT sector. Owing to the Finnish education strategy that has supported higher education in ICT and due to support agencies like Sitra, which have facilitated persistent cooperation and knowledge transfer between public and private sector, various forms of intangible assets continue flourishing in the ICT sector. The quality of Finnish ICT skills actually attracts international firms, which engage in high value-added operations in Finland. The skilled workforce also provides the knowledge base for entrepreneurial start-ups, which contribute to the rejuvenation of the ICT sector and promote its innovative edge (Salminen and Lamminmäki, 2014: 55). In this way, the Finnish ICT sector is a successful example of how policy measures may support a high road strategy of economic growth that relies on the nurturing and valorisation of a broad array of intangible assets. In this context, actors and strategies of local clusters, sectoral innovation regimes and national innovation systems interact in a complex policy setting, which needs to be adaptable to the changing concerns of the private sector.

2.1.4 Case: Sitra and the X-Road project

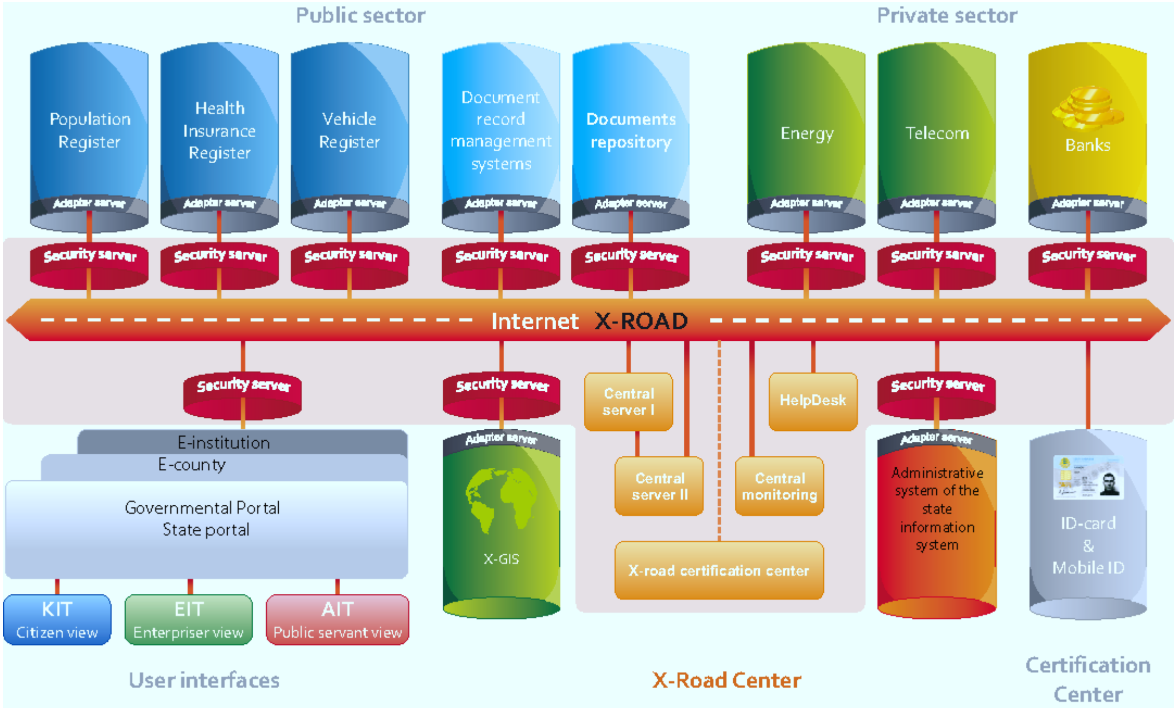
A quite unique organisation in the Finnish innovation system is the independent public foundation Sitra. It is a funding and development organisation, which directly reports to the Finnish parliament. It has a unique role in the Finnish innovation system because it is independent from governmental control in spite of being a public organisation. By offering a forum for discussion, it works as an intermediate organisation between polity and public sector organs on the one hand, particularly the parliament and ministries, and private sector industry on the other hand. Sitra is funded with endowment capital and returns from corporate funding operations. Its annual budget is about €40 million (Halme, Viljamaa and Merisalo, 2014: 93). The corresponding goals of Sitra aim at achieving a stable and balanced type of economic and social development by enhancing economic growth, international competitiveness and institutional cooperation. The main tasks in this official mission are the facilitation of technological, organisational and social innovations. In this vain, Sitra stands for a comprehensive societal understanding of innovation and learning, that accounts not only for firms as terrains of technological change, but also for their wider economic and social context (Sitra, 2013).

Sitra takes centre stage in the procedures of policy experimentation that characterise the Finnish innovation system. Indeed it has been maintained that industrial and technology policies in Finland exhibit an experimental character that allows for reflexive trial-and-error procedures, which are meant to prevent institutional and technological lock-in effects across the economy. This means that Sitra exceeds the function of merely providing research funding and related financial resources. Instead, schematically, it also plays the role of a knowledge mobilising and brokering agency within the governmental structures of the Finnish poliy (Edquist et al., 2009: 51). In order to promote institutional improvements, Sitra persistently designs and launches new initiatives in the spheres of funding technological R&D or promoting venture capital. Yet it is also Sitra's role to train and assist decision-makers and the wider public and to connect the key actors in related networks. Thus, Sitra facilitates informed policy decisions concerning the improvement of the Finnish economy in a technologically changing world. In this way, Sitra is to be regarded as a major agent of change whose operations are in line with the stimulation of investment in intangible assets (Halme, Viljamaa and Merisalo, 2014: 93).

Historically, Sitra was the first public fund for financing technological R&D. Its activities constituted the model for Tekes, the Finnish Funding Agency for Technology and Innovation, which was established in 1983. In between the years 1987 and 2000, Sitra's main focus was the promotion of business development and the provision of venture capital for technology companies. In this manner, it served as a syndicate partner for private venture capital investors and facilitated the provision of new kinds of venture capital with a public or public-private structuration (Edquist et al., 2009: 25). Since the new millennium, however, the new emphasis of Sitra's operations is on the experimentation and promotion of different types of innovations across economy and society. It proceeds as a catalyst of novelty-embracing processes that seek to reduce structural rigidities and network failures in the related innovative endeavours. In 2012, three specific themes were outlined in Sitra's general strategy, namely the sustainable and smart use of natural resources, new opportunities for economic growth, and new forms of well-being services. In this manner, technological, organisational and social innovations are integrated into a new framework that addresses problems of the socio-ecological sustainability of economic growth aligned with the conditions of the knowledge-based economy (Halme, Viljamaa and Merisalo, 2014: 93).

The promotion of information and communication technologies is a most prominent domain of Sitra's innovation funding. In this setting, a highly successful example of Sitra's operations is delivered by the cases of e-Finland and e-Services that support the use of computerised information in cooperation of public and private sectors. In effect, these projects target the stimulation of investment in the intangible assets of computerised information, in doing so providing a best-practice case of related policies. At the heart of the underlying approach is the fast and cost-effective exchange of digital data through the multilateral X-Road concept, which has been adopted from Estonia's digital public services. The X-Road data exchange layer is a technical and organisational environment that allows organising secure web-based data exchange between different information systems. It enables public institutions, companies and the civil population to securely exchange data and organise the access to databases. It is connecting and harmonising various e-service databases, including public and private sector databases (Bird, 2013). Figure 3 provides an overview of these issues.

Figure 3 **Data exchange layer X-Road**



Source: Adapted from EISA (2013: 5).

The concept associated with this data exchange layer refers to a perspective of cross-border data exchange in the European digital market, as piloted by Estonia and implemented in Finland later on (RIA, 2013). Due to its ability to connect different information systems, it has been regarded as a "best practice" component of its national information infrastructure by the Estonian government, which has been keen to promote the use of information and communication technologies in its overall service orientation. With Estonia pioneering key projects of electronic government services in Europe, then, the data exchange layer served as a strategic role model for the Finnish side, which went for its adaptive transfer to Finland in the format of the X-Road project. From early on, Sitra has taken on a strategic role in the implementation of this project. This is due to the fact that Sitra is responsible for surveying international knowledge on innovative ICT solutions and for building the transnational ICT cooperation process between Estonia and Finland, among other efforts at transnational knowledge transfer. This means that Sitra's role as a strategic knowledge broker exceeds domestic affairs and involves international collaborative affairs as well, quite in line with the international outreach of technologies and markets (Kalja, Reitsakas and Saard, 2005).

Also, Sitra provides support services to new users of this data exchange system. In particular, Sitra's task is to communicate operating mode, advantages and safety standards of the X-road system to actors from the private sector, public administration and civil society. This advisory function, which involves knowledge transfer between suppliers and users of new technologies, goes hand in hand with the strategic exploration of the local conditions of technology adoption. For example, Sitra is funding local data exchange trials in the municipalities of Lahti and Espoo in order to test the feasibility of the X-Road solution in the health care sector. In Lahti, the goal is to exchange patient records between general providers of primary health care and hospitals that are providing specialist medical treatment. In Espoo, the aim is to connect nursing sector information systems with the mobile information management system of home care services. Both of these projects stand for a strategy of local experimentalism that outlines possible conditions of technology adaptation and implementation in Finland. Local experience is evaluated, tested for generalisation and then feeds into the overarching national strategic framework (Suomalainen, 2014). In effect, then, the case of Sitra and the project of the data exchange layer X-Road pinpoint the exposed role of information and communication technologies in the sectoral specialisation of the Finnish innovation system and its policy profile in support of intangible assets.

2.1.5 Case: Tekes and the Innovation Mill project

The entrepreneurial introduction of new firms with an extensive growth potential in promising new industries is a key issue in Finland's evolution towards a knowledge-based economy. In this context, Finnish government policies that target the creation of new entrepreneurs are based on the idea of market failures; that is, the notion that pure market outcomes in the formation of new firms may be below the social optimum and thus policies need to remove the diverse institutional and financial barriers of entrepreneurship in order to improve the overall vibrancy of the firm population of key industries. In light of these conceptual underpinnings, the Finnish government's communication on the National Innovation Strategy highlights prominent themes such as company taxation and insolvency legislation as obstacles to the market entry and rapid growth of entrepreneurial firms. Corresponding action plans are meant to overcome these hindrances to a renewal of the Finnish economy (MEE, 2009). The financial aspects of these barriers to entrepreneurship are tackled by industrial and technology policy organisations such as Sitra which provide venture capital and support services for new innovative firms with an outstanding growth potential. Yet a key aspect of these kinds of policies in support of the knowledge base of the economy is addressed by the fact that the Finnish strategy puts an additional premium on the transfer of knowledge between established and new firms in strategic projects that are also meant to bridge the private and public sector (Murray et al., 2009: 160). The matter of knowledge transfer as a means to boost entrepreneurship thus resembles a major domain of policy activities in support of investment in intangible assets.

Tekes, the Finnish Funding Agency for Technology and Innovation, is the most important Finnish public funding agency for financing R&D and technological innovation. It is the intermediary organisation of the Ministry of Employment and the Economy and aims at broadly supporting innovation activities in public research institutions and industry. Tekes particularly targets the promotion of intangible assets through combining the concern with new technologies and new developments in the fields of service-related, design and business process innovations (Edquist et al., 2009: 23). As a matter of fact, these comprehensive efforts are set to even expand the range of intangible assets, for Tekes currently promotes projects on intangibles that involve human feelings as a source of new business opportunities. In this manner, customer experiences are meant to become an internal factor in the accumulation of intangibles on behalf of the involved firms (Tekes, 2014). Based on these wide ranging funding activities in the diverse areas of the Finnish innovation system, then, it has been claimed that besides the universities and polytechnics, both the Ministry of Employment and the Economy and the Tekes organisation are of prime importance for the operations of public-private knowledge transfer in Finland (Kotiranta et al., 2009). In this manner, Tekes is a key component in the policy-based promotion of private sector investment in intangible assets. This becomes particularly relevant when it comes to the organisation of collaborative projects between large established firms and entrepreneurial start-ups.

The case of the Innovation Mill project illustrates these strategic efforts quite remarkably. As an awarded initiative supported by Tekes, the Innovation Mill project is actually based on a public-private cooperation effort between Tekes, Nokia and Technopolis, the latter being an operator of technology and business parks. The target mission of the Innovation Mill is to promote innovative entrepreneurial start-up business activities across the Finnish economy. In a quite specific manner, the corresponding project sets out to utilise the innovative business potential that is contained in Nokia's intellectual property rights regarding certain product and process innovations that do not belong to Nokia's core business. These kinds of intangible assets are transferred to the scrutiny of entrepreneurial start-ups, which may further develop and commercialise them, in order to gain access to the markets. In fact, during the first year of its operation, more than 1300 companies in 18 Technopolis campuses across Finland have gained access to 4000 unused Nokia ideas in order to adopt them for commercial practice. Tekes serves as a selection organ as it finally comes to decide, which projects are set to receive funding for further activities. In this manner, the intangibles assets of a large established firm, namely the unused ideas of Nokia, are transferred to new firms, which are selected for funding by the policy organ Tekes (Technopolis, 2010a: 2). When the Innovation Mill was established in 2009, it was regarded as a unique and pioneering initiative concerning the creation of new businesses and market opportunities. Today, the initiative is still regarded as successful. The initial aim was to collect €8 million through public and private funding. Currently, five years since operations actually began, the project portfolio has a size of approximately €30 million including €15 million in risk capital (Salminen and Lamminmäki, 2014: 51). Also, since 2009, the Innovation Mill program has successfully promoted the entrepreneurial commercialisation of more than hundred technologies and created more than 1000 new jobs (Landowski, 2015).

The case of the Innovation Mill impressively demonstrates how large, technology-based companies may enable the creation of new innovative enterprises when supplemented by governmental initiatives that focus on the transfer of knowledge. A prominent example of one of the first successful Innovation Mill projects is the Nokia Sports Tracker, which is the winner of the 2009 Global Mobile Award for Best Mobile Internet Service. The Sports Tracker is a web application for smart phones that monitors fitness levels and makes the information available online (Technopolis, 2010a). Another one of the first successful Innovation Mill project is the Newelo Need4Feed service that won the World Summit Award for Mobile Content in 2010. Newelo Need4Feed is a service for media houses and news agencies that enables flexible mobile workflows and closer customer relationships. Furthermore, it may be adapted to the needs of NGOs and their related civil society communities (WSA, 2010). In this manner, again, the notion of intangible assets is elevated to a society-wide concern that cuts across policy fields and industrial domains.

2.1.6 Conclusions on Finnish policies for investment in intangible assets

Finnish policies in support of investment in intangible assets illustrate quite convincingly how a combination of industry and technology as well as science and education policies can foster the transition to a knowledge-based economy with a particular sectoral focus on the ICT industries. Especially for a small open economy like Finland, it is important to improve and sustain international competitiveness by means of upgrading and adapting the knowledge base of firms, industries and the economy at large in line with international technological trends and market dynamics. Finnish policy measures have successfully incorporated the analysis of these global development trends and changes while maintaining a societal model that stands for coherence and inclusiveness as it perceives intangible assets as a genuinely social phenomenon with wide-spread economic implications (Salminen and Lamminmäki, 2014: 58).

Indeed, Finland's policy approach in the domain of intangibles represents an outstanding case, as it constitutes the key to the Finnish understanding to the combination of economic growth, socio-ecological sustainability and the prevalence of a well-equipped welfare state. All of these concerns are actually based on the strategic thrust towards the formation of a knowledge-based economy, which utilises intangible assets as a key resource. It creates new potentials for the further development of computerised information, innovative property and economic competencies as preconditions of technological innovation and economic growth. While the Finnish innovation system reserves a driving role for the private sector and its entrepreneurial potential, it is still government that exercises the important role of fostering and governing the cooperation between public and private sector. The latter set of affairs is particularly relevant in the facilitation of knowledge transfer and the organisation of collective learning and adaptation across firms and industries (Lemola, 2014: 39). Owing to the interaction between private sector industry and the key organisations of the research and education system, which are framed by the corresponding agencies for policy and strategy setting as well as for funding and innovation support, it becomes obvious that Finland stands out as an institutional model of a technological advanced coordinated market economy that has made tremendous progress in building the foundations of an ICT-oriented knowledge-based economy.

Policies in support of investment in intangible assets have played a crucial role in this effort by combining a sectoral focus on the components of computerised information with complementary efforts in research and education. These policies have stimulated private investment in strategic sectors of the economy, and they have also contributed to their entrepreneurial renewal; an aspect that is most relevant once again in the ICT sector. These policies have been based on institutional structures laid down in the past – which means that they need to be perceived as context-specific and difficult to emulate (Boschma and Sotarauta, 2007: 172). However, the Finnish case also shows that it is possible to adopt both technological and institutional components from other countries as well, given appropriate local conditions – the transfer of the originally Estonian concept of the X-Road digital services project provide ample evidence for doing so (Lemola, 2014: 41). The latter example also provide s evidence for the spread of procedures of transnational knowledge transfer and collective learning in the European Union, in this case with Estonia, a former Soviet republic and new EU member state as innovative pioneer; and with Finland on its way as a high-performing knowledge-based economy that spreads its knowledge networks in support of intangibles across potentially confining national boundaries.

2.2 British policies for investment in intangible assets

2.2.1 Intangible assets in the British innovation system

The United Kingdom may be most adequately characterised as a liberal market economy, which exhibits a dominant pattern of market coordination through investment in transferable assets. Market-oriented characteristics dominate the major sub-systems of corporate governance, industrial relations, skill formation, education and training, finance, technology transfer, innovation, and polity. Most relevant with regard to the matter of intangible assets is the matter of skill formation, which proceeds basically on the job without a formal apprenticeship system for vocational skills. Accordingly, the system of education and training relies on investment in the formation of general skills and human capital. Technology transfer then proceeds in terms of a competitive mode of standardization and market-based mechanisms of technology transfer. Firms are expected to realise advantages in the more radical and disruptive types of innovations, due to the flexible institutional setting they are nested in. This mode of innovation feeds back into competitive advantages during periods of changing techno-economic paradigms with a strong bent for entrepreneurial initiatives. All of this is framed by a political system that operates in the mode of a liberal regulatory state that maintains the primacy of market-based incentives in the regulation of economic affairs (Casper and Kettler, 2001: 14; Hall and Soskice, 2001: 38-41).

During the post-war era, the British economy regained industrial strength in its internationally competitive industries such as automotive, aerospace and pharmaceuticals. Ever since the late 1970s, however, the British economy has been shaped by a politically enforced drive towards the service sector, although core activities in manufacturing prevail that are accompanied by the rise of new science-based industries such as biotechnology with its distinct knowledge environments and modes of innovation (Booth, 2001; Casper and Murray, 2004). Indeed, British industry is prominently specialised in the high-tech domain, yet with a comparatively reduced presence of manufacturing industry and a persistently strong service sector. Science-based industries stand out when it comes to technological innovation efforts. They include biotechnology, biosciences and pharmaceuticals accompanied by defence, aerospace and automobiles. This bias in industrial innovation also reflects the eminent role of financial markets in the provision of venture capital (Leijten et al., 2012). The metric of revealed technological advantage corroborates this assessment with British advantages in industries such as pharmaceuticals, chemicals and aerospace (Tylecote and Visintin, 2008: 258n.).

As outlined above in Table 3, the United Kingdom is a top performer when it comes to spending on investment in intangible assets. Indeed, its performance in this regard has been outstanding throughout the 2000s (BIS, 2012: 61). With reference to Figure 1 it may be added that this constellation of high investment in intangibles also means that the latter are much higher than comparable investment measures in the domain of tangible assets. Again, this prevalence of intangible investment underlines the reduced role of the manufacturing sector over an expanding service sector. Table 5 takes a focused look at the comparative profile of this British performance of investment in intangibles during the year 2005 when these investment volumes amounted to an impressive GDP share of 10.88%. In fact, in this mode, the British economy has been the top performer across all the European economies. In this year alone, investment in computerised information has amounted to a GDP share of 1.7%, while investment in innovative property held a share of 3.23%. It is noteworthy that investment in scientific R&D was only the fourth largest sub-category holding a share of 1.06%, while new architectural and engineering designs amounted to 1.2%, copyright and license cost amounted to 0.21%, and other product development held the largest share of 1.92%. Obviously, the performance of R&D in the United Kingdom stands out with regard to its high intensity in certain industries yet it is not a quantitatively exposed factor in the overall profile of investment in intangible assets. Investment in economic competencies held a comparatively large share of 5,95% with brand equity at 1.59%, organisational structure at 1.92% and firm-specific human capital, involving workforce training, at 2.45%.

Table 5 **Intangible investment as percentage of GDP in the United Kingdom, 2005**

• Investment in intangible assets	• Percentage of GDP
• ***Computerised Information***	• ***1.70***
• Computer software	• 1.70
• Computerised databases	• .
• ***Innovative property***	• ***3.23***
• Scientific R&D	• 1.06
• Mineral exploration	• 0.04
• Copyright and license cost	• 0.21
• Other product development	• 1.92
• New architect./ engin. designs	• 1.20
• ***Economic competencies***	• ***5.95***
• Brand equity	• 1.59
• Advertising expenditure	• 1.20
• Market research	• 0.39
• Firm-specific human capital	• 2.45
• Organisational structure	• 1.92
• Purchased	• 0.60
• Own account	• 1.31
• ***Total***	• ***10.88***

Source: Adapted from BIS (2012: 61, Table 2).

At this point, the matter of R&D expenditures in the basic setting of intangibles needs some more specification. As indicated by the available data, the British innovation system performs significantly better with intangible investments instead of tangibles. More recent data about the structure of investment in intangible assets for the year 2008 underline the comparatively reduced weight of R&D in this setting. Indeed, it held a share in intangible investment of about 11%, whereas software amounted to 15% and design to 17%: The share of training and organizational capital was at 22% (Dal Borgo et al., 2012). Further evidence from a business survey underdone in the late 2000s shows that the incidence of non-R&D intangible spending in domains such as workforce training, software and brand-building is much more widespread in the population of business firms at large than R&D spending. This underlines the impression that R&D expenditures – which still cover by far the highest average investment in the field of intangible assets – are subject to operations concentrated in certain firms, clusters and industries, while non-R&D intangible investment is much more common across firms and industries. This is primarily due to the extension of the service sector, in particular the financial services, which invest only marginally in R&D as compared with workforce training, software and brand-building, among others (Awano et al., 2010: 68n.). This actual spread of investment in intangible assets exhibits further interesting qualities when it comes to the international comparison of investment excellence. In fact, there are only two minor areas of intangible assets in which the United Kingdom stands out as a dedicated top-5 investor in the OECD world, namely the areas of "e-government readiness" and the "doctoral graduate rate in science and engineering" (OECD, 2014: 260n.).

Indeed, it seems that the British pattern of industrial and technological specialisation goes along with a comparatively narrow path of R&D operations. The GERD/GDP ratio for the United Kingdom has been operating way below the threshold level of 2 % all the way during the 2000s – with comparatively high shares of publicly funded and performed R&D. This GERD/GDP ratio is slightly below the average of all the European Union economies and significantly below the globally leading economies regarding GERD/GDP profiles, namely Japan and the United States. Patenting activities on the output side of innovation have remained below the OECD median value as well. In 2012, the GERD/GDP ratio remained at 1.73%, still way below the OECD level (OECD, 2014: 440; OECD, 2012b). More than 60% of all R&D in 2010 has been carried out by private sector businesses, 27% in higher education, 9% in government and the rest in non-profit organizations. In terms of a comparative perspective on the GERD/GDP ratio within the OECD, this R&D profile underlines the outstanding role of the organizations of higher education in British R&D (OECD, 2010c). In view of this pattern, a recent benchmarking study of the British innovation system pinpoints a sustained, long-term pattern of under-investment in public and private R&D and publicly funded innovation (Allas, 2014: 32n.). Thus, given the comparative weakness in R&D expenditures and broad- based cross-sectoral innovation, the strengths of the British innovation system seem to rely most heavily on the domestic knowledge base in the science sector and its relations with selected science-based industries.

The latter aspect reflects a pattern of university-related research activities with an emphasis on R&D cooperation, most recently augmented by efforts in high-tech sectors such as biotechnology that are characterised by a persistent cluster dynamism of entrepreneurial spin-offs, which reflects the relative ease of entrepreneurial activities (D'Este and Patel, 2007). Indeed, the British innovation system has been ranked by the World Economic Forum as a second placed top contender in an international comparison for university-industry collaboration in R&D. In international comparative perspective, it also stands out in terms of business R&D funding from abroad, which underlines its international openness and transnational linkages, and at the same time it performs persistently well in scientific output as measured by scientific citations (BIS, 2014b). Universities are a key terrain for investment in intangible assets related to technological change. In fact, according to a recent survey, universities in the United Kingdom provided services with a total value of £3.4 billion in the academic year 2011-2012 alone. The corresponding sets of university services include the commercialisation of new knowledge, delivery of professional training and a broad range of consultancy services (HEFC, 2013b). Nonetheless, the British economy faces major challenges in its drive towards a knowledge-based economy. Among others, corresponding policies need to address the ongoing supply of human resources in the domain of science and technology, which reflects the comparatively low share of science and technology occupations in total employment across the United Kingdom (OECD, 2012a; Cunningham and Sweinsdottir, 2012: 12).

2.2.2 Actors and policies in the British innovation system

The governance and policy dimensions of these distinct profiles of innovation and industrial change in the United Kingdom are straightforward. First of all, the market-based coordination patterns of liberal market economies such as the United Kingdom tend to rely more prominently on formal regulations and government activities in science and technology that are meant to promote radical technological change in line with the logic of market competition. In official expositions, thus, the private sector is said to be in the lead while government facilitates and provides adequate institutional conditions for technological innovation in promising industrial fields. In this context, references to the policy support for intangibles have been experiencing a prominent exposure in British politics quite recently. In order to target economic recovery and address barriers to growth, governmental organs have formulated a set of policy measures, which include both horizontal measures and the identification of key target sectors that are subject to selective measures (Warwick, 2013: 9). The ruling conservative-liberal coalition government that took over from Labour in 2010 actually continues with supporting industrial policy despite giving market forces the priority in shaping the competitive performance of British industries. An essential component of these efforts is the improvement of the innovation performance and the enhancement of the competitiveness of private sector firms. Both the generation and adoption of new technologies are taken to the fore with a specific concern for the technologically and sectorally specific utilisation of intangible assets, in particular those associated with innovative property and economic competencies. Thereby, the commercial utilisation of new technologies poses a major challenge that should be met by the support of investment in a broad set of intangible assets ranging from R&D via skilled human resources to new business models, design and branding as well as intellectual property rights (BIS, 2011a: 5n.; Cable, 2012). This interest in sector-focussed strategies encompasses the support of investment in intangible assets in the field of intellectual property rights, R&D and beyond. On the one hand, plans for government actions aim at developing collaborative strategic partnerships with key sectors and the support of emerging new technologies with huge growth potential. On the other hand, government plans intend to boost workforce skills, introduce a more strategic approach to government procurement and improve access to finance for small and medium-sized enterprises (Mason and Nathan, 2014: 5).

The institutional scaffold of the national innovation system of the United Kingdom that drives its overall performance is constituted by interactions between business firms, universities, research organisations, industry associations and unions, political and administrative organs as well as diverse actors in the complementary policy areas such as research, education, and finance. The coordination of these interactions combines the competitive dynamics of markets with extensive legal frameworks provided by government. In this setting, a key policy player in the governmental domain is the Department for Business, Innovation and Skills, which is responsible for several related policy areas such as technological innovation, intellectual property rights as well as science, research and higher education. In particular, it prioritises investments in emerging technologies that have a wide application and in which the United Kingdom already has significant scientific and commercial strengths (BIS, 2011a: 6). BIS also oversees the Government Office for Science and houses the Council for Science and Technology with its advisory functions for government. In this manner, BIS is a key governmental organ when it comes to the promotion of policies for investment in intangible assets.

A subsidiary public body is the Technology Strategy Board, a former advisory body within the Department of Trade and Industry, which has evolved into the United Kingdom’s premier innovation agency. It is an executive non-departmental public body that is sponsored by and reporting to the Department for Business, Innovation and Skills. As such, it targets the support of investment in those economic areas that are identified for having the most relevant impact on economic growth, which includes the domain of intangible assets in private sector business firms. These efforts proceed by leveraging additional private sector investment for business-led innovative projects. This entails the selective allocation of funding to particular market sectors and emerging technologies (BIS, 2011a: 33n). A complementing organisation monitored by the Board is the Small Business Research Initiative, which offers assistance to entrepreneurial start-ups as well as small and medium-sized enterprises in the commercialisation of their innovative products by providing lead customers from the public sector (SBRI, 2013). This initiative also stands for policy efforts at building the knowledge base of the business sector by promoting intangible assets in new, entrepreneurial firms. In this manner, TSB executes the logic of a market-enhancing type of industrial policy that is meant to overcome market failures when it comes to technological change. In view of these concerns, TSB actually changed its operative name to “Innovate UK” in 2014, in order to highlight its actual mission as an innovation agency that tackles key issues of intangible investment.

University-industry relations are the institutional backbone of the evolving knowledge base of the British innovation system. Governmental policies support the promotion of intangible assets that are nurtured at universities by means of complex strategies that comprise of the attraction of high-performing researchers, the expansion of competences and capabilities in operating procedures, and the training of future researchers that are meant to be channelled to the workforce of strategic industries (BIS, 2011a: 6). Ever since the 2000s, the Technology Strategy Board has co-hosted the N8 Industry Innovation Forum together with the Higher Education Funding Council for England and the N8 Research Partnership, which brings together the leading research-intensive universities and global firms involved with R&D in the UK, including AstraZeneca, Croda, National Nuclear Laboratory, Procter and Gamble, Reckitt Benckiser, Siemens, Smith and Nephew and Unilever. The Industry Innovation Forum supports the linkages among these key players in the national innovation system by creating collaborations between the established research base and industry (N8 Research Partnership, 2013).

The institutional and spatial pattern of British university-industry relations puts knowledge transfer and the utilisation of intangibles into the shape of knowledge agglomerations. In particular, regions such as Oxfordshire and Cambridgeshire exhibit clusters and networks of innovation deriving from world-class universities and research institutes combined with local university spin-offs and relocated business firms from within and outside the United Kingdom. The knowledge agglomeration of Cambridgeshire is characterised by a large share of small high- tech companies that are linked to the University of Cambridge. The success of this regional cluster is closely associated with the public funding of university spin-offs and the establishment of Science Parks that have furthered knowledge transfer out of academia into the market sphere of the commercialisation of innovation. For example, the Cambridge Partnership gathers together the private sector, government agencies and educational institutions in order to enable innovation and develop new entrepreneurial initiatives (Kramer et al., 2011: 451). The knowledge agglomeration of Oxfordshire draws on the excellent knowledge base of Oxford University and its diverse public and private research organisations. Several initiatives aim to support the formation and maintenance of high-tech firms in the region. An example is the Oxfordshire Investment Opportunity Network that is framed by the operations of a number of local science parks. In particular, the biotechnology industry has benefited from these kinds of dedicated initiatives that are partly funded by government. For instance, programmes for the commercialisation of university research support a professional spin-off system, which is the source of a growing number of biotechnology spin-offs with a high growth potential. Yet the Oxfordshire knowledge agglomeration with its distinct university-industry relations benefits not only from government investment, but also from non-governmental and private sector funding as provided by charitable trust and pharmaceutical industry funds, among others (Smith and Bagchi-Sen, 2006: 389).

Major financial support of higher education research facilities with the aim of advancing the opportunities of knowledge transfer is provided by the UK Research Partnership Investment Fund, set up by the Higher Education Funding Council for England in 2012 with a total of £300 million funds for 22 university projects and attracting additional private funds in the process (HEFCE, 2013a). It draws on experiences with the Higher Education Innovation Fund, which was established in 2000 to improve the funding of higher education, support the collaboration between industry and academia, and facilitate the commercialisation of university research (Abramovsky, Harrison and Simpson, 2004: 12). Currently, the fund targets the institutional structure of higher education in order to improve its role in the generation and transfer of knowledge based on linkages and interactions with the private sector. In effect, private sector organisations are stimulated to invest in the research capabilities of university students, who play a crucial part as future workforce in maintaining technological competitiveness. In this manner, the fund is set to stimulate investment in those kinds of intangible assets that relate to the human capital supplied by academia closely connected to the knowledge base of firms (PACEC, 2012: 86).

Modelled along the lines of intermediate research and technology organisations in countries such as Germany, which exhibit a tradition of publicly funded institutes for applied research closely cooperating with industry, the Technology Strategy Board also supervises the Catapult Centres, which have been set up as a nationwide network of research institutes operating in key areas of rapid technological change with wider implications for British industry and society at large, involving a range of topics from the life sciences to urban mobility. Withz regard to the underlying funding schemes, Catapult centres rely on core funding by the Technology Strategy Board – Innovate UK, which amounts to one third of the required financial resources, whereas the complementing two thirds need to be acquired by competitive funding mechanisms and contract research involving both the public and private sector (Hauser, 2014). These strategic thrusts of funding policies for furthering science-industry relations is shared by sectorally-specific sets of Research Councils operating as publicly funded research agencies with their particular funding and support opportunities. A related component of these kinds of efforts is the formation of Innovation and Knowledge Centres funded by the Engineering and Physical Sciences Research Council in a comprehensive university and business collaboration initiative (EPSRC, 2013).

Also the private non-profit sector contributes to the British innovation system in a remarkable manner that represents a defining characteristic of its institutional qualities. The funding activities of the Wellcome Trust in the domain of the life sciences are a case in point (Leijten et al., 2012). These efforts are paralleled by a major venture capital fund that is set to benefit the private sector, launched by the government and funded by the Department for Business Innovation and Skills as well as the Department of Health and the Department of Energy and Climate Change. This fund, the UK Innovation Investment Fund, promotes venture capital investment in high-tech SMEs and entrepreneurial start-ups. In 2009, Hermes Private Equity and the European Investment Fund have been selected as fund-of-fund managers of this largest European technology venture capital fund, which is actually a public fund (BIS, 2009). Therefore, quite remarkable in the setting of a liberal market economy, the finance-innovation nexus in the British innovation system involves public venture capital as a key resource of governmental efforts at moulding the transition towards a knowledge-based economy.

However, British policy initiatives in support of investment in intangible assets are not to be reduced to the matter of R&D, product development and human capital, all of which are prominent issues in policy debates. In fact, a further key aspect of ongoing efforts in stimulating private sector investment relates to the problems of intellectual property rights, which are constitutive for safeguarding the appropriability of returns on intangible investment. In view of the ongoing digitalisation of information and communication technologies, new legislation on copyright is in force from 2014 onwards to reflect the radical changes digitalisation has actually brought to the creation and distribution of scientific, academic, and creative material. This legislation on intellectual property rights extends the existing exceptions to copyright regulations, but with suitable safeguards for the involved holders of these rights. Other measures that are meant to improve the efficiency of the application and protection of intellectual property include the establishment of an Intellectual Property Office as well as an Intellectual Property Enterprise Court. Both the latter organs are set to adapt the institutional infrastructure of the British innovation system to the dynamism of the knowledge-based economy (OECD, 2014: 442).

2.2.3 Life sciences as lead sector

The highly innovative and dynamic life sciences industries are of particular interest for British policies in support of investment in intangible assets. The life sciences are commonly identified as a lead sector of the British economy in general, and of its national innovation system in particular. It is a fast growing sector that provides high-skilled and high-value adding employment opportunities. In international terms, the life sciences industries of the United Kingdom involve globally highly competitive firms, which operate in areas such as medical devices, medical pharmaceuticals and synthetic biotechnology. Pharmaceuticals, medical biotechnology and medical technology together comprise of nearly 4.500 firms in the British business population with 165.000 employees, R&D investment of closely £5 billion and an annual turnover of over £50 billion. Life sciences manufacturing accounts for 8% of total gross value added in the United Kingdom – with pharmaceuticals alone accounting for over 28% of British business R&D, way above the other manufacturing industries (BIS, 2011b: 4; Life Sciences UK, 2014: 2). In terms of international competitiveness, in particular when it comes to the European context, the science-oriented knowledge base of British life sciences remains an outstanding feature. In the European setting between 2008 and 2012, the United Kingdom persistently held the highest numbers of science graduates, the highest shares in the top 1% of the most cited life science citations, the highest volumes of total private equity investment, and the highest volumes of government spending on health R&D – the latter being an indicator that underlines the sectoral concentration of an otherwise mediocre British R&D performance (BIS, 2015: 5).

This competitive edge of the science-based efforts of British life sciences is also reflected in the excellent international performance of the leading British research universities in this field. The Universities of Cambridge and Oxford held ranks 3 and 4 in the Times Higher Education world universities ranking for the life sciences in the years 2014-2015, right behind US-American leaders Harvard University and Massachusetts Institute of Technology. Rank 10 is taken by Imperial College London, rank 17 by University College London. No other European Union member country is represented in these international top contender places in the life sciences, which are otherwise dominated by US-American universities (Times Higher Education, 2015). Actually, the locations of these universities outline the spatial structure of the knowledge agglomerations in the London, Oxford and Cambridge city areas, which constitute the core of the British life science cluster, in particular with medical biotechnology companies linked to universities and other research organisations. As a result, already since the 1990s, the universities of Oxford, Cambridge, the University College London and Imperial College London have been the dominant receivers of funding in biotechnology and they have persisted with this path dependent pattern of specialisation ever since (Lambert, 2003). Indeed, this so-called “golden triangle” of life science firms and research institutes being located in London, Oxford and Cambridge has also been largely responsible for the increasing venture capital backing for the life science sector with a volume of £527m in 2014 (Roland, 2015).

Competitive advantages in the life sciences rely heavily on persistent investment in intangible assets that are moulded by the formation of an industry-specific knowledge base. For instance, the United Kingdom hosts globally leading firms in the fields of

Stratified Medicine, which targets treatments based on genetic type and cell therapy, which aim to treat damaged or partially functioning organs. In order to support treatments for diseases such as Parkinson's, diabetes, strokes and heart disease, the Technology Strategy Board and the Medical Research Council are investing in specific life science projects like the Stratified Medicine Innovation Platform (TSB, 2011; BIS, 2011a: 21). These efforts have become part of the governmental "Strategy for UK life sciences" that focuses on healthcare applications. It aims at the promotion life sciences by means of an extended cooperation between firms, research institutes and governmental organs. Intangibles come to the fore as strategic resource as organisations in science and education are meant to attract highly skilled researchers, clinicians and technicians, also on an international scale. All of this is to be framed by a regulatory environment that aims to create incentives for entrepreneurial initiatives and innovative ventures (BIS, 2011b: 7).

An example for efforts at building a sectoral innovation network in the life sciences is delivered by the case of Imanova. It is a public-private collaboration formed by the Medical Research Council, Kings College London, University College London and Imperial College London. Imanova provides a state of the art imaging research facility that builds on current strengths in neuroscience and cancer imaging by making use of most advanced information and communication technologies. Based on the efficient operation of these facilities, Imanova is set become a specialised imaging centre that harbours partnerships for both industry and academia (UCL, 2012). These collaborative ventures are paralleled by efforts at attracting a skilled workforce with increasingly inter-disciplinary qualifications. Crucially, education and training efforts reach scientific knowledge as they also include economic competencies in entrepreneurship and management. Moreover, workforce skills in the life science sector are going to be advanced by means of training programmes and a new apprenticeship system (BIS, 2011b: 20n.).

When it comes to regulatory efforts and fiscal incentives in support of intangible assets, the life sciences are also targeted by means of industry-specific measures. Thus, since 2011, a set of policy initiatives was introduced that aimed at modifying the system of taxation in order to create conditions that encourage investment and increase growth in the life science sector. First of all, the R&D tax credit for small and medium-sized enterprises was expanded to the level of super-deduction relief available to 200% – and 225% from April 2012 – while removing the minimum spend requirement. Moreover, the "Patent Box" was introduced, a measure that would reduce corporation tax on profits from patents to 10% from 1 April 2013 onwards. Its strategic goal is the formation of a suitable tax environment for firms in the life sciences, which should be encouraged to locate high-value adding manufacturing and services related to the exploitation of patents within the United Kingdom. Also smaller enterprises are included in the scheme, as patents developed collaboratively also count in. Profits from the sale of patents are eligible for the reduced tax rate, too. This is meant to promote their re-investment in the operations of the firm. Further actions with regard to improvements in the R&D tax credit scheme and the tax-advantaged venture capital schemes involve a Seed Enterprise Investment Scheme that offers a 50% income tax relief on investment. Additionally, an above the line R&D tax credit is introduced that is designated to improve the visibility and certainty of R&D tax relief in order to attract large scale investment in innovation (BIS, 2011b: 25n.). In fact, recent assessments of these fiscal measures such as the "Patent Box" tax break on investment in R&D claim that they have been behind the current upsurge in investor interest in the life sciences. This renewed focus on the life science sector as a key terrain of the evolving knowledge-base of the British economy is framed by symbolic measures such as the appointment of a life science minister, who oversees the policies in support of the sector (Ward, 2014).

Crucially, the role of the National Health Service for policies for investment in intangible assets related to life sciences has become a major affair in this regard. It addresses the adoption and diffusion of innovation within the public health system, and it also tackles the matter of public-private knowledge flows and the stimulation of private sector innovation. A key policy initiative in the "Strategy for UK Life Sciences" takes on the model of academic health science networks that are meant to include the NHS and private sector industry to align clinical research, informatics innovation, training and education and healthcare delivery. Obviously, these concerns match the idea of a cross-sectoral policy approach that combines certain types of intangible assets which relate to the advance of a knowledge-based economy. The combination of information and communication technologies with research efforts and workforce training, as outlined in this strategic approach, is a most relevant point. In more details, the NHS' patient databases are set to be utilized for the organization of clinical research trials as a means to encourage private sector investment in the life sciences. For this reason, the Health and Social Care Information Centre should set up a secure data linkage service that is available to all users of health and care information. It should operate on a self-financing basis with users paying the linking costs. The local clusters of life sciences in the United Kingdom are an essential component of this approach. Thus, London's academic health science centres at Imperial College, Kings College, and University College of London enter a database partnership that should lay the foundations for a commonly shared knowledge pool in an enlarged life science cluster in South East England. This regional effort coincides with attempts at tapping the knowledge flows of multinational enterprises with their expertise in R&D and commercialisation (BIS, 2011b: 13n.).

2.2.4 Case: Cell Therapy Catapult Centre

The utilisation of intangible assets in the knowledge base of firms and industries requires an institutional setting that is capable of transforming dispersed segments of public and private knowledge into a competitive position of private sector firms. Thus, when it comes to the role of scientific research in technological innovation, a successful commercialisation of basic research depends on institutions that facilitate the transfer of technology from the public to the private sector. This intermediate sector is positioned in between the domains of academia and business users of technology. It involves a broad range of organisations whose activities bridge existing gaps and weak linkages in the process of converting scientific research outcomes into marketable process and product innovations. An example is the National Physical Laboratory, which provides specific expertise and related services in order to support business applications of science and technology. Due to the outstanding role of university-industry relations in the high-technology industries of the British innovation system, it is fair to suggest that these kinds of intermediate organisations are an indispensable component in the stimulation of investment in the knowledge-based segments of British industries. The crucial role the intermediate sector plays for the overall UK productivity is reflected in its high impact on R&D activities. In 2006, the intermediate sector was responsible for a third of all UK-based private sector extramural R&D expenditures by UK private sector firms. In effect, it has been estimated that the intermediate sector contributes at least £3 billion annually to the British GDP, and in doing so supports over 62,000 jobs (Oxford Economics, 2008: 7).

Yet the Department for Business, Innovation and Skills still regards the intermediate sector as a widely underused asset in governmental efforts to encourage higher levels of investment in intangible assets. Thus, as a part of the government's strategy to use the experience and expertise of the intermediate sector, a system of Research and Technology Organisations has been established as a further contribution to the intermediate sector. These organisations work with university-based researchers and private sector businesses to encourage and support the commercial development of research results (BIS, 2011a: 56). Their facilitating role draws on the assistance of companies in gaining access to new knowledge generated elsewhere, or when they find solutions to problems which arise during the process of new product development. However, the British network of Research and Technology Organisations has been repeatedly assessed as performing inferior when compared to similar intermediary organisations in several other European countries. A major reason is the lack of an adequate amount of core government funding (EARTO, 2007: 16). In comparison, the warranty of core funding is the formula for the success of the Fraunhofer Institutes in Germany, the Organisation for Applied Scientific Research in the Netherlands and the Technical Research Centre of Finland. In these cases, core funding enables the engagement in strategic research projects of medium- and long-term duration and the sustained development of internal competencies (EARTO, 2007: 8-13).

In view of this criticism, a process of policy learning set in which involved the governmental adaptation of mechanisms of core funding owing to a recommendation of the Department for Business Innovation and Skills in 2010. The corresponding report on technology and innovation in the United Kingdom recommended that selected organisations involved with the commercialisation of new knowledge should be provided with approximately one-third of core funding without time-limit (Hauser, 2010). This recommendation was accepted by the Labour government and has been implemented subsequently by the conservative-liberal Coalition government in the format of the "Catapult centres" (Mason and Nathan, 2014: 15-17). This documented willingness to learn from best practices in other countries and to adopt policy concepts, in this case the concept of core funding in the intermediate sector, needs to be viewed as a major institutional contribution to the design and implementation of policies for investment in intangible assets.

Catapult centres are established as a national network of excellent technology and innovation centres. They are built around the extended system of Research and Technology Organisations and other research units that specialise in certain technological areas, which government perceives as strategically important and which have a promising market potential. The centres are funded in a variable manner. Two thirds of funding is set to be based on competitively earned commercial funding both in terms of business-funded R&D contracts and collaborative applied R&D projects, funded jointly by the public and private sectors. This is complemented by about one third of core public funding provided by the Technology Strategy Board – Innovate UK and aimed at long-term investment in infrastructure, expertise and skills development. These Catapult centres focus on late stage research and development, which is deemed close to commercial utilisation and marketability. In view of this support mission, they are set to provide comprehensive access to specialist expertise in order to promote the innovative output of valuable products and services. Due to this focus on product innovation, Catapult centres also involve assistance in product design as a means of commercialising new knowledge. Owing to the collaboration with external partners, they are meant to contribute to the formation of innovation networks and clusters at designated local hubs. In order to achieve this strategic policy goal, they support measures in workforce training with a focus on applied engineering skills. Thus, they should enhance the accumulation of intangible assets associated with economic competencies. In this vain, they also further knowledge transfer by stimulating the movement of skilled personnel between research units and the business sector (BIS, 2011a: 26). Currently, seven Catapult centres have been established as pioneering support organisations with an assurance of one-third funding through core grants. They cover the following industrial domains, which refer altogether to the evolving knowledge-based economy of the United Kingdom (Hauser, 2014: 8):

- Cell Therapy,
- Digital,
- Future Cities,

- High Value Manufacturing,
- Offshore Renewable Energy,
- Satellite Applications,
- Transport Systems.

Actual operations of these centres highlight the matter of knowledge and learning, and thus directly affect the stimulation of investment in intangible assets such as R&D, workforce training, and product design. They include R&D services through a combination of in-house specialist facilities and a highly skilled technical workforce as well as precompetitive R&D and systems integration procedures. The development of human capital in business firms is promoted by measures in vocational training, advanced R&D competency training, and manufacturing advisory services, all of which target the knowledge base of the firm. Furthermore, the centres provide advice on industry-specific regulatory frameworks and access to public as well as private finance. Thus, they play the role of knowledge brokers in a complex market setting (Hauser, 2014: 23).

A particularly well established Catapult centre is the Cell Therapy Catapult, which operates since 2012. Its main purpose is to support the creation of a worldwide leading cell therapy industry in the United Kingdom, set to provide a further domain of technological and industrial specialisation for the vibrant British life science industries. Its mission in promoting the cell therapy industry in the United Kingdom involves: taking products into clinical trial as means to de-risk them for further investment, providing clinical expertise and access to clinical partners in the National Health Service, providing technical expertise and infrastructure to ensure products comply with the standards of Good Manufacturing Practice, providing regulatory expertise, creating opportunities for national and global collaboration, and providing information on grants and investment support programmes (CTC, 2014: 2). This focus on the commercial utilisation of scientific research comes together with the attempt to further linkages between universities and business firms in the field, assisted among others by the establishment of a specialised Cell Therapy Manufacturing Centre that is designated to operate as subsidiary of the Catapult. It is explicitly meant to provide the infrastructures and services of a “manufacturing hotel” for both domestic and international firms with a view on positioning the United Kingdom with its strong knowledge base in the life sciences as premier location for the market supply of cell therapies in Europe (CTC, 2014: 11).

The leading British cell therapy company ReNeuron delivers an example of a productive collaboration with the Cell Therapy Catapult. ReNeuron specialises in clinical-stage stem cell therapy with two products the phase of in clinical trials. A mix of private and public funding in support of innovation, involving a £33 million financing package from a group of funders and investors that includes the Welsh Government, has elevated ReNeuron to the position of the leading cell therapy company in the United Kingdom, currently operating among the global business leaders in stem cell development. The firm’s collaboration with the Cell Therapy Catapult is meant to accelerate the development of manufacturing processes for the company's lead CTX stem cell therapy product candidate. Thereby, ReNeuron makes use of the infrastructure, expertise and services that the Cell Therapy Catapult provides for its partners. This partnership should promote matching knowledge segments in scientific research and industrial production with a view on the dynamics of international market competition (RENE, 2013). ReNeuron's first product named ReN0001 is targeted at the medical treatment of stroke patients; it is facing Phase II in clinical trials. The second product, ReN009, enters Phase I of clinical trials for the treatment of limb ischaemia. The analytical, process development and manufacturing expertise of the Cell Therapy Catapult shall facilitate the clinical development of both products and allow for the swift transition from the trials to manufacturing and marketing. More precisely, the collaboration entails a scale up of the manufacturing of the cell line and the automation of manufacturing and potency assays. Part of the collaboration comprises of the utilisation of the manufacturing skills at Roslin Cells in Edinburgh and the University of Loughborough (CTC, 2015).

2.2.5 Case: Knowledge Transfer Partnerships and Feasibility Studies Programme

The combination of policies supporting combined investment in innovative property and economic competencies stands out as a feature of programmes that the formation and expansion of innovation capabilities by promoting investment in intangible assets. A major set of programmes in this regard is represented by the programme framework of Knowledge Transfer Partnerships, KTP, which tackles the issue of workforce as well as management capabilities in a manner that is set to improve the overall knowledge base of firms and industries by promoting flows of expertise from the domain of science and education. In effect, this means that university-industry relations, which are at the core of the science-based industries in the British innovation system, are revamped in a manner that adds to the accumulation of human capital across industries and sectors. Knowledge Transfer Partnerships aim at supporting the employment of science, engineering and management graduates and postgraduates in firms that need to augment their knowledge base in order to improve their innovation capabilities both with regard to internal and external business routines and knowledge flows. Crucially, the programme targets firms without previous experience of employing graduates and postgraduates; that is, they are focussed on upgrading academic knowledge content in those types of firms and industries, which rely more on tacit knowledge and practical experience of their workforce and management. The support mechanism draws on initial support provided by TSB Advisers, who seek to bring together the latter types of firms and academic partners from the domain of higher and further education institutions, research and technology organisations, and public sector research institutions to develop collaborative project proposals. Successful proposals receive KTP grants that part-fund the costs of employing so-called associates, who are recruited as university graduates, post-doctoral researchers or other formally qualified individuals on an advanced vocational qualification level. All of these projects are accompanied by the continuous involvement of academic supervisors, who are tutoring the involved associates and their work environment (TSB, 2014a: 2).

Evaluations of the KTP programme have identified significantly positive effects of the related measures on the sales and employment performance of the firms that take part in the projects. Additional benefits in the form of enhanced innovation capacities, increased involvement in business networks and spill-over effects for suppliers of participating firms also apply (Regeneris Consulting, 2010). At this point, the question arises whether KTP merely help firms to enhance their already achieved level of innovative activities or whether these firms may develop innovation capabilities for the first time with lasting effects on their business performance. Evaluation evidence suggests that KTP are also capable of creating new innovation capabilities in a setting that has been previously shaped by common routines. Thus, KTP may prove to be a stimulant of novelty-embracing practices (Ternouth et al., 2012). As a result, the effects of KTP projects are broadly associated with improved technical knowledge, new product and process development, increased employment and access to new markets (Mason and Nathan, 2014: 39). Recent TSB data show that for every £1 million of government investment in the KTP programme during the years 2012 and 2013, 44 new jobs were created, 366 company staff were trained, £1.6m was invested on average by companies in plant and machinery, £1.18m was invested on average by companies in R&D while involve firms predicted a post-project increase in annual pre-tax profit of £6.95m. All together, over 1100 new jobs were created and over 9000 company staff was trained in this period (TSB, 2014a: 8).

A case example of how KTP project are set to support investment in innovative properties and economic competencies is delivered by the case of the biotech company Biocatalysts Ltd, which worked with the University of Nottingham and an associate named Jonathan Wood. The two year project was sponsored by the Biotechnology and Biological Sciences Research Council and the Welsh Government. The associate transferred academic knowledge from the University of Nottingham and applied it to a commercial context by opening up new areas of research concerning the use of novel carbohydrase enzymes for food applications. The creation of an internal enzyme development system improved the competitive efficiency of the firm he was involved in, strengthened its market position and removed the dependence on the knowledge base and expertise of external suppliers. From initially having no experience in enzyme cloning, the firm is currently about to become a leading speciality enzyme producer with a strong competitive standing. As a result of the KTP project, new products have fuelled significant investment in staff and facilities of the firm: £342k profit was realised just 12 months after project completion, two years ahead of original projection, and the academic partner gained £48k in research contracts. After the project had come to an end, the associate actually joined Biocatalysts as a business development manager for the field of novel enzyme development (TSB, 2014b).

A variation of the KTP framework is pursued by the Collaborative Research and Development programmes, which addresses those kinds of firms that are already active in the domain of science-based business operations. They are meant to bring together business firms and research organisations to work on collaborative R&D projects in priority areas of science and technology from which successful new products, processes and services are likely to emerge. These programmes are co-funded through the governmental system of Research Councils and the Technology Strategy Board in a range from 25% to 75% shared contributions to project costs (BIS, 2011a: 33n.). Evaluations of the CRD programmes identified positive outcomes for the majority of participating firms. Positive effects were measured in terms of the ensuing level of technical knowledge, the development of new processes and products, the increase of employment and the opening up of new markets (PACEC, 2011).

What is more, collaborative R&D involving diverse actors from the business and research communities faces major challenges when it comes to the matter of intellectual property rights. In order to tackle this issue, the governmental Intellectual Property Office together with the TSB communicates model agreements on intellectual property rights such as the "Lambert toolkit" that includes a model agreements and material for decision-making and procedural guidance. This set of legal advices should assist in facilitating contract negotiations between private sector firms and publicly-funded research organisations such as universities which engage in research and development collaborations. Also, sectorally-specific model agreements are provided such as the one on collaboration in the life sciences. In this case, the National Institute for Health Research offers a suite of model agreements for use in research partnerships involving the pharmaceutical and biotechnology industries, universities and organisations of the National Health Service with the aim of shortening the negotiation and contracting process for intellectual property ownership and management (IPO, 2015).

While the above programmes cover all types of firms regarding size and structure, related initiatives also target the specific problems of knowledge transfer and intangible investment in small and medium-sized enterprises. The Grant for Research and Development scheme, which was rebranded Small Firms Merit Award for Research and Technology, SMART, in 2012, assists SMEs engaged with high-risk and potentially high-reward technologically innovative projects in the expansion of their knowledge base. Different types of grants are designed to support the search for the commercial viability of projects, the technical feasibility and commercial potential of new technologies, products and processes, and the development of prototypes (BIS, 2011a: 34). As a more recent addition to the strategic thrust of this framework, the Feasibility Studies

Programme is set to promote the innovative potential of small and medium-sized firms. It supports exploratory studies on the technical feasibility of selected ideas for new products and processes. The competitively distributed grants are designed to initiate further R&D in the same areas and may be complemented, among others, by the CRD programme. Yet in contrast to GRD, respectively SMART, these competitions for FSP grants are more closely targeted on specified areas of technology and thus come to favour a more sector-specific outlook on knowledge and innovation (Mason and Nathan, 2014: 24). A recent programme evaluation that focused on 325 projects funded under the FSP provides evidence for the assessment that is effective in stimulating further R&D, technological and commercial activities. Accordingly, it is fair to suggest that FSP substantially contributes to the advancement of skills, capabilities and knowledge in innovative small and medium-sized enterprises (WECD, 2013).

An illustrative example for the working mechanism of the Feasibility Studies Programme is the Biomedical Catalyst funding scheme that aims at supporting the life science sector in the United Kingdom. In cooperation with the TSB and the Medical Research Council, dedicated grants are distributed through the channel of Feasibility awards to both small and medium-sized firms and academics. The biotech company BioMoti represents a successful case for a firm that has received £150,000 as a Feasibility award winner of the Biomedical Catalyst programme. This Biomedical Catalyst award served as a signal that would transform the firm's communication with private sector investors and raise the confidence of the latter with regard to the projected business performance in an uncertain market setting (TSB, 2012). The basis of the award was provided by successful proof-of-concept studies in associated academic laboratories at Queen Mary, University of London, followed by technology validation from a major global pharmaceutical company. The latter aspect underlines the potential of large international firms as supportive actors when it comes to advancing research or business ideas of small firms seeking market entry (Kramer et al., 2011: 456; HEFCE, 2013b). The initial grant awarded to BioMoti worked as a stimulating mechanism that attracted private risk capital and launched commercial development at the earliest and most uncertain stage of the overall project (BIA, 2013: 16). In the phase of clinical practice, the award facilitated BioMoti to plan and validate the clinical development of their lead ovarian cancer drug candidate based on the oncojan technology platform, a new class of advanced therapeutic microparticles that can gain entry to the interior of cancer cells. The whole procedure aims at increasing the efficacy of chemotherapy and significantly reduces associated side effects in the treatment of ovarian cancer (BIA, 2013: 23).

2.2.6 Conclusion on British policies in support of investment in intangible assets

As the British system of innovation exhibits a marked bias towards competitive advantages in selected science-based industries, in particular in the life sciences, so do

British policies for investment in intangible assets address the matter of knowledge transfer, capabilities upgrading and commercial applications. University-industry relations play an outstanding role in this regard, combined with the recognition that an intermediate research and technology sector is indispensable for translating scientific research into commercially viable products that benefit firms and industries while providing employment and income opportunities. The role of the life sciences as lead sector of a new, knowledge-based set of competitive industries such as biotechnology and healthcare underlines the advantages of liberal market economies in driving the formation of new technological paradigms, which puts market signals and adaptively flexible institutions in the centre of economic affairs. Indeed, in these particular industrial fields, firms from the United Kingdom are able to compete with US-American firms in competitive markets with high returns.

In view of these constellations, British policies in support of investment in intangibles assets put strategic priorities on the domain of knowledge transfer and commercialisation, which actually addresses all the fields of the concept of intangible assets, namely computerised information, innovative property, and economic competencies. In particular, economic competencies stand out as a domain of policy activity, which, in the British case, relates decisively on the matter of investment in firm-specific human capital and organisational structure. Both of these, however, are strategically connected with the domain of innovative property, and here in particular with scientific R&D and product development. This is due to the need for policy support in the commercial application of the operations of the clusters of scientific excellence in the British knowledge base. Prominent policy measures such as research grants and co-funding agreements have been accompanied by fiscal incentives such as tax breaks. In promoting the required institutional frameworks for knowledge transfer, policy learning from international best-practices has been a prominent device. For instance, the establishment of a system of core funding for research operations, which informs the introduction of the Catapult centres, actually represents such a case of policy learning from international models, which is meant to enable domestic research and technology organisations to stimulate the innovation performance level of British firms.

A further insight to be drawn from the British case of policy support for investment in intangible assets refers to the fact that the promotion of the commercialisation of research and development efforts in science-based industries needs to tackle the spatial issue of knowledge agglomerations that are located near excellent research and technology organisations. Indeed, the actual points of intervention of British policies supporting investment in intangible assets come to be concentrated in few regional agglomerations of universities, research institutes and business firms, where strengths in scientific research are meant to be translated into commercial products and services, supplemented by adequate infrastructural and institutional facilities. The policy challenge is to strengthen the productive profile of firms in these agglomerations while advancing spill-over effects across regions and sectors. All of this refers to the need for the establishment of intermediary institutions that assist in organising the collaboration between science, research and business. In this manner, the intangible assets of business firms serve as key resources for knowledge transfer and utilisation.

2.3 German policies for investment in intangible assets

2.3.1 Intangible assets in the German innovation system

The German economy represents the type of a coordinated market economy that developed as a late industrialiser with major investment in education and training since the late 19th century, framed by the institutional patterns of 'organised capitalism' with corporatist compromises between capital, labour and the state. Soon after World War II, the Western German 'economic miracle' of the 1950s made the Federal Republic an export-oriented economic power-house in the world economy. In effect, Germany remained comparatively unhampered through the phase of international stagflation in the 1970s by flexibly adapting its production regime and maintaining the prevailing patterns of market and non-market coordination well for the ensuing decades (Hall, 2007: 60-63). These qualities of gradual change may be derived from a rationale of consensual decision-making and implementation, which is to be traced both in the domains of business and politics, and which may be approached in terms of a neo-corporatist consensus democracy as political-institutional backbone of the German production model (Kitschelt and Streeck, 2004).

This production model underlines the specificity of German industry regarding quality production, skilled workforce, cooperative industrial relations and inter-firm networks with international competitive advantages and high export shares in industries like automobiles and machine tools that are most prominent in the states of Baden-Württemberg and Bayern, which serve as key locations for the most competitive branches of German manufacturing industries (Dore et al., 1999). Complementary institutional scaffolds which carry this production model include coordinated wage bargaining governed by employer associations and labour unions, paralleled by an extended influence of the unions in the domain of human resource issues, which is a key domain of intangible assets. The related system of skill formation is based on an organized apprenticeship system with wide-ranging industry involvement, framed by a system of education and training that underlines firm- and industry-specific requirements and thus promotes sunk-cost investment in skills and human capital. This rationale of long-run investment in intangible assets also reflects basic patterns of predominantly bank-based Germany's financial system with its complementary links to the stakeholder system of corporate governance. The corresponding role of relational aspects in intercompany relations permits the transfer of knowledge on industrial standards and practices that supports a cooperative mode of inter-firm technology transfer. These qualities also resonate with the innovation regime of the German variety of capitalism that exhibits a basic pattern of innovation which is rather incremental. The involved firms exhibit advantages in business operations and innovation processes that are pursued within the framework of established techno-economic paradigms, which allows for long-run expectations and relational strategies. Yet this pattern of long-term non-market coordination that has been relatively successful in past settings of established paradigms and routines may lead to rigidities in the context of rapid technological change, when short-term and market oriented approaches come to gain in competitive impact (Hall and Soskice, 2001: 28n.).

In fact, constellations of institutional change and related political-economic conflicts have become ever more pressing since the 1990s. Mounting unemployment and fiscal problems, involving the impact of reunification, have persistently exercised further pressures for institutional reforms. These initiatives have also mirrored a concern with strengthening a comparatively underdeveloped service sector in an economic setting dominated by the manufacturing industries (Annesley, 2004). Corresponding analyses that underline a hybridization of the German variety of capitalism highlight reform efforts concerning the selective deregulation and flexibilisation of various institutional domains such as wage bargaining, industrial relations and labour market regulation may have contributed to a less egalitarian outlook of economy and society. Still, despite these kinds of supply-side reforms with a liberal bias, it is safe to argue that the core of the German variety of capitalism remains within the framework of the coordinated market economy (Carlin and Soskice, 2009; Hall, 2007: 69-71).

In view of this dynamism of persistence and change, then, the corresponding performance profile of the German innovation system draws extensively on the knowledge base of the involved firms and industries with their predominantly asset-specific investment. It corroborates the argument that coordinated market economies exhibit advantages in incremental innovation, predominantly in medium-tech industries. In fact, empirical explorations of OECD economies during the 1990s and early 2000s have confirmed the assessment that coordinated market economies such as Germany tend to specialise in the type of medium-tech exports that relies both on skilled workforce combining formal and tacit knowledge as well as on R&D operations and their innovative outcomes (Schneider and Paunescu, 2012). Nonetheless, evidence on new knowledge-based industries such as biotechnology suggests that coordinated market economies such as Germany may provide niches for these science-based industries with their cooperative research and commercialisation agreements between firms, universities and non-university research institutes. In biotechnology, in particular, this may hold for areas that are specialised in platform technologies and less in the high-risk domain of research in therapeutics (Kaiser and Prange, 2004; Casper and Kettler, 2001).

The corresponding patterns of economic growth and innovation have contributed to the outstanding relevance of intangible assets in the German economy. Investment in intangible assets in the German business sector has been increasing from €138,6 billion in 1995 to €180 billion in 2006; a major expansion in the volume of investment owing to a disproportionately high increase in the intangibles categories of computerized information and innovative property (Crass, Licht and Peters, 2014: 13). In line with the specialisation of the German production model, then, firms of the manufacturing industries contribute almost 50% of the investment in intangible assets. Thus, the knowledge base of German industries is subject to continuous investment efforts, which elevate intangible assets to an even greater economic relevance as compared to investment in tangible assets (BMWi, 2009: 111).

Table 6 **Intangible investment as percentage of GDP in Germany, 2006**

Investment in intangible assets	Percentage of GDP
Computerised Information	***0.73***
Computer software	0.71
Computerised databases	0.02
Innovative property	***3.59***
Scientific R&D	1.72
Mineral exploration	0.01
Copyright and license cost	0.21
Other product development	1.65
New architect./ engin. designs	0.9
Economic competencies	***2.84***
Brand equity	0.56
Advertising expenditure	0.41
Market research	0.15
Firm-specific human capital	1.29
Organisational structure	1.00
Purchased	0.54
Own account	0.46
Total	***7.16***

Source: Adapted from BIS (2012: 61, Table 2).

Table 6 gives an overview of the structuration of investment in intangible investment as percentage of GDP in Germany during the year 2006. The domain of investment in computerised information accounts for a 0.73% share of GDP, which is among the lower levels in comparison with other OECD economies. Investment in innovative property amounts to a GDP share of 3.59%, including scientific R&D accounting for a GDP share of 1.72%. This stands for a comparatively strong performance in international comparison. Investment in economic competencies then takes a 2.84% share in GDP. It involves investment in firm-specific human capital with a GDP share of 1.29% and investment in organisational structure with a GDP share of 1%. The total GDP share of investment in intangible assets was at a level of 7.16% in 2006 which is among the high performing performance patterns in both the European Union and the OECD world.

Crucially, these investment profiles need to be assessed in terms of the actual differentiation of public and private sector activities when it comes to the accumulation of intangible assets in the knowledge base of firms and industries. In the German case, for instance, workforce training in the private sector is a major characteristic of the German production model. Indeed, workforce training plays an important role in the approach to skills development as implemented in German firms, supported by both labour unions and employer associations which stick to that approach also during the ongoing changes of industrial structures (Grund and Martin, 2012: 3536). The corresponding training programmes are mainly financed by the employing firms, yet they are supported by an array of public infrastructures and policy schemes that may distort the comparative international evaluation of private sector investment in that regard. However, it is fair to suggest that the domains of scientific R&D, product development, firm-specific human capital and organisational structure are the key fields of investment in intangible assets in Germany.

When it comes to the performance of the German innovation system, thus, the performance of R&D operations stands out as a key quality. Indeed, on the basis of this profile, it is safe to state that Germany remains one of Europe's most innovative economies. According to the European Innovation Scoreboard, Germany is well established in the group of innovation leaders, with an innovation performance far above EU27 average levels – although the performance gap in favour of the United States remains significant (European Commission, 2009). The ratio of Gross Expenditures of R&D over the Gross Domestic Product has been at a level of 2.5% and above during the 2000s, approaching a threshold value of 3%, with comparatively high shares of privately funded and performed R&D and thus operating well above OECD average and way ahead of other major European economies such as the United Kingdom (OECD, 2012b). In 2012, the German GERD share of GDP was at a level of 2.98% with a public share of 0.86%, again well above the average performance of all the other OECD economies (OECD, 2014: 324). Joint research of companies and research institutes is a key factor in the performance of the German innovation system. R&D expenditures of industry more than doubled from the mid-1990s to the early 2010s, from €30 billion in 1995 to €63.4 billion in 2011. During the same period of time, external R&D expenditures, which are funded but not conducted by industry, have increased four-fold from €3,1 billion to €12,3 billion (Stifterverband, 2013: 8).

All of this is set to promote Germany's strong position in the top 5 best performing OECD economies in the domain of R&D. This leading position holds in particular for the following items (OECD, 2014: 260n.):

- public expenditures on R&D per GDP,
- industry-financed public R&D expenditure per GDP,
- amount of triadic patent families per GDP,
- amount of young patenting firms per GDP.

Corresponding R&D profiles reflect patterns of industrial specialisation in medium-tech industries with a strong presence of manufacturing industries. Industrial contributions to GERD are predominantly based in these kinds of established high-skill, high-quality industries such as automobiles, electronics, chemicals, pharmaceuticals, mechanical engineering, and machine tools whereas newly emerging high-technology industries such as biotechnology as well as knowledge-based business services leave ample opportunities for further improvement. This assessment holds despite recent advances in science-based technological niches such as nanotechnology and advanced environmentally-friendly technologies. Revealed technological advantages of German industry, representing national shares in world patents of a certain good divided by its total share in world patents, have actually highlighted the industrial specialisation in automobiles, chemicals and engineering that feeds back into a strong innovation performance (Tylecote and Visintin, 2008: 258n.). In fact, basic research accounts only for 20% in the overall R&D profile, which is way below OECD average – an aspect that is aggravated by the fact that international R&D investment in Germany only amounts to a share of nearly 20% in overall R&D efforts, which sheds light on the outstanding role of the manufacturing home base for the German innovation system. Further challenges in the field of intangible assets point at a shortage of human capital in high-tech industries as well as a slow growth of knowledge-intensive services (Ebner and Täube, 2009). All of these aspects are subject to current policies in support of investment in intangible assets.

2.3.2 Actors and policies in the German innovation system

The institutional structure of the German innovation system consists of a set of decentralised networks in the business domain that involve both large and small firms, the latter denoted as Mittelstand structure of small- and medium-sized enterprises, accompanied by scientific-technological and legal-political infrastructures for innovation at the federal and regional levels involving universities and polytechnics, which are predominantly public. The main industrial pillars of innovative efforts in the German innovation system are to be found in the high-value added manufacturing industries, which are also the carriers of the high export shares of the German economy. The international competitiveness of these industries relies on a vibrant knowledge base, which utilises intangibles assets for achieving and maintaining competitive positions on international markets. At the same time, the German economy advances also in new science-based industrial domains such as biotechnology, which are subject to comprehensive support and funding mechanisms. Also, based on the knowledge-base of the manufacturing industries, German firms exhibit a strong standing in the field of low-carbon technologies and renewable energy, which is the key to the transition towards a sustainable mode of economic growth (EFI, 2012).

The institutional architecture of the German innovation system is outlined in Figure 6. In policy terms, the main institutional actors of the German innovation system are the Federal Ministry for Education and Research, the Federal Ministry for Economy and Technology and other ministry departments that are concerned with science, research and innovation on the federal level, augmented by the regional ministries of the Bundesländer that retain key competences in the domains of science and education. This institutional differentiation underlines the multi-level approach to policies in support of investment in intangible assets that informs the German innovation system. The federal level of support for science and research is well represented by the Deutsche Forschungsgemeinschaft, which funds public research at universities. Non-profit research organisations that run specialized research institutes include Max-Planck-Gesellschaft with a focus on basic research across the natural and social sciences, Helmholtz-Gesellschaft with a focus on basic research in the natural and life sciences, Leibniz-Gesellschaft with its applied research across the natural and social science disciplines, and – last but not least – Fraunhofer-Gesellschaft with its focus on applied research across the natural and social sciences that is exercised by a nation-wide network of research institutes (BMBF, 2012: 49n.).

In reflecting the impact of the German model of diversified quality production, public institutions of scientific research are most intimately related with the R&D facilities of large enterprises, whereas entrepreneurial spin-offs, which tend to be highly relevant in newly emerging science-based industries, remain comparatively underdeveloped (Belitz and Kirn, 2008). Thus, the bias towards mature industries in the German model of diversified quality production may obstruct entrepreneurial start-up dynamics, which are typically most relevant in new knowledge-based industries with a high level of market entry (Ebner, 2010). This entrepreneurial performance, however, remains subject to a mixed assessment. Measured in its total early-stage set of entrepreneurial activity, Germany takes one of the lowest ranks in start-up activity among the OECD countries. Still, according to the European Commission’s Innovation Scoreboard, there are positive signs of an entrepreneurial turn to be taken into account. Germany is well above EU average – yet significantly behind the UK – regarding the number of small and medium-sized enterprises innovating in-house, and it also stands out regarding their innovative collaborations as well as market entries and exits (European Commission, 2009). In this context, is fair to state that the evolution of the German knowledge-based economy is set to be based on the formation and extension of cooperative relations between universities, research institutes, large enterprises and new entrepreneurial ventures that can adequately utilise their particular intangible assets.

Policy programmes in the domain of technological innovation and industrial change encompass the following initiatives, which also target investment in intangible assets. First, a pact for research and innovation, Pakt für Forschung und Innovation, has been running since 2005 and is extended until 2015 with governmental funding for non-university research institutes. It is meant to operate as a counter-part for the Exzellenzinitiative that provides additional funding for research and teaching excellence at selected universities. A further variety of these concerns with innovation in promising technological fields is the Central Innovation Programme of the Ministry of Economic Affairs, which supports the innovation efforts of small and medium-sized enterprises. This array of policies is completed by the High-Tech Strategy 2020 of the federal government that is designed as a push for innovation in new technologies and industries that are expected to become key domains of the evolving knowledge-based economy (Leijten et al., 2012: 100-114; OECD, 2012a: 67).

The High-Tech Strategy is well perceived in terms of an integrated approach that aims to specifically promote science, research and innovation activities beyond the established patterns of specialisation in manufacturing. This integrated approach is supported by a broad coalition of actors from both the public and private sector. It seeks to further improve the position of Germany as an attractive and dynamic innovation location worldwide that combines a vibrant knowledge base with competitive positions in the lead industries and markets. In doing so, the framework conditions for innovation are meant to be improved. This issue tackles regulations, standards and taxes as well as intellectual property; the latter being aspect of intangible assets. Also, paralleling the expansion of science-industry relations, the High-Tech Strategy addresses the matter of small- and medium-sized enterprises, which require specific support programmes. When it comes to the promotion of entrepreneurial high-tech start-ups, not only public funding is part of the Strategy, but also the supportive contributions of large firms in the advanced manufacturing industries such as Siemens, Daimler and BASF matter (BMBF, 2013). Content-wise, the Strategy addresses environmental sustainability, mobility, health, communication, and safety as core areas of policy activity – with secure identities and internet-based services as major domains of intangible investment that relate to the category of computerised information (BMBF, 2012: 21).

This strategic framework has been revamped most recently in terms of a "new High-Tech Strategy", which accounts even more explicitly and in a more comprehensive manner for the support of investment in intangible assets. Among the priority areas of the new approach, the following areas stand out as being directly linked to the domain of intangible assets, namely (BMBF, 2014a: 5):

- the digital economy and society, which is meant to address challenges and opportunities inherent in digital technologies,
- the innovative workplace, which addresses changes related to creative ideas and technological innovation taking place in the modern workplace,
- civil security with regard to ever more complex systems and infrastructures, involving the matter of communications.

Yet also the more indirectly linked focal areas such as sustainable economy, healthy living and intelligent mobility need to be perceived in terms of the intangible assets of the involved firms and industries, for they all draw on the promotion of technological innovations, knowledge creation and diffusion as well as new organisational structures. Research and innovation for the digital economy, in particular, include the matter of industry 4.0, smart services, smart data and cloud computing, and digitalisation, all of which stand for intangible assets in the field of computerised information (BMBF, 2014a: 20n.). The initiative for innovative workplaces refers explicitly to the need for economic competencies that relate to technological innovation and new organisational practices, thus pointing at the corresponding category of intangible assets (BMBF, 2014a: 23). Finally, the field of civil security relates to aspects of computerised information again, highlighting distinct aspects of both cyber-security and IT security (BMBF, 2014a: 28n.).

Further initiatives in support of investment in intangible assets highlight the role of university- industry linkages, which are identified as crucial components of an evolving knowledge-based economy. Prominently, the “Forschungscampus” programme is a funding scheme of the Ministry of Education and Research that addresses the function of German universities in regional innovation networks with the business sector. Thus, the mandatory character of public-private partnership goes along with the spatial proximity of the various research activities as preconditions of funding (BMBF, 2011). Currently, nine of these research campuses are operating at selected universities, each of them receiving €1-2 million Euro over a period of up to 15 years, which needs to be matched by the private sector. Thus, the programme aims to strengthen and lever the effects of public investment in the knowledge base of regional knowledge agglomerations (Koschatzky, 2014: 13). The EXIST programme parallels these efforts as it highlights universities and polytechnics as terrains for the creation of entrepreneurial start-ups. It seeks to establish a culture of entrepreneurship and thus promotes new business ventures that stem from the commercialisation of academic research results. Technology transfer offices and specific centres of entrepreneurship at universities and polytechnics are specifically targeted for their supporting role in the flow of knowledge and expertise to the new entrepreneurial firms, which aim at developing the intangible assets (Kulicke et al., 2012: 141; Egeln et al., 2002: 18).

The strategic orientation towards knowledge agglomerations is shared by the initiative of the “Spitzencluster-Wettbewerb”, a programme that highlights a scheme of competitive funding for regional industrial clusters with a view on innovation in new technologies. Universities and polytechnics may be part of these cluster structures yet the emphasis is on locally agglomerated and technologically specialised inter-firm networks that are part of a value chain and thus share certain a common knowledge base. In this manner, the strategy of leading-edge cluster competition for public funding refers to the spatial proximity of public and private partners collaborating in the domain of technological innovation. The selection of winners is based on the assessment of market opportunities and performance expectations with funding of up to €40 million allocated for a maximum of five years. The go-cluster programme points in the same direction. It addresses the formation of innovative industrial clusters, which still need to develop an internationally competitive edge; an approach that is also shared by most regional programmes on cluster development (BMBF, 2014c: 240n).

2.3.3 Automotive as lead sector

The automotive sector with its core of export-oriented large firms that are part of the global networks of automobile production plays a strategically decisive role for the German innovation system. Its patterns of industrial relations and governance is most representative reflection of the German variety of coordinated capitalism, which allows for a strong managerial presence of the labour unions, in this case the IG Metall union, which is accompanied by a persistent governmental interest in the performance of this sector with its major global players such as Volkswagen, Daimler, BMW, among others. Indeed, the automotive industry is the largest industrial sector in Germany with 20% of total German industry revenue and a workforce of around 756,000 in 2013. As a matter of fact, around 77% of all cars produced in Germany in 2013 were sold as exports, while, on a global scale, about 20% of all cars produced are made by a German original equipment manufacturer, amounting to a share of 30% in Europe only (GTAI, 2015: 2n.). Crucially, when it comes to investment in intangible assets, the knowledge base of the automotive sector combines expertise in quality manufacturing with technological leadership based on extensive R&D activities. Indeed, the performance of the German innovation system is very much influenced by the automotive sector and its related activities. German original equipment manufacturers provide about 30% of international R&D expenditure in the automotive industries. Also domestically, Germany’s automotive sector excels in its innovative efforts as it stands for 33% of R&D expenditures of German manufacturing industry while employing about 25% of the total R&D workforce in Germany’s private sector. Also, the automotive sector spends almost 50% of Germany’s total external R&D investments (GTAI, 2015: 5n.). On the output side of innovation, viewed on a global scale, automotive manufacturers and suppliers from Germany are among the world’s leading patent applicants with the automotive sector harbouring nine out of the German top ten patent filing firms. The corresponding market performance speaks for itself: about 50% of turnover in the automotive sector resulted from product innovations in 2012, while almost 70% of all firms in this sector introduced new products or processes (GTAI, 2015: 10).

Crucially, when it comes to the impact of intangible assets, about 90% of these automotive innovations in 2012 have been featuring electronics and software (GTAI, 2015: 7). Therefore, all three domains of intangible assets – namely computerised information, innovative property and economic competencies – actually matter in the knowledge base of the automotive firms and industries, which means the policies in support of investment in intangible assets, need to account for the comprehensiveness and interdependence of these assets. Indeed, as Germany hosts the highest concentration of all the European automotive original equipment manufacturer and tier supplier R&D centres, so joint research activities with excellent automotive technology research institutes and universities are at hand. This is well exemplified by Germany's automotive industry clusters with their R&D, education and training networks involving universities, research institutes, and firms that operate in domains such as mechatronics, microelectronics, mechanical engineering, manufacturing processes, and material sciences. A key research organisation in this regard is the Fraunhofer Institute for Communication Systems with its internationally acknowledged competencies in vehicle information and communication technologies (GTAI, 2015: 11). Indeed, empirical evidence shows that these kinds of inter-organisational arrangements for various types of R&D contribute crucially to the accumulation of intangible assets in the involved firms. In the automotive sector, in particular, collaborative R&D projects enhance in-house capacities of firms and increases their productive efficiency (Becker and Dietz, 2004: 210).

In view of these patterns of investment in intangibles, the Research Campus programme includes specific measures in support of these kinds of investment in the automotive industry. A prominent case is the project ARENA 2036, Active Research Environment for the Next Generation of Automobiles, which constitutes a research campus in its own right. It is based on a public-private cooperation between the University of Stuttgart, two Fraunhofer Institutes, the Institute of Textile Technology and Process Engineering Denkendorf, the German Aerospace Centre, and prominent industry partners such as BASF, Daimler, Bosch as well as small- and medium-sized enterprises. The project emanated from the procedures of the procedures of the Forschungscampus programme which provides core funding under conditions of a comparative assessment of selected projects. In 2012, the ARENA 2036 project won this competition established by the Federal Ministry of Education and Research. It thus gained a capital endowment of more than €70 million. On the one hand, this includes funding guaranteed by the federal government, which may be further increased after the accomplishment of specified targets in 2017. The industry sector, however, also contributes in the format of financial means as well as machinery and staff (Guhlich, 2014). Strategically, ARENA 2036 aims at increasing the power efficiency and reducing the energy consumption of automobiles, while maintaining highest standards of safety and convenience. In this way, it is meant to contribute to a low-carbon restructuring and more sustainable outlook of the automotive sector. The key concepts to be utilised in that regard involve the elaboration of intelligent lightweight construction and the optimisation of flexible production systems in the manufacturing of automobiles (Fraunhofer IPA, 2012: 29). The contribution of the University of Stuttgart is based on its experience in light construction with uniaxial-fibre-reinforced synthetics. The complementary input of non-university research centres from the fields of ergonomics and industrial engineering is based on their knowledge of modelling and simulating the characteristics and operation modes of new materials (BMBF, 2014b: 4). In promoting these dedicated efforts in the collaborative application of scientific and industrial knowledge, the programme actually sponsors an improvement of the productive knowledge base of the involved firms, which is particularly relevant for investment in intangible assets such as R&D and new designs.

Yet also policy programmes on the level of the Länder come to promote investment in intangibles specific to the automotive sector, some of them with the explicit rationale of supporting transnational knowledge transfer. An example is the Bavarian automotive cluster, which takes part in the European Network on Electric Vehicles and Transferring Expertise project funded by the European Regional Development Fund with the aim of promoting electric mobility by means of transnational public-private partnerships among academic, policy and business actors. More than 15 partners from North-Western European countries are part of the network in order to exchange information and knowledge as point of departure for collaborative projects in the design of adequate infrastructures, mobility concepts and pilot projects for speeding up the diffusion of electric mobility across Europe (StmWIVT, 2013: 5). Recently, this network has been revamped as ENEVATE 2.0 in order to intensify the shared understanding of regional best practices. In this context, the Bavarian automotive cluster cooperates most closely with the University of Applied Sciences in Kempten as a means to further regional knowledge flows (Bayern Innovativ, 2015).

In line with the extensive efforts of German manufacturing firms regarding workforce training and applied research, the automotive industry stands out with regard to firms-specific programmes and projects that are subject to fiscal incentives and co-funding arrangements with the public sector. An illustrative example is the AutoUni training network of the Volkswagen Group, which is established for the lifelong training of all Volkswagen employees ranging from apprentices to managers. In carrying out this mission, AutoUni cooperates with both domestic and international universities and research institutes in carrying out training programmes and research projects in the areas of marketing and sales, human resources and procurement. In 2013, for instance, the research project “Transformation Potential of Mobility by 2030 – Future Mobility

Developments in Germany" was carried out in partnership with the Institute of Transportation Design at Braunschweig University and other international partner universities; a format of collaboration that reflects the transnational reach of knowledge flows in the global production networks of the automotive industries (Volkswagen, 2015).

2.3.4 Case: EffizienzCluster LogistikRuhr

As outlined above, German cluster policies are closely related with maintaining prevailing competitive advantages in manufacturing industries such as automotive, machinery, and precision engineering as well with the promotion of new science-based industries such as pharmaceuticals and biotechnology as well as in emerging industries related to renewable energies and low-carbon technologies that are the key to the transition towards a knowledge-based economy that proceeds along an ecologically sustainable growth trajectory. In general, German cluster policies both on the national and the regional level are regarded as comparatively successful concerning the promotion of regional innovation networks and the stimulation of innovation processes in the involved firms (Rothgang and Lageman, 2011: 161; Stahlecker and Kroll, 2012). At the same time, while collaborative R&D plays an important role for the creation of knowledge in regional clusters also the mode of technology and knowledge transfer between universities, research institutes and the involved firms, yet of course also the modes of inter-firm technology and knowledge transfer, crucially contribute to the dynamism of a cluster and its capacity for renewal by stimulating entrepreneurial start-ups (Hülsbeck and Pickavé, 2012: 123). As clusters are based on these patterns of inter-firm relations, also the international openness of the knowledge base of clusters requires attention. Indeed, multinational enterprises play a major role in the enhancement of regional knowledge pools and the generation of spill-over effects within and across clusters. The corresponding provision of network capital is based on the ability to choose appropriate partners, facilitate exchange among them and support collaborative projects (Kramer et al., 2011: 456).

Effects of federal programmes such as Leading-Edge Cluster Competition, which provide funding for dedicated cluster projects, tend to corroborate this assessment. It seems that funding efforts have stimulated collaborative R&D activities, leading to an increased output of patents and the market introduction of innovative products in a sustained manner across the involved clusters and industries (BMBF, 2014c: 232n.). The regional dimension of this policy approach is well exemplified by the Cluster Initiative Bavaria, the "Cluster Offensive" programme of the Bavarian Ministry of Economic Affairs, Media, Energy and Technology, which supports 19 selected industry clusters. A recent evaluation of 1.700 Bavarian companies that participate in this cluster project illustrates that their competitiveness and innovation capabilities have increased significantly. In effect, the public promotion of clusters by means of dedicated funding mechanisms seems to be successful in strengthening the knowledge base of the involved firms and industries, accelerating the implementation of new technologies, and facilitating the market entry of both established and newly founded firms (StmWIVT, 2013: 3). In this manner, cluster policies may be singled out as key feature in the German setting of policies for investment in intangible assets.

The case of EffizienzCluster LogistikRuhr illustrates the corresponding policy efforts in a most prominent manner. More than 160 companies and twelve scientific institutes have become part of this extensive cluster structure, which is located in the Ruhr area, Germany's heartland of traditional heavy industries, which have been going through comprehensive structural changes in recent decades. Based on coordinated funding in the context of the Leading-Edge Cluster Competition programme of the German government, EffizienzCluster LogistikRuhr currently represents Europe's largest research and innovation cluster in the domain of logistics. Involved companies range from local small- and medium sized enterprises to multinational enterprises with their globalised production and service networks. These include most leading firms related to the logistics sector such as:

- Bayer MaterialScience AG,
- Continental Reifen Deutschland GmbH,
- Daimler AG,
- DB Mobility Logistics AG,
- Deutsche Bahn AG,
- Deutsche Telekom AG,
- Fraport AG,
- Infineon Technologies AG,
- Kühne + Nagel AG & Co. KG,
- Lufthansa Cargo AG,
- Metro Group,
- Schenker Deutschland AG,
- Siemens AG,
- ThyssenKrupp Xervon GmbH,
- United Parcel Service Deutschland Inc & Co.,
- Vallourec & Mannesmann Deutschland GmbH,
- Vattenfall Europe AG,
- Volkswagen AG.

Academic partners of the cluster initiative include universities and research institutes such as:

- Bremer Institut für Produktion und Logistik,
- Fraunhofer Institute for Material Flow and Logistics,

- Fraunhofer Institute for Software and Systems Engineering,
- Kulturwissenschaftliches Institut, Essen
- Rheinische Friedrich-Wilhelms-Universität Bonn
- Technische Universität Dortmund
- Universität Duisburg-Essen.

The intermediary organisations that take part in the initiative cover an array of regional industry associations, chambers of industry and commerce, as well as administrative organs of locational policies such as:

- Industrie- und Handelskammern im Ruhrgebiet,
- Initiativkreis Ruhr,
- Logistik.NRW,
- NRW.Invest GmbH,
- Speditions- und Logistikverband Hessen/Rheinland Pfalz,
- Verband Spedition und Logistik NRW,
- Wirtschaftsförderung Dortmund
- Wirtschaftsförderung metropoleruhr GmbH.

Pioneering efforts in bringing together this cluster organisation were put forward from within the Fraunhofer Institute for Material Flow and Logistics, IML. While a first submission to the Leading-Edge Cluster Competition in 2008 was prone to failure, a second submission proved to be successful in 2010. Key selection criteria were the significant financial involvement of industry and private investors, the projected increase in innovative capability and the attainment of international market positions as well as the establishment of cluster-specific training mechanisms for the workforce, carried out by the involved firms. In this manner, the stimulation of private sector investment in intangible assets is a key rationale behind the approach of the Leading-Edge Cluster Competition as funding framework for the EffizienzCluster. The Ministry of Education and Research, BMBF, has subsequently funded the EffizienzCluster initiative with €40 million. The first phase lasted from 2010 to 2012 with 27 projects receiving funds up to €36 million, and from 2012 to 2015 further four projects were included, thus receiving €4 million together. Also, a number projects that were already funded elsewhere would be associated with the cluster, in doing so considerably augmenting its knowledge base. In effect, the total volume of financial means carried by the EffizienzCluster initiative would amount to €100 million (EffizienzCluster LogistikRuhr, 2015). The strategic aims of the cluster that are to be achieved during the duration of its operations from 2010 to 2015 highlight not only an increase of resource efficiency in regional logistics by more than 20%, but also the creation of 4,000 new jobs and the generation of 100 new products and patents (Fraunhofer ISST, 2010).

Crucially, the spatial and political-administrative range of the cluster structure resembles the metropolitan Ruhr area, quite in line with the developmental strategy of the Länder government of Nordrhein-Westfalen, which aims at restructuring this region as a globally visible centre for innovative, resource-efficient logistics in a knowledge-based economy, framed by a complementary research infrastructure. In reflecting this industrial orientation, then, the programmatic ideas developed in the cluster combine manufacturing expertise with digitalisation in a globalised setting of material and knowledge flows, involving technologies such as cyber-physical systems, the Internet of Things, cloud computing, and the ubiquity of data in digital society. Thus, the projects in the EffizienzCluster LogistikRuhr are meant to stimulate innovations with a broad range of logistical applications. A focus, however, is on innovation in production technology of the “Industry 4.0.” type of digitalized industrial production that is viewed in the context of an emerging “Industrial Data Space”. In line with these innovative efforts, the cluster has generated entrepreneurial spin-offs such as the training provider GlobalGate, which applies the new knowledge in digitalised logistics to programmes in workforce training and management consulting (BMBF, 2015: 68n.). Accordingly, the range of intangible assets covered by the EffizienzCluster covers all the domains of computerised information, innovative property and economic competencies. In this manner, investment in intangible assets should drive a self-sustaining process of innovation and economic growth across the Ruhr area and beyond, which combines the more traditional industrial routines of logistics with new sets of information and communications technologies.

2.3.5 Case: Intellectual property rights and intellectual capital statements

Small and medium-sized enterprises play an important role in the performance of the German economy. In particular in the manufacturing industries, this Mittelstand excels with its technological expertise and productive specialisation that also benefits the supply networks of large firms. The corresponding knowledge base of these small and medium-sized firms, which involves both formal and tacit knowledge, is paramount for the accumulation and utilisation of intangible assets across firms and industries. The German government promotes innovative activities in small- and medium-sized enterprises among others through its dedicated Central Innovation Programme, ZIM. It provides funding for collaborative research projects between small- and medium-sized enterprises and research institutes. The programme highlights the support of R&D operations in pre-competitive projects that are close to the phase of market introduction. The positive effects of this programme have been noteworthy, as the involved firms have been persistently encouraged to engage in R&D activities for the very first time since market entry while boosting their performance by doing so (ISI and GIB, 2010). The ZIM support programme is implemented in a counter-cyclical manner, too. Thus, during the recent financial crisis in 2009, German government increased the financial support for the ZIM programme by €900 million. This additional support generated positive effects in terms of the maintenance of existing jobs and the creation of new employment opportunities (BIS, 2011a: 14). Corresponding support for small- and medium-sized enterprises are provided by the Länder as well. For example, North Rhine-Westphalia has been setting up a Promotion of Innovation and Technology programme that provides financial support for R&D in targeted SMEs (BMWi, 2009: 97n.).

However, crucial hindrances in the promotion of these kinds of innovative efforts of small- and medium-sized enterprises are the problematic issues that relate to the problems of measuring and valuing intangible assets in the innovation process, followed by the matter of intellectual property rights and the legal protection of these intangible assets. In view of this issue, the Ministry for Economic Affairs, BMWi, launched the initiative "Fit for the Knowledge Competition" in 2002 as a means to support the knowledge management of small- and medium-sized enterprises (BMWi, 2013a). One particular tool of the initiative is the project "Intellectual Capital Statement – Made in Germany", Wissensbilanz, which gives support to small- and medium-sized enterprises in dealing with the depiction and development of intellectual capital and the corresponding measurement of intangible assets. A central element in this project is the instrument of the knowledge survey, which is based on a method that was conceptually developed and practically tested in cooperation with more than 50 firms. The knowledge survey guideline seeks to encourage executive and project managers of small- and medium-sized firms to promote the measurement of intangible assets within the firms in order to gain an overview of the strategic knowledge-based resources that are actually available for competitive use (BMWi, 2013b: 5). The framework of the intellectual capital statement has become an internationally recognized standard, which allows firms to capture the asset value of their knowledge base. Accordingly, this outline of an evaluation of intangible assets is a first step towards the strategic utilization of intangible assets in the overall investment outlook of firms.

However, in proceeding with these knowledge-based competitive efforts the legal protection of intangible assets comes to the fore. In fact, German legislation actively seeks to protect intellectual property rights that are commonly associated with intangible assets such as patents, trademarks and copyrights (BMWi, 2009: 16). This corresponds with the prominent status of the legal protection of intellectual property in the rationale of the patenting activities of German firms, which is far more important than issues such as the blocking of competitors or the mere enhancement of shareholder value (Blind et al., 2006: 664). In order to overcome the lack of information and expertise that characterises many specialised small- and medium sized enterprises, several federal and regional agencies provide supporting concerning the promotion and protection of intellectual property rights. Table 7 provides an overview of these support structures. At the national level, corresponding governmental measures are conducted by the Ministry of Economic

Affairs and the Ministry of Justice, paralleled by the legal advice that is provided by the Association of the German Chambers of Industry and Commerce, DIHK.

The Ministry of Economic Affairs governs the support initiative SIGNO, which is designed to support the legal aspects of collaboration efforts between universities, small- and medium-sized enterprises, and individual innovators. A specifically relevant programme is the SIGNO Innovation market that consists of an electronic marketplace, where innovators can present their technologies and patents. The aim is to bring together small- and medium-sized enterprises, licensing partners and investors. The marketplace contains entries in the categories “innovation searches for capital”, “innovation searches for companies” and “company searches for innovation”. The preparation of these entries is supported and standardised by the SIGNO partners. Such a submission of an entry into the database receives financial support of up to 30% of total costs (BMWi, 2009: 94). Evaluations of this instrument of an innovation market platform highlight its positive effects. It is recognized that the SIGNO partners are qualified concerning the promotion of entries and the ensuing facilitation of cooperative projects. Also, the official character of the platform allegedly signals professional reliability of the involved partners and thus invites further investment from the private sector (Prognos, 2010: 73).

Table 7 **Policy programmes in support of intellectual property rights**

IPR programme	Supporting agency
SIGNO innovation market	BMWi
SIGNO information desk	BMWi
SIGNO SME patent campaign	BMWi
BMWi patent server	BMWi
Legal advice and license promotion service	BMJ
Legal aid	BMJ
Basic information and workshops	BMJ
Patenting and licensing information	DIHK

Source: Adapted from BMWi (2009).

A related programme that seeks to tackle the problem of information deficits on behalf of small firms in coping with intellectual property rights is the SIGNO information desk for innovators and inventors. It provides initial consulting for individuals as well as small- and medium-sized enterprises in need of advice and consulting regarding the utilization and protection of intellectual property rights. In this vain, the information desk provides access to expert knowledge, which is then translated into a strategic approach to the management of intangible assets (BMWi, 2009: 94). When it comes to evaluations, the information desk is subject to high demand by users and exercises positive effects for their projects and firms. The programme is regarded as successful, owing to its open access structure and the opportunity for free initial consulting. Another factor of success is the focussed knowledge of the involved SIGNO experts, for they supply insights from technology forecasting and thus elucidate key aspects concerning the economic prospects of inventions. Furthermore, individual inventors may benefit from the professional networks of the SIGNO partners (Prognos, 2010: 87). This kind of provision of high qualitative individual advice is also a main pillar of the promotion of licensing activities, as provided by the Ministry of Justice. Yet also trade and industry associations that constitute a self-governing institutional support structure for business firms provide information services on intellectual property rights. These include patent information centres and patent utilisation agencies, as carried by the local Chambers of Commerce and Industry across Germany.

2.3.6 Conclusion on German policies in support of investment in intangible assets

German policies in support of investment in intangible assets reflect the specificities of the German production model with its specialisation in high-quality manufacturing industries. This production model is framed by a national innovation system that is comparatively strong in its diversified position of knowledge intermediaries such as the Fraunhofer Institutes, which translate academic knowledge and applied research into a format of information and expertise that can be readily applied by firms and industries as a means to further their knowledge base and to advance their innovative activities. Public funding for these kinds of knowledge intermediaries is a key feature of the German innovation system, which maintains a strong standing of the public sector while including industry associations, labour unions and non-governmental organisations form across civil society in its extended governance structures. At the same time, the strategic emphasis on investment in firm-specific human capital is indispensable for maintaining the knowledge base required in high-quality manufacturing – as represented by the automotive sector.

This rationale of long-run investment also coins related policies for investment in intangible assets in all the major domains of computerised information, innovative property and economic competencies. Indeed, it becomes most obvious that these domains of intangible assets are intimately related with each other when it comes to the ongoing transition towards a knowledge-based economy. The support of investment in computerised information stands out as a policy feature that relates to the notion of Industry 4.0, which designates the digitalisation of manufacturing and industrial logistics. Information and communication technologies evolve as backbone technologies for manufacturing processes, which are of major importance for the performance of Germany’s manufacturing industries. However, this technological enhancement also provides opportunities for diverse process and product innovations that require collaborative R&D activities. The support of digitalised manufacturing and logistics thus informs a variety of policy initiatives that tackle the support of investment in intangibles. A prominent case is the leading-edge cluster initiative of EffizienzCluster LogistikRuhr, which is part of the German cluster policy framework, and which positions the matter of

Industry 4.0 as a prominent issue for scientific research as well as academic education, management consulting and workforce training.

Related efforts in promoting the matter of innovative property and economic competencies can be traced in policy initiatives such as the Research Campus programme that seeks to support the interaction between universities and business firms in a variety of technological and industrial fields with the aim of building regional knowledge agglomerations that can serve as strategic hubs for co-located clusters of high-performing industries. In effect, these programmes provide funding as well as fiscal and financial incentives to establish and strengthen regional networks of innovation that further integrate universities and research institutes into the interactions of manufacturing and service industries. At the same time, as universities become places of entrepreneurial activities, so the legal protection of intellectual property rights such as patents becomes a major aspect of dedicated policy initiatives that are meant to enhance the innovative property and economic competencies of the involved firms. A best practice case in this regard is the SIGNO programme of the German Ministry of Economic Affairs, which provides data platforms, information desks and patenting advice for innovative firms which lack professional competencies in that regard.

3. Policy implications

3.1 Summary: Best practices in the support of investment in intangible assets

As the ongoing transition from resource-based economies to knowledge-based economies boosts the economic relevance of intangibles, so do policies in their support become ever more important. The preceding survey of best practices as to how to support investment in intangible assets has so far highlighted specific national and regional sets of comprehensive policy efforts that combine the provision of physical and legal infrastructures with fiscal and financial incentives, public funding schemes and mechanisms of knowledge-transfer, all of which are meant to lever financing from the private sector. Of course, high-performing innovation systems are usually driven by the investment activities of the private sector, which enhance the knowledge base of firms and industries by the upgrading of intangible assets, yet government may provide a stimulating context augmented by selective interventions. In particular, when it comes to the new type of industrial policy that tackles the support of investment in intangible assets across traditional policy fields and beyond top-down modes of selective intervention, government has the important role to coordinate the sustained cooperation between public and private sector with regard to interactions in research, training, and innovation. In addition to the involved firms, these efforts involve actors from government and administration, funding and support agencies, universities, research institutes and training organisations, as well as industry associations, labour unions and non-governmental organisations. The effects of these policies transcend the narrow economic domain of industries and markets. In fact, investment in intangible assets affects the knowledge-base and learning modes of society at large, which allows for a policy perspective that combines a socially inclusive and ecologically sustainable model of economic growth.

In view of this concern, the surveyed economies – Finland, Germany and the United Kingdom – each stand for a particular variety of market economy, which combines market and non-market modes of coordination with distinct policy efforts in combining industrial structures and patterns of innovation with the prevailing outlook of comparative institutional advantages. In these efforts, the Finnish innovation system exhibits major advances in building a knowledge-based and service-oriented economy by means of combined infrastructural and institutional provisions. The dominant reference to information and communication technologies allows for general insights into the prospects of utilising the latter's potential in furthering the knowledge base of firms and industries. In this context, the recent restructuring of the Finnish ICT sector provides key insights into the challenges of policy-making under conditions of rapid technological and structural change, which highlights the need for a persistent renewal of intangible assets in order to keep up with the international competition. The national innovation system of the United Kingdom comes together with a liberal type of service-oriented market economy, which is characterised by the prevalence of market relations in the coordination of firms and their institutional environment. It serves as institutional and industrial backbone for related sets of policies that underline the leading position of the private sector when it comes to the accumulation of intangible assets. The prevailing policy rationale is focussed on fiscal and legal incentives for stimulating investment in intangibles, accompanied by informational services. The support of R&D operations and the protection of intellectual property rights can be identified as major policy thrusts that draw on the utilisation of university-industry relations in science-based industries such as biotechnology, which receive policy support for the commercial advancement of intangibles. Germany's economic model, however, combines market and relational modes of governing economic affairs in the setting of an industrial specialisation in medium-tech manufacturing industries such as automotive and mechanical engineering. The German innovation system is particularly engaged with efforts in applied R&D as it draws on the role of research and technology organisations, which serve as core funded knowledge intermediaries between academic research and business firms. This setting also informs the policy-assisted formation of regional clusters of firms and industries that share a common knowledge pool and develop collective strategies for intangible investment.

Accordingly, the surveyed best practices in support of investment in intangible assets illustrate the cross-national emergence of a new type of industrial policy that pinpoints public-private interactions in all the fields of intangible assets, namely computerised information, innovative property and economic competencies. Major elements of this policy perspective integrate these domains and put them into a wider policy context while maintaining a focus on certain intangibles. In view of surveying best practices in the policy support of investment in intangible assets, then, the most decisive policy endeavours and the related best practices as surveyed above may be summarised as follows:

a. Policy support of investment in computerised information

Best practices of policies supporting investment in computerised information highlight the role of government in the provision of infrastructural public goods. In particular, the provision of components of technologically most advanced components of information and communication technologies infrastructure prove to be decisive for stimulating complementary private sector investment in software and databases that augment the knowledge base of firms and industries

- Information and communication technologies infrastructure

Information and communication technologies constitute the backbone of the evolving knowledge-based economy. The digitalisation of information storage and knowledge transfer allows for complex processes of collective learning that feed into the innovation profile of firms and industries. Aspects such as the diffusion of broadband access pinpoint the need for the persistent renewal of these infrastructures in line with the requirements of rapid technological change.

Best practice: X-Road Solution in Finland. Run under the supervision of the Finnish innovation agency Sitra, "X-Road Solution" is a data-exchange layer that provides a technical and organisational environment for the secure exchange of data that can be used by commercial and non-commercial users alike. In effect, X-Road is the result of a transnational ICT cooperation that has allowed for the transfer of the underlying technological and organisational concept from pioneering Estonia to Finland. Its operational rationale is particularly relevant for the promotion of investment in databases whose content can be stored and transferred in a more secure manner.

b. Policy support of investment in innovative property

Investment in innovative property addresses the knowledge base of firms and industries in so far as it relates directly to the generation of process and product innovations involving new ways of organising resource inputs as well as the actual appropriability of returns by means of safeguarding property rights. In view of the overall activity related to the corresponding sets of intangible assets, it is fair to state that the promotion of investment in R&D stands out as most relevant aspect.

- Fiscal incentives for R&D investment

A most promising way of supporting investment in R&D operations is the reduction of tax burdens by means tax breaks, special tax rates and related mechanisms that are meant to provide fiscal incentives for investment and its appropriability. Due to the fact that investment in R&D targets a complex process with an uncertain market outcome, it is quite obvious that fiscal incentives prove to be effective, because they tackle the key variables of a firm's investment decision.

Best practice: R&D tax relief in the United Kingdom. British government not only expanded R&D tax credit for small and medium-sized enterprises, it also introduced a "Patent Box" that reduces corporation tax on profits from patents with a focus on tax relief for firms operating in the domain of the life sciences. Patents developed collaboratively also count in while profits from the sale of patents are eligible for the reduced tax rate, too. A Seed Enterprise Investment Scheme offers a 50% income tax relief on investment. Also, an above the line R&D tax credit improves the visibility of R&D tax relief (BIS, 2011b: 25n).

- Intermediate research and technology organisations

The strategic fostering of intermediate research and technology organisations by means of core funding has become a prominent issue across the surveyed countries. Funding these organisations may facilitate extended flows of knowledge and information in the commercialisation of research results. It adds particularly well to domains of innovative property such as R&D, new product development and new designs, yet it also impacts upon economic competencies such as workforce training and management consulting.

Best practice: Fraunhofer institutes in Germany. The Fraunhofer-Gesellschaft is a crucial component of the intermediate sector in the German innovation system, based on core funding by national and regional governments that is complemented by contract research for industry and competitively won publicly funded research projects. Research activities focus on applied industrial research across the natural and social sciences that is exercised by a nation-wide network of specialised research institutes, which currently amount to 67 institute organisations. Specific expertise relates to Germany's manufacturing industries.

Best practice: Catapult centres in the United Kingdom. Currently, nine Catapult centres have been established, core funded by Innovate UK with additional two thirds of funding based on competitively earned business-funded R&D contracts and collaborative applied R&D projects funded jointly by public and private sectors. They offer industry- and technology-specific access to specialist expertise in order to promote innovative output of products and services. The development of human capital in business firms is promoted by measures in vocational and R&D competency training, complemented by informational services on regulatory frameworks and access to finance.

- Collaborative public-private research networks

Collaborative projects in the field of R&D rely in university-industry links that facilitate knowledge transfer in innovative projects. These kinds of partnership may be supported by policy means that are commonly applied to the promotion of investment in R&D at large, namely dedicated grants and funding incentives. The transfer of knowledge and expertise from universities to firms and industries aims at the co-production of technological innovations. Also, these processes are set to feed back on universities with regard to the entrepreneurial dynamism of science.

Best practice: Leading-Edge Cluster Competition in Germany. The "Spitzencluster-Wettbewerb" highlights a scheme of competitive funding for regional industrial clusters with a view on innovation in new technologies. Universities and polytechnics are part of the cluster structures, which build on locally agglomerated inter-firm networks that share a common knowledge base. The selection of winners in competitive programme is based on the assessment of market opportunities and performance expectations with funding of up to €40 million allocated for a maximum of five years.

Best practice: Collaborative Research and Development programmes in the United Kingdom. These programmes target firms that operate in the domain of science-based business operations. They promote the interaction of firms and research institutes in collaborative R&D projects pursued in priority areas of science and technology from which successfully marketable products, processes and services are likely to emerge. The programmes are co-funded through the governmental system of Research Councils and the Technology Strategy Board in a range from 25% to 75% shared contributions to total project costs.

- Provision of information on intellectual property rights

The public provision of information on available modes of securing intellectual property rights facilitates the implementation of patenting, licensing and other mechanisms that allow for the appropriability of returns on innovation. The elucidation of rules and methods concerning patents, trademarks and copyrights, among others, thus stimulates investment in innovative projects and is indispensable for outlining the legal environment that characterises the evolving knowledge-based economy.

Best practice: The "Lambert toolkit" in the United Kingdom. The Intellectual Property Office together with the Technology Strategy Board communicates model agreements on intellectual property rights such as the "Lambert toolkit" that includes advice for legal decision-making and procedural guidance, which is meant to assist in facilitating contract negotiations between private sector firms and publicly-funded research organisations such as universities which engage in research and development collaborations.

Best practice: The Knowledge Account programme in Germany. The German Ministry of Economy and Technology governs the project "Wissensbilanz – Made in Germany", which provides information for small and medium-sized enterprises in accounting for their intangible assets related to patents, trademarks and copyrights. In this setting, the SIGNO programme supports patent applications and organises the inter-firm exchange of knowledge and technologies.

- Promotion of entrepreneurial start-ups

Entrepreneurial start-up firms play an important role in the introduction of new technologies and the provision of related employment and income opportunities. Policies promoting entrepreneurial start-ups combine access to financial resources and fiscal incentives with the provision of information on market opportunities and legal aspects of innovation. Also, the facilitation of interaction between established firms and entrepreneurial start-ups proves to be beneficial.

Best practices: Innovation Mill in Finland. The Finnish Funding Agency for Technology and Innovation, Tekes, operates the "Innovation Mill" programme, which marks a collaboration between Tekes, Technopolis, a Finnish operator of technology parks, and the leading ICT firm Nokia. The objective of the Innovation Mill is to promote entrepreneurial activity by selecting and implementing innovative ideas submitted by aspiring technology entrepreneurs, who are potentially awarded the opportunity to get their projects implemented in cooperation with Nokia.

c. Policy support of investment in economic competencies

Major efforts in policy support of investment in economic competencies address the matter of workforce training and management consulting both of which stand for those intangible assets that are most fundamentally related to the accumulation of human capital in the knowledge base of firms. In promoting the upgrading of skills and capabilities of labour and management, the corresponding policies also pave the way for persistent endeavours in both technological and organisational innovations.

- Financial and fiscal incentives for training programmes

Policy efforts in the promotion of workforce training transcend the public provision of education and training infrastructures as well as the public-private co-organisation of training programmes, for they directly tackle private sector investment in training measures. These policy efforts may be based on financial means such as funding programmes or fiscal incentives that relate to reduced tax rates and other means of reducing the taxation of business firms.

Best practice: Knowledge Transfer Partnerships in the United Kingdom. The programme of Knowledge Transfer Partnerships provides informational advice and financial support for collaborative projects between universities and polytechnics, research organisations, and business firms. The programme targets firms without previous experience of employing graduates and postgraduates. TSB Advisers assist in the development of collaborative project proposals. Successful proposals receive KTP grants that part-fund the costs of employing university graduates, post-doctoral researchers or other formally qualified individuals on an advanced vocational qualification level. The involvement of academic supervisors allows for the continuous tutoring and training of the involved personnel and their work environment.

Best practice: The Volkswagen AutoUni in Germany. The AutoUni training network of the Volkswagen Group harbours the lifelong training of all Volkswagen employees ranging from apprentices to managers. AutoUni cooperates with both domestic and international universities and research institutes in carrying out training programmes and research projects in the areas of marketing and sales, human resources and procurement. The federal state of Lower Rhine-Saxony, which is also a major Volkswagen shareholder, provides financial support for cooperation programmes and projects, in particular with regional actors.

- Provision of information and consulting for management

The enhancement of the knowledge base of firms involves policy programmes in support of the provision of information on market data and legal frameworks, combined with strategic advice and consulting for management. These efforts are meant to tackle investment decisions on the upgrading of intangible assets with a particular focus on technological innovation and organisational restructuring. In this manner, the transfer of knowledge becomes a key policy measure.

Best practice: Intellectual Capital Statement programme in Germany. The German Ministry for Economic Affairs has launched the initiative "Fit for the Knowledge Competition" as a means to support the knowledge management of small- and medium-sized enterprises. One of its tools is the Intellectual Capital Statement programme, "Wissensbilanz", which supports small- and medium-sized enterprises in dealing with their accounts of intangible assets. A knowledge survey guideline encourages management to gain an overview of the strategic knowledge-based resources of the firm.

3.2 Outline of an action plan

Intangible assets are conceptually differentiated into computerised information, innovative property and economic competencies. In order to establish a socially inclusive, ecologically sustainable and knowledge-based growth path for the economies of the European Union, the stimulation of investment in intangible assets by means of adequate policy programmes is of most fundamental importance. The underlying policy approach needs to be conceptualised in terms of a new type of comprehensive industrial policy, which reaches across the traditional policy fields of industry, technology, entrepreneurship, and education. The concern with the knowledge base of firms and industries, however, remains at the core of such a more comprehensive policy approach, which tackles key domains such as ICT infrastructures, R&D, intellectual property rights, and workforce training. Also, as indicated in the best practice cases surveyed above, such a new approach to industrial policy in support of investment in intangible assets needs to come up with a cooperative view on public-private interactions in the design and implementation of policy mechanisms. In effect, policies in support of investment in intangible assets are meant to facilitate technological as well as organisational innovation as basic factors of competitiveness in the evolving European knowledge-based economy. Therefore, their actual conceptualisation needs to be compatible with the evolution of both the technological and institutional context in the involved nations and regions across the European Union.

An action plan for promoting policies in support of investment in intangible assets should comprise of the following strategic thrusts:

- Information and communication technologies infrastructure

The European Union needs to maintain its efforts in harbouring the most advanced information and communication technologies infrastructure. This involves not only a further expansion of technological components that provide features such as high-speed internet access under conditions of data security, but also an adequate institutional setting with related legal frameworks in place.

In this manner, the European Union should seek the urgent expansion and upgrading of these infrastructures, the provision of access opportunities for all parts of society, and the implementation of a harmonised legal setting for data security and privacy that are sensitive to the particular concerns of business firms. Accordingly, a further synchronisation of national efforts is indispensable, while the formation of transnational networks for data exchange requires a concerted effort on the side of the Commission.

In these efforts, it is advisable to learn from cases of transnational knowledge transfer, as exemplified by the Estonian-Finnish cooperation. In particular, some of the more recent members of the European Union have been going through a phase of technological leapfrogging that may give them a pioneering status in the European upgrading of information and communication infrastructures.

- Fiscal incentives for R&D investment

Fiscal incentives for R&D investment play a key role in European policies for the support of intangible assets. Further endeavours in this policy domain remain chiefly under the supervision of the member states. Specific modes of supporting investment in R&D operations by means tax relief in the format of tax breaks, special tax rates and related measures may be subject to a persistent tax competition that allows for combining the matter of fiscal incentives with a strategy for intra-European locational competition on a national and even regional scale.

Also, efforts at stimulating private sector R&D expenditures by means of fiscal incentives should include industry- and technology-specific initiatives. These could include frameworks for the conditional reduction of corporate taxes on profits from patents that is directed towards strategically most promising industries when it comes to achieving the goal of a new growth path for Europe. Furthermore, collaborative R&D operations are to be furthered and sustained by means of tax relief.

- Intermediate research and technology organisations

A European policy strategy in support of investment in intangible assets needs to be most active in fostering intermediate research and technology organisations on the national level by means of core funding. The public provision of about one third of financial budgets of these organisations may be a useful target, while the remaining funds need to be acquired by means of competitively won private or public research projects. Crucially, transnational collaboration between these organisations needs to be further extended and intensified in a common European framework of funding.

As the chief objective of intermediate research and technology organisations is the commercialisation of research results, so their policy support needs to account for the transnational orientation of their industry- and technology-specific expertise that includes measures in vocational and R&D competency training as well as informational services on regulatory frameworks and access to finance. In particular the latter aspect hints at the need for a more accessible European platform for related data and information that can be easily translated into highly specific local concerns.

- Collaborative public-private research networks

Collaborative public-private research networks with their organisational roots in well established university-industry links are a key issue in the formation of a policy framework in support of intangible investment. These kinds of partnerships may be supported by policy means such as grants, yet also fiscal incentives may prove to be effective. In this context, further efforts in stimulating public universities to entry cooperation agreements with the private sector are an indispensable condition for setting up these research networks.

Policies in support of collaborative public-private research networks also need to account for the local embeddedness of these networks. Therefore, a cluster approach to stimulating public-private research networks can provide most effective results. The core funding of regional clusters is best organised by means of a competitive funding schemes, which involve transparent selection criteria such as the assessment of market opportunities and performance expectations.

- Provision of information on intellectual property rights

Policies for the provision of information on intellectual property rights are particularly relevant for small- and medium-sized enterprises which lack expertise and human resources in this particular domain. It is advisable to expand and intensify activities of the European Commission as well as those of the member states with regard to the provision of accessible information platforms that cater the needs of these small business firms. In particular, the public information services of the European Patent Office as well as those of the national offices should be monitored and examined with regard to further improvements in their informational outreach.

A key component of the related information services should be the adoption of service packages including model agreements on intellectual property rights that provide advice for legal decision-making and procedural guidance in contract negotiations. Also, service packages may address the format of knowledge capital statements as a means to allow business firms an improved account of their intangible assets related to patents, trademarks and copyrights.

- Promotion of entrepreneurial start-ups:

The policy support of entrepreneurial start-up firms is crucial for the establishment of a new growth path for Europe. Corresponding policies combine financial resources and fiscal incentives with informational services that include market data, technology forecasts and legal aspects of innovation, among others. These efforts need to be improved with regard to their actual outreach, in particular when it comes to the public provision of financial resources in the start-up phase of the new firms. Public venture capital is an effective support mechanism that should be supplied in all member states in a more prominent manner.

Also, the facilitation of interaction between established firms and entrepreneurial start-ups proves to be beneficial. Corresponding policy measures may take on options of inter-firm collaborations, which allow entrepreneurial start-ups to make use of the resources of a large incumbent firm in order to develop innovative products and to cooperate in their introduction to the market.

- Financial and fiscal incentives for training programmes

The policy support of investment in workforce training addresses private investment in training measures by means of financial transfers or fiscal incentives. European policies need to pay attention to these efforts in a manner that is responsive to the needs of local firms and industries in the diverse regions of the European economies, which are subject to different structural and institutional conditions that affect the related investment rationale of firms. Thus, while the Commission might provide a common framework for funding, more specific programmes and projects should be subject to the subsidiarity principle that puts the emphasis on national and regional actors from the public and private sector.

A key issue in policies for investment in workforce training is the inclusion of small- and medium-sized enterprises which lack experience in the internal upgrading of human resources. In these cases, policy programmes should provide informational services and funding for collaborative projects involving these kinds of firms as well as universities, polytechnics, and research organisations. Policy advisors should assist in the development of collaborative project proposals, which are set to receive training and upgrading grants.

The involvement of academic supervisors can be useful for continuous tutoring of the involved personnel.

Furthermore, European polices should address the phenomenon of corporate universities in a more prominent manner. Major European firms are currently running their own training and education networks for the purpose of organising firm-specific efforts in lifelong learning on all levels of the corporate organisation. In doing so, they cooperate with both domestic and international universities and research institutes. Both the Commission and the member states should prepare a strategy for supporting these kinds of corporate universities, which effectively complement the established education and training infrastructures while advancing the knowledge base of firms and industries.

- Provision of information and consulting for management

The policy-based advancement of the informational resources available to decision-makers in business firms needs to be tackled in a more explicit manner. A European strategy for knowledge management may be a most appropriate framework when it comes to furthering the provision of information on market data and legal frameworks, combined with strategic advice and consulting that may lead to organisational changes with positive effects on the knowledge base of the involved firms.

Again, small- and medium-sized enterprises at large as well as entrepreneurial start-ups in particular should be the targets of concerted European as well as national and regional policy efforts for the upgrading of managerial competencies in coping with intangible assets. The corresponding policy programmes need to be adapted to the local business environment with its distinct conditions and requirements.

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Project Information

Welfare, Wealth and Work for Europe

A European research consortium is working on the analytical foundations for a socio-ecological transition

Abstract

Europe needs change. The financial crisis has exposed long-neglected deficiencies in the present growth path, most visibly in the areas of unemployment and public debt. At the same time, Europe has to cope with new challenges, ranging from globalisation and demographic shifts to new technologies and ecological challenges. Under the title of Welfare, Wealth and Work for Europe – WWWforEurope – a European research consortium is laying the analytical foundation for a new development strategy that will enable a socio-ecological transition to high levels of employment, social inclusion, gender equity and environmental sustainability. The four-year research project within the 7th Framework Programme funded by the European Commission was launched in April 2012. The consortium brings together researchers from 34 scientific institutions in 12 European countries and is coordinated by the Austrian Institute of Economic Research (WIFO). The project coordinator is Karl Aiginger, director of WIFO.

For details on WWWforEurope see: www.foreurope.eu

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ICLEI - Local Governments for Sustainability	ICLEI	Germany
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Institute for World Economics, RCERS, HAS	KRTK MTA	Hungary
KU Leuven	KUL	Belgium
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