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INTANGIBLE ASSETS, RESOURCE ALLOCATION AND GROWTH: A FRAMEWORK FOR ANALYSIS

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ABSTRACT/RESUME

Intangible assets, resource allocation and growth: a framework for analysis

This paper explores the growing importance of intangible assets as a potential source of innovation and productivity gains, and the contribution of efficient resource allocation to this process. Realising the growth opportunities implied by intangible assets depends on the ability to reallocate labour and capital to their most productive use, which is determined by the design of framework policies. The redeployment of tangible resources takes on heightened importance given the inherent difficulties in allocating intangibles efficiently. Indeed, the characteristics of intangible assets create market imperfections, which hinder the allocation of new ideas to where they can be developed most efficiently. While a number of policy instruments are typically deployed to address these market failures, the paper also explores how the growing importance of intangible assets is affecting the suitability of these policy tools. In turn, a number of policy issues are identified, spanning the financing of start-up firms, the treatment of intangibles in corporate valuation and accounting frameworks, competition policy in the digital economy and the role of intellectual property rights frameworks in rapidly growing domains such as information technology.

JEL classification codes: L20; O30; O40.
Keywords: Intangible assets; innovation; reallocation; growth.

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Les actifs intangibles, l'allocation des biens de production et la croissance : un cadre d'analyse

Cette étude examine le potentiel des actifs intangibles comme source d'innovation et de gains de productivité, ainsi que la contribution de l'allocation des ressources à ce processus. Afin de réaliser les opportunités de croissance offertes par les actifs intangibles, il est nécessaire de pouvoir redéployer les ressources en capital et en travail pour les utiliser de la manière la plus productive. Le redéploiement des ressources tangibles est d'autant plus important que les actifs intangibles peuvent êtres difficiles à allouer de manière efficiente. En effet, leur caractère immatériels entraîne des défaillances de marché qui font en sorte que l es idées les plus innovantes ne sont pas toujours développées là où leur potentiel commercial peut être exploité de manière optimale. Cette étude explore dans quelle mesure l'efficience des politiques publiques mise en place pour pallier aux défaillances des marché est mise en cause par l'importance croissante des actifs intangibles. Les champs de politiques publiques jouant un rôle déterminant incluent le financement des nouvelles entreprises innovantes (start-up), le traitement des actifs intangibles dans la comptabilité et l'évaluation financière des entreprises, l'application des politiques de concurrence à l'économie numérique ainsi que cadre législatif visant à protéger les droits de propriété intellectuelle.

Classification JEL : L20 ; O30 ; O40.
Mots-clés : Actifs intangibles ; innovation ; redéploiement ; croissance.

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INTANGIBLE ASSETS, RESOURCE ALLOCATION AND GROWTH: A FRAMEWORK FOR ANALYSIS

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1. Introduction

1.1 Context and purpose

1. This paper sets up a framework for dealing with two related issues that are seen to be increasingly relevant for growth in both OECD and emerging economies: *i)* the growing importance of investment in intangible assets as a potential source of innovation and productivity gains; and *ii)* the contribution of efficient resource reallocation in unlocking the innovation and growth potential of intangible assets.[1]

2. While investment in innovation has traditionally been proxied by a few indicators, such as spending on R&D and the purchase of capital (both hardware and software) embodying new technologies, there is growing recognition that innovation-based growth is underpinned by a much broader range of intangible assets, including employee skills, databases, design, organisational know-how, brands and various forms of intellectual property. A number of features specific to intangibles may curb private incentives to invest in such assets, which could thereby fall short of the desired level from a social welfare perspective. Harnessing the full growth potential from intangible assets would in such a case not only require that the gap between social returns and private incentives be narrowed, but also that intangible assets be allocated efficiently. The latter, in turn, requires the presence of well-functioning reallocation mechanisms, including a sufficiently developed market for ideas. However, the development of such mechanisms is complicated by some of the characteristics of intangible assets and also by the fact that many institutions have yet to adapt to their growing importance.

3. A number of key findings emerge:

- The importance of intangible capital – *i.e.* assets that have no physical or financial embodiment – has been rising steeply in OECD and emerging economies with implications for innovation and economic growth.

- Realising these growth opportunities partly depends on the ability to rapidly reallocate labour and capital to their most productive use, which is determined by the design of framework policies. Indeed, the redeployment of tangible resources is especially important, given the inherent difficulties in reallocating intangibles.

- The characteristics of intangibles present challenges with respect to the financing of start-up firms and the allocation of new intangibles to where they can be commercialised most efficiently and successfully.

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1. Corresponding authors are: Dan Andrews (Dan.Andrews@oecd.org) and Alain de Serres (Alain.DeSerres@oecd.org) from the OECD Economics Department. This paper has benefited from earlier work conducted in the Directorate for Science, Technology and Industry for a project on *New Sources of Growth: Knowledge-Based Capital*. In this regard, the authors would especially like to thank Alistair Nolan, as well as Brian Kahin, Chiara Criscuolo, Mariagrazia Squicciarini, Carlo Menon and Dirk Pilat. The authors are also grateful to Jørgen Elmeskov, Giuseppe Nicoletti and Jean-Luc Schneider for their valuable comments, and Catherine Chapuis and Irene Sinha for providing excellent statistical and editorial support. The views expressed in this paper are those of the authors and do not necessarily reflect those of the OECD or its member countries.

- Policy reforms in areas such as competition, intellectual property, taxation and regulation may be required to deal with issues arising from the increasing importance of intangible assets.

- Network effects in the intangible economy can foster market structures that may conflict with traditional competition policy goals but that may be defensible on economic growth grounds.

- Well-defined intellectual property rights (IPR) are a key mechanism to provide firms with an incentive to innovate. However, existing IPR frameworks – *e.g.* patents and copyrights – may not perform as intended in rapidly growing domains such as information technology, at the risk of inhibiting the development of the market for ideas.

- The characteristics of intangible assets also reinforce traditional market failures in capital markets. While capital market imperfections are typically addressed through greater corporate disclosure, standardised valuation and accounting frameworks for intangibles are inadequate to address information asymmetries and facilitate the flow of credit to intangible-based firms.

- Policies to promote the development of financial intermediaries (*e.g.* venture capital activity at the seed and early stages), which specialise in allocating capital towards high-potential intangible-based firms, may need to be reassessed.

1.2 Roadmap

4. The next section discusses the basic classes and characteristics of intangible assets, as well as their contribution to growth through increasing returns to scale and knowledge spillovers. Section 3 focuses on the contribution of intangible assets to growth and how it depends on the efficiency of resource allocation. It discusses in particular how the allocation of new ideas to where they can be developed most efficiently is hindered by market failures. Section 4 reviews the set of policy instruments used to address the various market failures and how their design is affected by the growing importance of intangible assets. The final section concludes.

2. Intangible assets and growth

2.1 Categories of expenditure commonly covered under intangible assets

5. According to standard growth theory, all expenses incurred in any one year should be treated as investment if they entail foregoing current production in exchange for higher future production (Hulten, 1979; Corrado *et al.,* 2005). If this principle has been applied fairly rigorously for all forms of physical or tangible capital – both in corporate and national accounts – this is far from being the case with most types of intangible business expenditures (*i.e.* that have neither physical nor financial embodiment).

6. Following an approach originally proposed by Corrado *et al.,* (2009) – that has since been widely adopted in the economic profession – intangible assets have been classified, somewhat arbitrarily, under three broad categories, *i.e. computerised information*, *innovative property* and *economic competencies* (Table 1). For each type of assets included in these categories, a distinction can be made between the effort or input flow that goes into the creation of the asset and the nature of the value or capital stock generated, even though such distinction is, in practice, made difficult by conceptual issues. Moreover, this classification is useful for conceptualising the links between intangibles and innovation. For example, if one treats as innovation not only new products (including software) and processes but also the introduction of new business practices and knowledge management systems, as well as the creation of new markets, then investment in all three categories of intangible assets can lead to innovative outcomes. Of course, not all intangible assets are necessarily socially desirable: expenditures on marketing may in some cases be

undertaken to create significant upfront costs to deter firm entry while rent seeking behaviour is also an intangible investment from the firm's perspective (Hunter *et al*., 2005).

7. Aside from R&D, patents and software, comprehensive and internationally comparable data on intangible assets are for the most part difficult to come by even though significant progress has been made in incorporating some specific intangible assets in the National Accounts.[2] Achieving a broad consensus on the appropriateness and methodologies for treating other expenditures as investment in National Accounts is likely to take several more years, at least for some categories. These measurement difficulties notwithstanding, estimates of aggregate investment in intangible assets (based on their cost of production) have been generated for several countries, on the basis of the expenditure categories listed in Table 1 and the methodology proposed by Corrado *et al.,* (2006). Among the countries for which sufficient time series data are available, most have become progressively more intensive in the use of intangible assets, as illustrated in the case of the United States (Figure 1).[3]

8. The intensification of competition pressures (prompted by the reduction in regulatory barriers to entry and greater openness to foreign trade and investment) and the advent of information technology are regularly cited as factors behind the growing importance of intangibles since the early 1980s. Other potential drivers include the rise in educational attainment which can facilitate the production and effective use of intangible assets, as well as the fact that many household products are becoming more and more knowledge intensive, with their functioning increasingly dependent on some software-based technologies. These trends have been common to most advanced countries. Even so, noticeable variations across countries in terms of the share of business investment in intangibles are observed (Figure 2). Furthermore, major discrepancies exist also across countries in the composition of intangible assets.[4]

2. For example, no intangibles were included in GDP until SNA93, but since then software, mineral exploration and artistic/literary originals have been included, and R&D will be added to the list in a few years time.

3. In the United Kingdom, investment in intangibles is estimated to have more than doubled as a share of market sector gross value-added between 1970 and 2004. In Australia, average annual growth in intangible investment has been around 1.3 times that of tangibles since 1974-75 (Barnes and McClure, 2009). In Japan, the ratio of intangible investment to GDP has risen throughout the past 20 years (Fukao *et al.*, 2009). In Canada, between 1976 and 2008, real investment in intangibles increased at 6.4% a year, while investment in tangible assets grew at 4.1% a year (Baldwin *et al.*, 2011). Finally, between 1995 and 2005 business investment in intangibles increased faster than investments in tangibles in almost all countries of the European Union (Jona-Lasinio *et al.*, 2011).

4. For example, over the period 1995 to 2005, innovative property was the largest category of intangibles investment in Finland and Germany. By contrast, in the Czech Republic, Italy and the United Kingdom, the predominant area of intangibles investment was in economic competencies (Jona-Lasinio *et al*., 2011).

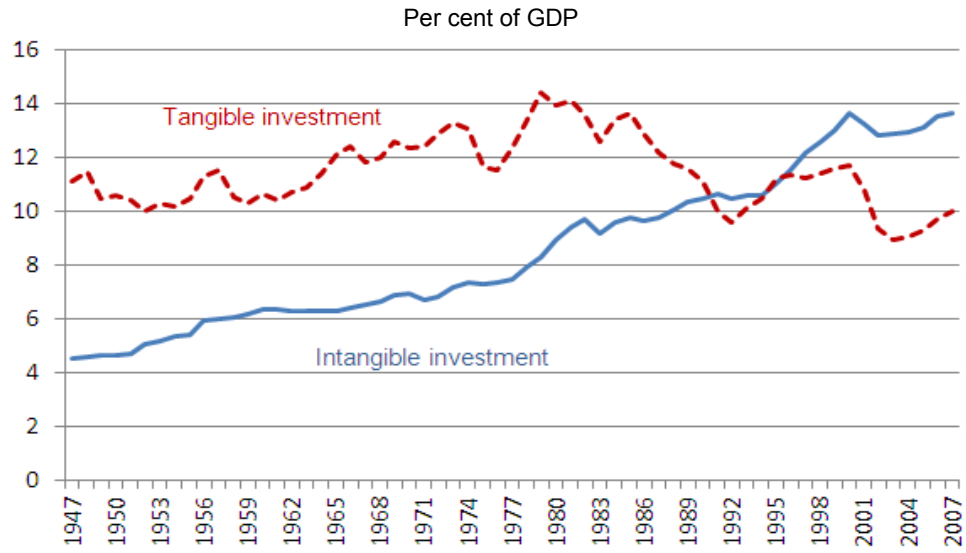
Table 1. The classification of intangible assets: A flow and stock perspective

	Spending in the form of (flow):	Creates value in the form of (stock):
Computerised information		
Computer software	- In-house development or acquisition of software	- Better management of information and knowledge, improved process efficiency
	- R&D in software industry and outlays on software purchases	- New software applications (copyrights)
Computerised database	- In-house development or acquisition of database	- Better informed or data-driven decision making
	- Included in outlays on software	- Database with significant market value
Innovative property		
Mineral exploration	- Early-stage exploration of natural resources	- Knowledge about underlying geology of specific areas
	- R&D spending in mining industry	- Rights on future exploitation of mineral reserves
Scientific R&D	- Science and engineering research	- Knowledge leading to new or higher-quality products and production processes
	- In-house or outsourced R&D in manufacturing and selected industries	- Patents, licenses and industrial secrets
Creative property	- Development of entertainment or artistic originals	- Artistic and cultural creations
	- Non-scientific R&D : Development costs in entertainment and book publishing industries	- Copyrights and licenses
Design	- Physical appearance, quality and ease of use of product and on workspace layout	- Better commercial appeal, product differentiation; improved planning and problem solving
	- Outsourced architectural and engineering designs and R&D spending in social science and humanities	- Design rights, blueprints
Economic competencies		
Brand (equity)	- Spending on advertising and market research	- Better-valued product, better market potential; good reputation and costumer relationship
	- Outsourced advertising market research services	- Trademarks, customer base, internet domain names
Firm-specific human capital	- On-site worker training, tuition payments for job-related education	- Increased overall skills level, more productive workforce
	- Direct and wage costs of employee time in training; vocational training surveys	
Organizational structure	- Organizational changes	- Improved business practices, better management of internal knowledge; inter-firm networks
	- Outsourced management consulting services and company formation expenses	- Blueprints for business methods

Notes: In each case (cell), the top entry provides a conceptual definition of the input (investment) and intermediate output (capital) respectively, while the second entry refers to respective sources of measurement or valuation. As can be seen, the link between investment in a particular type of intangible asset and the resulting capital is often far looser than in the case of physical capital. This is not only due to the inherent pitfalls in properly *capitalising* specific investment expenditures but also to the potentially wide range of values one may find for the capital stock depending on whether it is derived from capitalised investment methods or based on the valuation of intellectual property rights (patents, trademarks, licenses. etc.) held by businesses. While the former may be more relevant from a macro growth accounting perspective, it is the latter that matters most from a firm's balance sheet point of view.

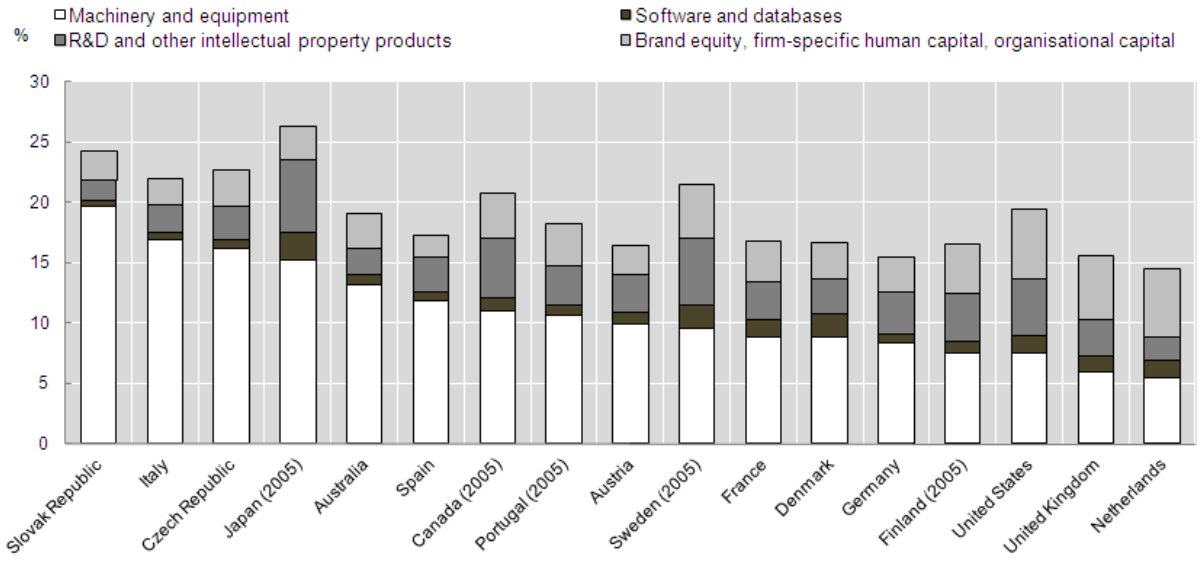
Source: OECD Secretariat.

Figure 1. Rising US non-farm business investment in intangible assets



Source: Corrado and Hulten (2010)

Figure 2. Investment in fixed and intangible assets as a percentage of GDP, 2006



Source: OECD Science, technology and Industry Scoreboard 2011.

2.2 The defining features of intangibles

9. The different classes of intangible assets reported in Table 1 share a number of characteristics that distinguish them from other forms of productive capital, the most common being:

- *Lack of visibility*: By definition, intangible assets do not have physical embodiment, which complicates the task of assessing the stock of a specific intangible asset based on past investment flows.

- *Non-rivalry*: Many intangible assets can be used simultaneously by multiple users without engendering scarcity or diminishing their basic usefulness, such as in the case of software or new product designs.

- *Partial excludability*: In part due to their virtual nature, the property rights of many intangible assets cannot be as clearly defined and well enforced as is the case with tangibles. Insofar as they cannot preclude others from partly enjoying the benefits of these assets, owners do not have full control and may fail to fully appropriate the returns on their investment. Indeed, intangibles tend to be subject to the forces of diffusion that underpin the spread of knowledge, which cannot be constrained in the same manner as physical assets (Brown and Kimbrough 2008). One of the primary forces driving diffusion is employee mobility.[5]

- *Non-tradability*: Intangible assets used by firms are often generated internally and while some of them – *e.g*. software, patents – can eventually be traded on organised markets, many remain inherently non-marketable. This creates issues regarding transparency and makes the quality of a firm's intangibles difficult to verify for external investors.

- *Non-separability*: Intangible assets have in some cases a full value that is firm specific. Therefore, such assets cannot be separated from the original unit of creation without some loss of value *(*Webster and Jensen, 2006), which can create complications in the event of firm bankruptcy.

- *Knowledge transferability*: The conditions under which knowledge can be transferred across firms depend in part on whether it is tacit or codified. To be transferable, tacit knowledge requires some form of embodiment, such as human capital.

- *Uncertainty and perceptions of risks*: Intangible investment is prevalent throughout the innovation process, but particularly so in the early stages of basic research, invention and experimentation where sunk costs can be large, and failure frequent (Hunter *et al.,* 2005).[6]

10. Among these features, excludability may be also hard to establish for some physical assets – the best example being fish stocks in the ocean – but this is likely to concern a relatively narrow set of tangibles. The other characteristics clearly represent more exclusive or distinguishing features of intangibles assets. However, the extent to which they apply to various assets differs across them, as qualitatively reported in Table 2.

11. In comparing characteristics across types of assets, there are major differences, primarily between those classified under *computerised information* and *innovative property* on the one hand, and those included in *economic competencies* on the other. Assets in the former two categories are, for the most part, fully non-rival, only partly excludable and they can generally be separated from the original firm without substantial loss of value. In addition, the type of knowledge generated can be more easily codified and protected through mechanisms that facilitate its transfer.

5. For example, 71 percent of the firms included in the Inc 500 (a group of young, fast growing firms in the United States) were established by managers who exploited a business opportunities created by their previous employer Bhide (2000).

6. Moreover, to the extent that mechanised investments produce more reliable outcomes than those dominated by people, the production of intangible assets – which are often embodied in people – is likely to be more uncertain than tangible capital, which is more conducive to replication through standard routines (Hunter *et al.,* 2005).

12. By contrast, rivalry and excludability are more prevalent among the types of assets that reflect *economic competencies*. This is particularly the case with investment in brands and human capital which generate assets that reflect a large degree of corporate or individual embodiment, in addition to being often firm specific and, therefore, not so easily separable. Within economic competencies, organisational changes somewhat stand out as being largely non-rival and less than fully excludable, though attempting to imitate and implement the business model of a successful rival firm is no simple task.[7]

Table 2. How the characteristics vary across different classes of intangible assets

	Rivalry	Tradable (market-based transaction)	Excludability	Separability	Knowledge transferability
Computerised information					
Computer software	Fully non-rival	Not for own-account software	Partial only (code access protected)	Separable	High (codified)
Computerised database	Fully non-rival	Not for internally-generated data	Partial only	Separable	High (codified)
Innovative property					
Scientific R&D	Fully non-rival	Outsourced R&D services and patents	Partial only	Separable	High for patents/ Low for secrets
Creative property	Fully non-rival	Outsourced R&D services and copyrights	Partial only	Separable	High (codified)
Design	Fully non-rival	Outsourced design services and IPR forms	Low for visible products/ High for workspace	Separable	High (codified)
Economic competencies					
Brand (equity)	Largely rival	Outsourced marketing services	High / Firm specific	Partly Separable	Via transfer of firm ownership
Firm-specific human capital	Largely rival	Outsourced training	High / Firm specific	Non- separable	Via human capital mobility
Organizational structure	Largely non-rival	Outsourced consulting services	Partial only	Non- separable	Moderate / aspects difficult to codify

Source: OECD Secretariat.

2.3 Market failures and the direct links to growth

13. The characteristics of intangible assets entail a number of market failures, which in turn lead private investment in such assets to fall short of the socially-desirable level. They do so by mainly generating positive growth externalities while at the same time making private incentives to invest low. For completeness, the nature of these market failures is described in Box 1. While many of these issues are discussed in Sections 3 and 4, this sub-section focuses on two particular market imperfections associated with intangibles assets, namely non-rivalry and only partial excludability, since they carry particularly important implications for economic growth:

- The non-rivalrous nature of knowledge means that the initial cost incurred in developing new ideas – typically through R&D – does not get re-incurred as the latter are combined with other inputs in the production of goods or services. This gives rise to increasing returns to scale – the important property that makes ideas and knowledge an engine of growth (Jones, 2005).

7. This may entail far-reaching changes in work practices or even enterprise culture. In many respects this is less straightforward than replicating a specific product and process innovation (Brynjolfsson *et al.,* 2002).

Moreover, this source of scale economies can be reinforced by network externalities (*i.e.* the benefit from the network rises with the number of users) – characteristics which are particularly prevalent in industries, such as ICT, that are intensive in intangibles. However, because they foster a market environment that is sometimes characterised by strong market power, scale economies also carry adverse consequences that may mitigate or even offset the benefits if not carefully managed.

- When ideas – and the associated increasing returns to scale – are the engine of growth, the growth rate of GDP in the long run is ultimately pinned down by population growth (which determines the expansion in the number of researchers) and cannot be influenced merely through the intensity of innovation efforts.[8] However, the productivity of researchers is influenced by the extent of knowledge spillovers which arise from the only partial excludability of knowledge. Indeed, the more broadly new knowledge gets diffused, the more it contributes to the development of new ideas and discoveries (the so-called *standing on the shoulders of giants* effect). In turn, this can drive a wedge between the growth rate of GDP on the one hand, and growth in population and the workforce on the other.

14. At least in terms of R&D spending – which measures the resources invested in the production of ideas – there is considerable empirical evidence of these channels in operation. Hall *et al*. (2010) provide a comprehensive review and some key results include:

- Studies focusing on developed countries tend to find strong positive effects of R&D investment on productivity, with (private) rates of return often found to be in the range of 20-30%. This is higher than those estimated for physical capital, which at least to some extent is consistent with higher risk associated with intangible capital. Moreover, these effects not only operate when R&D generates innovation at the technological frontier but also when it facilitates technological catch-up by enhancing absorptive capacity (Griffith *et al.*, 2004).

- While estimating R&D spillovers is challenging,[9] studies have generally found these effects to be relatively large. Among studies discriminating between specific sources of external knowledge, one found flows from competitors, suppliers and other plants belonging to the same enterprise to have a significant impact on firm productivity growth (accounting for up to one-half of TFP growth), albeit with only the first of these sources being clearly considered as pure spillover (Crespi *et al*., 2008). There is mixed evidence regarding the spillover effect of public R&D, with a strong effect identified at the aggregate level (Guellec and Van Pottelsberghe, 2004) but a much weaker one at the firm or industry level.

15. Of course, R&D spending is an imperfect proxy for intangible assets and has a strong sectoral bias (it is most relevant to the manufacturing sector). Moreover, while the properties of non-rivalry and only partial excludability are common to many other types of intangible assets (see Table 2), it is not clear that other intangibles – such as creative property or design – will have as large an impact on growth as

8. In this simple model, if there are no knowledge spillovers – *i.e.* the productivity of a researcher is independent from the accumulated stock of ideas – the growth rate of GDP is equivalent to the rate of population growth in the long run.

9. The magnitude of these estimates tends to be sensitive to the choice of estimation method and sample. Identification difficulties also arise because knowledge flows across firms can in many cases be fully paid for and, therefore, do not necessarily correspond to pure spillovers. It is useful to distinguish between rent and pure knowledge spillovers (Griliches, 1979). The former arises from the fact that quality improvement embedded in new products is less than fully reflected in higher prices (as is the case for instance with personal computers), thereby directly benefiting firms who use such products as intermediate inputs. Pure knowledge spillovers are those related to the partial excludability of ideas generated through R&D.

R&D, since this depends on the scope for new knowledge generated through these intangibles to stimulate further productivity-enhancing discoveries.

Box 1. Key market failures affecting different types of intangible assets

The characteristics of intangible assets (Section 2.2) give rise to a number of familiar market failures (Section 2.3), which result in the social returns being higher than the private benefits accruing to firm owners, leading to investment in new ideas being below socially desirable levels. For example:

- *Supply-side economies of scale*: The increasing-return-to-scale property arising from the *non-rivalry* of intangible assets leads to a breakdown of the (Pareto-optimum) result whereby property rights and perfect competition – characterised by marginal cost pricing – are sufficient to ensure efficient resource allocation. Given that creating new ideas typically involves high fixed costs (borne upfront) and low marginal cost, pricing at marginal cost would not yield sufficient revenues to pay all factors their marginal productivity, and provide sufficient incentives to invest in new knowledge in the first place (Jones and Romer, 2010).

- *Knowledge spillovers or externalities*: The only *partial excludability* of many intangibles implies that privately created knowledge diffuses beyond its place of creation, thus providing wider benefits. This has two implications:

  - Rapid diffusion of knowledge may deny firms the market power required to price above marginal costs, reducing thereby the appropriability of returns on investment in innovation.

  - Markets fail to properly internalise the positive impact from this diffusion, notably on the productivity of investment in knowledge elsewhere.

- *Information asymmetry and market incompleteness*: The *non-separability* of intangibles makes collateralisation difficult, reducing the scope for asset-backed financing strategies. The *lack of visibility* and *non-tradability* of intangible investments creates asset valuation problems and pricing difficulties for outside investors, possibly leading to a higher cost of capital.

  - Barriers to the valuation and marketability of intangible assets can lead to important gaps in the external funding of innovative projects, especially those in the early stages of development and that involve new products whose commercial success is highly uncertain.

- *Monitoring and enforcement costs*: The rising share of products that are commercialised in forms that are technologically easy to copy and distribute through the internet implies that achieving excludability through legal means – such as IPR protection – may increasingly be difficult to enforce due to high monitoring costs.

While these classic market failures have been extensively analysed within the neoclassical framework, other market imperfections of a more systemic nature and that could potentially generate lock-in and path dependence effects have also been identified.

- *Demand-side economies of scale or network externalities*: Positive network externalities arise when the value of a good or service (and, therefore, its demand) increases with the number of users (*e.g.* subscribers to social or professional networks). Although network externalities do not necessarily result from a specific characteristic of intangibles, the latter are more prone to the type of feedback effects that characterise networks and which in extreme cases lead to a *winner-takes-all* outcome. Network effects can lead to cases of natural monopoly or create high barriers to entry, limiting competition in areas where competitive pressures might raise efficiency.

- *Co-ordination failures*: One by-product of network effects is the risk that specific technologies dominate a market, including at the expense of more efficient ones. Indeed, there is a risk of users being locked into a sub-optimal standard if moving to a better standard setting involves a co-ordination of decisions by private actors. While such failures are not specific to intangibles, they are likely be more frequent where network effects are more predominant. Co-ordination failures raise switching costs in the case of networks. Conversely, there is a risk that competition may lead to several standards co-existing where a single standard would be more efficient.

- *Infrastructural failures*: The pure non-rivalry and non-excludability nature of certain areas of knowledge creation means that they will fall outside the realms of private sector investment. Both this and the importance of broad knowledge diffusion underscore the role of public infrastructures, such as basic research institutions, libraries, testing facilities, etc., in achieving high private and social returns to innovation.

- *Learning by doing and initial market size effects:* The pursuit of social goals, for instance in the field of health or environment, may require the emergence of breakthrough technology, the development of which can be hampered by two types of failures:

  - Even when technologies have passed the prototype stage, they may fail to take-off if potential customers prefer to wait until the technology is available at lower cost.

  - Learning-by-doing effects give established technologies an advantage over newer technologies in terms of short-term profitability (Acemoglu *et al.,* 2009).

3. Resource allocation, intangibles and growth

3.1 Stylised facts on reallocation and aggregate productivity, and links with intangibles

16. Since the non-rivalrous nature of intangibles gives rise to increasing returns to scale, the growth opportunities implied by the rising importance of intangibles are potentially vast. Realising this growth potential, however, depends on the ability to reallocate labour and both tangible and intangible capital to their most productive use. Furthermore, the ability to effectively reallocate tangible resources takes on heightened importance, given the inherent difficulties in reallocating intangible assets, as discussed in Section 3.3. Accordingly, this sub-section reviews evidence on the efficiency of resource allocation in OECD and emerging countries, and draws some links between intangible assets, resource allocation and productivity at the firm level.

3.1.1 Firm heterogeneity reflects varying use of intangibles and scope for reallocation

17. Productivity and growth at the macro level are the result of an aggregation of firm-level outcomes. However, a focus on average outcomes can obscure some important nuances (Altomonte *et al.,* 2011), including the links between intangible assets and resource allocation. Indeed, the distribution of firm productivity and size is typically not clustered around the mean (as would be the case with a normal distribution) (Figure 3). Instead, in countries for which evidence is available, the distribution is characterised by many below-average performers and a smaller number of star performers, captured in the long right tail of the distribution (Altomonte *et al*., 2011; Haltiwanger, 2011). For example:

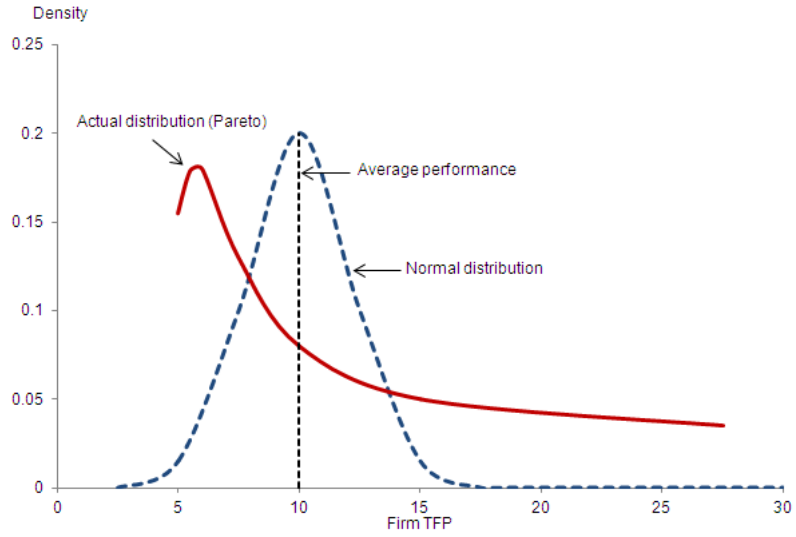
- Within four-digit manufacturing industries in the United States, the 90th percentile of the productivity distribution makes, on average, about twice as much output with the same measured inputs as a plant at the 10th percentile (Syverson, 2004). Moreover, in China and India, this differential in the efficiency with which production factors are used (*i.e.* total factor productivity – TFP) is more than five-fold (Hsieh and Klenow, 2009).

- On average, manufacturing firms in the top quartile of the size distribution are over 200 times larger in the United States and more than 100 times larger in the Netherlands and the United Kingdom, than firms in the first quartile of the within-industry size distribution (Bartelsman *et al.,* 2009).

18. This widespread heterogeneity and asymmetry in the distribution of firm performance and size reflects a number of within-firm factors, including – among others – different innovation strategies (e.g. market experimentation: firms may initially test the market at small scale) and varying intensity of (use of)

intangibles such as managerial ability (see Syverson, 2011). Indeed, investments in intangible assets (such as R&D) tend to be associated with higher firm TFP (Griliches and Mairesse, 1990), implying that firms that invest heavily in intangible assets are more likely to be situated amongst the high performing firms in the right hand tail of Figure 3. Furthermore, at any point in time, this heterogeneity in firm performance within industries is an outcome of the shift in resources across firms in preceding periods. Indeed, a key issue is the extent to which national institutions can facilitate a reallocation of resources to new sources of growth based on intangible assets.

Figure 3. A stylised representation on the distribution of firm total factor productivity within sectors



Source: Altomonte *et al.* (2011).

3.1.2 A healthy economy reallocates resources to their most productive use

19. The pace of reallocation of inputs and outputs is generally high in OECD countries: on average, about 15-20% of all firms and more than 20% of jobs are created or destroyed each year.[10] This is not to say that resource reallocation is always desirable – shifting resources also entails costs for firms, workers and governments – and excessive reallocation is no more desirable than the persistent trapping of resources in inefficient activities. Nevertheless, continuous reallocation is a key feature of well-functioning market economies and aggregate productivity will be maximised if resources are reallocated away from less productive to more productive businesses and activities over time. The key mechanisms through which this process occurs are firm turnover (*i.e.* entry and exit), shifts in resources across incumbent firms and resource reallocation within firms.

20. Empirical evidence suggests that, over time, resources tend to be reallocated toward more productive activities. Most existing studies tend to focus on labour. For instance, while within-firm improvements in performance account for the majority of aggregate labour productivity growth over a five-year window, the contribution from firm entry and exit is estimated to reach at least 20% in some OECD countries (the estimates are higher for emerging countries), while that from reallocation of labour across existing enterprises is generally small, but positive (Bartelsman *et al.*, 2004; OECD, 2003a).[11] There

10. Over the first-half of the 1990s, firm turnover rates (entry plus exit rates) in OECD countries were in the range of 15 to more than 20% in the business sector (see Bartelsman, Haltiwanger and Scarpetta 2004). Meanwhile, average annual gross job reallocation – the sum of job creation and job destruction between $t–1$ and t – was about 22% of dependent employment in the business sector between 1997 and 2004 (see OECD, 2009a)

11. These estimates are likely to understate the contribution of reallocation since the direct contribution of net entry is reinforced by an indirect effect whereby incumbents raise their own productivity to maintain market share in the face

is also considerable heterogeneity across firms in their ability to use capital productively and existing studies show that capital – as measured by sales of property, plant and equipment, and acquisitions – also tends to flow from less productive firms to more productive firms (Eisfeldt and Rampini, 2006; Jovanovic and Rousseau, 2002). Finally, recent evidence suggests that resources flow towards firms that patent – an important intangible asset and indicator of innovation – at the expense of non-patenting firms (see Box 2).

Box 2. Innovation as a trigger for reallocation: empirical evidence

Studies exploiting firm level longitudinal data from the United States suggest that patenting (a proxy for innovation) tends to be associated with important changes within firms, with increases in firm size, scope, and skill and capital intensity observed after firms patent (see Balasubramanian and Sivadasan, 2011). Innovation also triggers reallocation across firms. Looking at all factors of production, Kogan *et al.* (2012) find strong patterns of reallocation towards innovating firms, and away from firms that do not innovate. For instance, an increase in innovation by a firm from 50th to 90th percentile of the innovation distribution increases a firm's physical capital investment rate by 0.4-0.9 percentage points, which is economically significant given the sample median firm investment rate of 10% (see column 1 from Table below). Moreover, for firms that do not innovate, a one standard deviation increase in the level of innovation by a firm's competitor triggers a decline of 1.2-1.6 percentage points in that firm's investment rate. Innovation also triggers similar patterns of reallocation for both labour and financial capital (columns 2 and 3). Similar patterns have also been identified using data for other OECD countries, such as Denmark (see Lentz and Mortensen 2008).

Innovation and reallocation in the United States

Reallocation of inputs triggered by innovation by a firm or by its competitors

	Physical Capital (Firm's net investment rate)	Labour (Firm's hiring rate)	Financial Capital (Net capital inflows)
Innovating firms Increase in innovation by a firm from 50th to 90th percentile	+ 0.4% to 0.9%	+ 0.1% to 0.7%	+ 0.6% to 0.7%
Non-innovating firms One standard deviation increase in innovation by a firm's competitors	-1.2% to -1.6%	-1% to -3%	-0.1% to -0.6%
Memo: sample median firm outcome	10%	3%	0

Source: Kogan *et al.,* (2012).

Notes: To estimate the economic magnitude of firm-level technological innovations, Kogan *et al.,* (2012) use stock market responses to news about patents over the period 1926-2007. Net capital inflows are calculated as: debt issuance plus equity issuance minus payout (and are normalized by assets).

3.1.3 But the efficiency of resource allocation varies across countries

21. A number of stylised facts emerge from firm-level empirical studies which reveal important cross-country differences in the degree of firm heterogeneity, the scope and ease of reallocation as well as in the prevalence of certain innovation strategies across countries. For example:

- the size of entering and exiting firms tends to be smaller in the United States than in Europe and successful young firms tend to expand relatively more quickly in the United States than elsewhere (Bartelsman *et al.,* 2004; Bravo *et al*., 2012).

of strong entry pressures (see Aghion, *et al.*, 2007). And, the contribution from reallocation – particularly net entry – tends to increase when the analysis is conducted over longer time horizons (Foster *et al*., 2001; Bartelsman *et al.,* 2004).

- Firm productivity within industries tends to be more dispersed in the United States than in Europe (Bartelsman *et al.,* 2004), though more recent evidence points to important differences in the extent of productivity dispersion among countries in Europe (Altomonte, 2010).

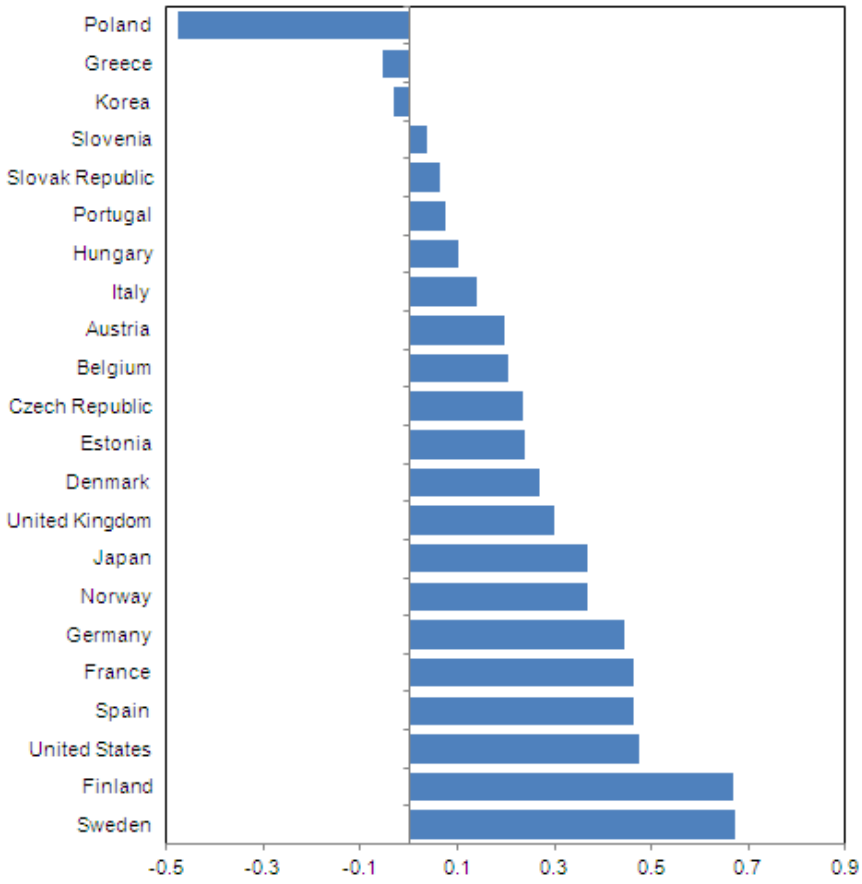
22. One interpretation of these findings is that there is a greater degree of experimentation and "learning by doing" among entrants in the United States, while larger entrants and exiting firms in Europe may reflect more cautious entry strategies that target more established markets (Bartelsman *et al*., 2008).[12] While this interpretation is tentative, it is striking that such cross-country differences tend to be largest in high technology and emerging sectors (Bartelsman *et al.,* 2008), where the imperative for experimentation and intensity of intangible assets use is likely to be greatest. For instance, this raises the prospect that institutional factors, which increase the cost of reallocating resources, can explain the relative sluggishness of some European countries to capitalise on the ICT revolution (Arnold *et al*., 2011; Bartelsman *et al.,* 2010). This has potentially important implications for cross-country differences in aggregate growth performances, which depend to a large extent on the performance of key ICT-intensive sectors (*e.g.* Triplett and Bosworth, 2004).

23. Indeed, empirical evidence highlights that some countries are more successful in channelling resources towards high productivity firms. A key issue in this context is the extent to which *ceteris paribus* it is the most productive firms that hold the largest market shares, a metric that has been taken to represent the degree of allocative efficiency in an economy (Olley and Pakes, 1996). Estimates using a similar metric suggest that the degree of allocative efficiency tends to vary across countries – for example, more productive firms are likely to account for a much larger share of employment in the United States than in some Southern European countries (see Figure 4) – and such differences can have important repercussions for aggregate outcomes. For example, Hsieh and Klenow (2009) estimate that if China and India were able to align their efficiency of resource allocation to that observed in the United States, manufacturing TFP could rise by 30-50% in China and 40-60% in India. It is generally recognised that cross-country differences in the efficiency of resource allocation partly reflect differences in framework policies (see Section 4). In turn, appropriately designed framework policies – which facilitate the flow of resources to their most productive use – can improve the ability of economies to capitalise on the growth opportunities implied by the rising importance of intangible assets.

12. This interpretation is based on the assumption that higher dispersion in productivity performances reflects a higher degree of experimentation, which in turn would signal a greater ability for some firms (the so-called gazelles) to stay close to the technological frontier.

Figure 4. Contribution of the allocation of employment across firms to manufacturing labour productivity

Log points; selected OECD Countries in 2005



Notes: The estimates shows the extent to which the firms with higher than average labour productivity have larger employment shares in the manufacturing sector, based on the Olley and Pakes (1996) decomposition of the log level of labour productivity. In most countries, the covariance between productivity and employment share is positive, suggesting that the actual allocation of employment boosts manufacturing labour productivity, compared to a situation where resources were allocated randomly across firms (this metric would equal zero if labour was allocated randomly). Labour is allocated relatively efficiently in the United States and some large Continental and Northern European countries – *e.g.* manufacturing productivity in the United States is boosted by around 50% due to the rational allocation of resources – while there is considerable scope to improve resource allocation in most southern and eastern European countries. The sample excludes firms with one employee as well as firms in the top and bottom 1% of the productivity distribution. To enhance representativeness, re-sampling weights based on the OECD Structural and Demographic Business Statistics are applied.

Source: OECD calculations based on firm-level data from the ORBIS Database. See Andrews and Cingano (2012).

3.2 A stylised framework linking intangible capital, resource allocation and growth

24. The links between intangible assets, resource allocation and growth are highlighted by the options that innovative firms face after introducing a new idea or discovery. These are illustrated in Figure 5. The focus here is on start-ups – an important source of new ideas[13] – and the strategy that they

13. When entry is the main engine of radical innovations, small entrepreneurial firms have a comparative advantage in undertaking explorative R&D and account for a disproportionate number of major innovations (Akcigit and Kerr, 2010). By contrast, larger incumbent firms tend to focus on exploitation (process-driven) R&D, reflecting the many product lines that management must concentrate on (Akcigit and Kerr, 2010) and their limitations in commercialising

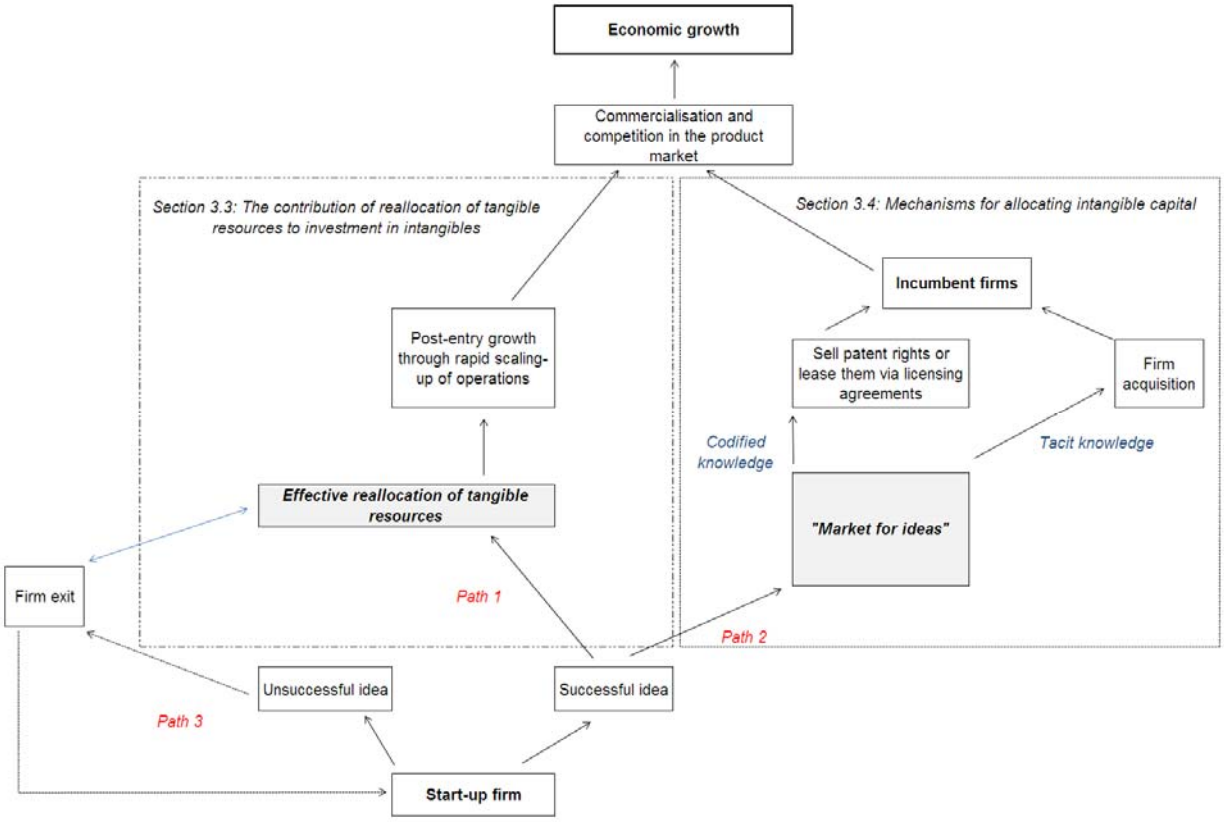
adopt to bring new ideas to the product market. Three paths can be envisaged for firms that come to the market with a new idea:

- Path 1: Attempt to bring the idea to the product market independently, which entails being able to acquire complementary tangible and intangible inputs so as to scale-up production fairly rapidly and challenge incumbents.

- Path 2: Transfer the rights to exploit the innovation to another firm by bringing the idea to the market for ideas. One mechanism for this is via mergers and acquisition. Alternatively, this can occur either through the sale of property rights (*e.g.* patents) on a market or through a direct agreement (*e.g.* licensing) with an established firm, sometimes facilitated by an intermediary (*e.g.* venture capitalist).

- Path 3: The firm's idea is unsuccessful in the product market and it thus exits the market.

Figure 5. A stylised depiction of the links between intangibles, resource allocation and growth



Source: OECD Secretariat.

25. In principle, the innovative firms will choose the option that will maximise the expected value of its idea. In this context, well-functioning reallocation mechanisms are needed to ensure that the idea is developed and commercialised where it is most efficient to do so. In practice, the firm's choice may be constrained or distorted by several market imperfections or malfunctions, leading to sub-optimal

radical innovations due to bureaucratic inertia and fear of "cannibalising" their own market (see Squicciarini *et al.,* 2011).

allocations. Section 3.3 – in a setting where start-up firms follow Path 1 – discusses how the ability to effectively reallocate tangible resources can promote investments in intangible capital and the challenges that intangible assets present to traditional reallocation mechanisms (Path 3 is also discussed here). Section 3.4 examines the case where start-up firms use the market for ideas to extract value from their invention (Path 2), and then explores the efficiency of existing mechanisms for allocating intangible capital. While each of these strategies are challenging for different reasons, a common feature is that implementation is complicated by the basic characteristics of intangible assets and this affects the ability to unlock the growth potential inherent in intangibles. Moreover, the feasibility of these strategies is influenced by framework and other public policies.

26. While the model in Figure 5 provides a useful depiction of the links between intangibles, reallocation and growth from the perspective of a start-up firm, the role of incumbent firms is not fully elaborated. For example, incumbent firms may outsource R&D to young firms, use venturing to find external partners (*e.g.* start-ups) for commercialising innovations that are not used internally and in some cases, assist with the financing of young firms as part of strategic portfolios. Furthermore, many start-ups firms are actually spin-offs, in that their proprietors are former employees of larger incumbent firms and universities (Klepper and Thompson 2010; Foray and Lissoni 2010).[14] Indeed, recent research suggests that such spin-off activity is a key factor behind the formation of cluster economies (Klepper, 2011), which in turn can spur innovation and growth through spillover effects (Delgado *et al*., 2011).

27. Finally, while start-up firms are generally viewed as a key source of radical innovation, innovation in large incumbent firms is more likely to be incremental, reflecting the highly cumulative nature of knowledge and lower technological opportunities (see Breschi *et al.,* 2000). These characteristics tend to translate into a market structure that is relatively stable and concentrated, entry opportunities for new firms are limited and innovation-driven labour adjustments are less likely to have to be accommodated through worker turnover. From this perspective, while the scope for reallocation across firms is more limited, incremental innovations are still likely to be associated with significant internal factor reallocations aimed at improving efficiency and accommodating incremental process and product innovations. Accordingly, policies – especially those affecting the labour market – may have hetereogenous effects on resource allocation and investments in intangibles and innovation across different types of firms (Boxes 3 and 5).

3.3 The obstacles faced by innovative firms in mobilising resources to challenge incumbents

28. For a firm that chooses to bring a product to market independently (Path 1), ease of resource reallocation is particularly crucial to ensuring the returns to innovation and realising the growth potential implied by the increasing returns to scale properties of intangible assets (Section 3.3.1). While access to financial markets provides a key mechanism for resource reallocation, there is a disconnect between the characteristics of intangibles and the requirements for external finance, which in turn raises a number of policy issues (Sections 3.3.2 and 3.3.3).

3.3.1 Reallocation mechanisms influence investment in intangibles and innovation strategies

29. From the perspective of an intangible-based start-up firm, profitability depends not only on technological success but crucially on the ability to leverage the fixed cost of investments in intangibles – which are subject to strong returns to scale – through increases in the scale of production (Bartelsman and Groot, 2004).[15] The latter, in turn, depends on the ability to reallocate tangible resources, such as labour

14. In many innovative industries, around 20% of the entrants are intra-industry spinoffs, and these firms consistently outperform other new entrants (Klepper and Thompson, 2010).

15. For firms in the services sector, scaling-up may take place through the opening of new outlets.

and physical capital. Given that intangibles are subject to only partial excludability, however, this redeployment of resources must occur rapidly in order for the start-up firm to capture the value of the investment before imitation by followers. Similarly, in the event of technological failure (Path 3; Figure 5), the ability to rapidly scale down operations – *via* divestitures of labour and capital – is crucial to facilitate exit and thereby release resources that can be used by other firms and to provide the entrepreneur with sufficient space in order to experiment with alternate ideas. Indeed, this is consistent with anecdotal evidence that suggests that the most successful entrepreneurs have experienced some form of business failure in the past. As discussed in Box 3, the ability to rapidly redeploy tangible resources – which is influenced by framework policies – not only influences the returns to innovation but also the type of strategy firms employ to boost their own productivity.

Box 3. Resource reallocation and innovation strategies

Existing studies suggest that the ability to rapidly redeploy resources is more important to firms pursuing radical innovations, which lead to major changes in technology or business methods or practices, than to firms whose strategy is based on adoption or incremental innovation, which build on a cumulative process of more modest changes whose continued economic impact may, nonetheless, be significant. This partly reflects the idea that radical innovations require large and drastic employment adjustments, because the human capital of existing workers is rendered obsolete (Aghion and Howitt, 1997). Reflecting this, radical innovations will necessitate a significant reallocation of resources, but may also be inhibited if firms perceive the cost of reallocation to be overly high. Similarly, radical innovations tend to be more risky (Saint-Paul, 1997; 2002), which favours an experimentation strategy, whereby young entrepreneurial firms initially search for novel combinations at small scale (Bartelsman *et al.*, 2008). But, the process of experimentation implies frequent failure, requiring within-firm reallocations of labour and capital inputs, and firm exit. If the costs of reallocation – particularly exit – are deemed to be too high, new firms may reject the experimentation path in favour of a more conventional strategy involving existing products and processes.

Empirical evidence concerning the ease of labour reallocation provides support for these propositions: in environments characterised by less stringent employment protection legislation (EPL), disruptive resource shifts are easier to accommodate so firms tend to favour radical innovations over incremental innovation (Griffith and Macartney, 2010) and high risk technologies over low-risk technologies (Bartelsman *et al.,* 2010). Similarly, OECD evidence suggests that strict EPL deters R&D in industries where the innovation process is driven by strong product differentiation, with technologies being often renewed through entry and exit of firms and extensive worker turnover. However, strict EPL is not necessarily a constraint on R&D in high-technology industries characterized by cumulative innovation processes, where the best worker competencies to complement innovation reside within the firm and skill-upgrading of existing employees may be less costly than training new workers (OECD, 2003a) Of course, this argument should not be overstated since even in environments where EPL is low, firms may choose to carry out internal training programs if it is in their business interests. Finally, well-designed bankruptcy regimes, by improving exit mechanisms for business, can promote the release of resources from inefficient firms, and encourage high-risk business start-ups and innovation (Jia, 2008; Armour and Cumming, 2006).

3.3.2 Problems in collateralising intangibles create barriers to external financing

30. The rapid scaling-up of production is not a costless exercise, requiring the acquisition of complementary tangible resources – such as qualified staff and capital goods – which young firms typically need to fund through external finance. While competitive financial systems can promote the entry of new firms (de Serres *et al*., 2006) and the post-entry growth of successful firms (Aghion *et al.,* 2007), accessing external financing mechanisms for young firms with a capital base skewed towards intangibles is difficult due to collateral constraints. This is particularly the case for start-ups who plan to target the product market without the assistance of incumbent firms (Path 1; Figure 5).

31. Intangible assets are difficult to collateralise. This partly reflects valuation problems, arising from the lack of visibility and non-tradability of intangibles, but also complications related to separability and transferability – two necessary features to facilitate mobility of an asset across parties and to salvage value in the event of firm bankruptcy (Path 3; Figure 5). Indeed, the uncertainty surrounding the treatment of

intangibles during bankruptcy is likely to accentuate financing difficulties, partly because the value of intangible assets are more prone to erosion during asset fire sales given the greater tendency of intangible assets to generate firm-specific value (*e.g.,* growth opportunities, managerial firm-specific human capital, monopoly power, and operating synergies whose value depends on the firm's assets being kept together; see Hotchkiss *et al.,* 2008; Gilson *et al.,* 1990).

32. The inherent difficulties in collateralising intangible assets mean that they are not particularly conducive to traditional debt financing and asset-backed securitisation (Jarboe, 2008), and as a result, intangibles tend to be financed out of retained earnings (Hall and Lerner, 2009). The financing constraint tends to be more acute for young entrepreneurial firms to the extent they have limited internal funds and lack a track record to signal their "ability" to investors. Indeed, when asymmetric information problems are large, a "missing markets" problem may emerge where, in the absence of alternative funding mechanisms, many of the innovations associated with young start-up firms may never be commercialised. Difficulties in financing intangibles can be reinforced by existing distortions in taxation systems which favour debt financing over equity financing (OECD, 2009b).

3.3.3 Effective corporate disclosure is difficult in the case of intangibles

33. The special characteristics of intangible assets also reinforce traditional market failures in capital markets. For example, information asymmetries – arising from inventors having better information about the nature and probability of success of an innovation project than potential investors – are exacerbated by the inherent riskiness of intangibles (Section 2). For many firms, capital market imperfections are typically addressed through greater corporate disclosure, such as through the release of financial accounting statements (Healy and Palepu, 2001). Indeed, high quality corporate disclosure regimes can promote a more efficient resource allocation (EC, 2003) and firm growth by lowering the cost of external financing. Moreover, Rajan and Zingales (1998) show that industrial sectors that are more dependent on external finance grow more quickly in countries with higher quality corporate disclosure regimes.

34. The benefits arising from corporate disclosure, however, are more difficult to realise for firms with a capital base heavily skewed towards intangible assets. Given the property of only partial excludability (see Section 2), firms cannot reduce asymmetric information *via* full disclosure due to the risk that imitators will appropriate any rents arising from their intangibles. More fundamental, perhaps, is the inability of current corporate accounting frameworks to properly deal with intangibles. To be recorded in company accounts, intangibles must adhere to five strict criteria (see Box 4). There is a clear disconnect, however, between these accounting attributes and the economic characteristics of intangibles discussed in Section 2 (Hunter *et al.,* 2005). For example, the non-separability characteristic – partly due to the tendency for intangibles to be embodied in people – is clearly at odds with the identifiability criterion (see attribute (a) in Box 4). There is also a tension between the limited appropriability and inherent uncertainty of intangibles on the one hand, and the capacity to control the asset and the probability of future benefits required for accounting purposes (attributes (b) and (d) in Box 4).

35. From an economic standpoint, the adherence to such strict accounting criteria leads to an inadequate – but also arbitrary and ad hoc – treatment of intangible assets in corporate accounting (Hunter *et al.,* 2005). While internally-generated intangibles are expensed, otherwise indistinguishable intangibles that are acquired externally (as a complete set) through the market are treated as assets since they are separable and have a verifiable cost. Likewise, intangibles that are acquired through mergers and acquisitions are recorded as assets since they are valued in a "market" transaction (Von Hippel, 1988), based on a negotiated acquisition cost which is often quite arbitrary.

Box 4. Treatment of intangible assets in International Accounting Standards (IAS)

As outlined in Hunter *et al.,* (2005), accounting frameworks do not employ the term "capital" when referring to expenditures with expected long-lived benefits (a property of intangibles) but use the term "assets". Moreover, intangibles are only recorded in the accounting system as assets if the items, first, meet the asset definition criteria and, second, meet the asset recognition criteria.[1]

Asset definition criteria for intangibles comprise three attributes:

a) Identifiability: *i)* the asset is separable, being capable of being separated or divided from the entity and sold, transferred, licensed, rented or exchanged, either individually or together with a related contract, asset or liability; or *ii)* the asset arises from contractual or other legal rights, regardless of whether those rights are transferable or separable from the entity or from other rights and obligations[2];

b) Control: "an entity controls an asset if the entity has the power to obtain the future economic benefits flowing from the underlying resource and to restrict the access of others to those benefits."[3]

c) Future economic benefits: benefits flowing from an intangible asset that may include revenue from the sale of products or services, cost savings, or other benefits resulting from the use of the asset by the entity.[4]

Asset recognition criteria for intangibles comprise two attributes:

d) It must be probable (presumably more than 50% probable) that the economic benefits embodied in the asset will eventuate; and

e) The asset must possess a cost that can be measured reliably.[5]

1. IAS 38 Intangible Assets, paragraph18.
2. IAS 38 Intangible Assets, paragraph 12.
3. IAS 38 Intangible Assets, paragraph 13.
4. IAS 38 Intangible Assets, paragraph 17.
5. IAS 38 Intangible Assets, paragraph 17.

36. The current deficiencies in formally accounting for intangible investments are particularly worrying from a policy perspective in the light of empirical evidence which suggests that corporate disclosure of intangible assets has important implications for performance. For example, in sectors that are more dependent on external finance, growth in R&D expenditure as a share of value-added is higher in countries with higher quality corporate disclosure regimes (Carlin and Mayer, 2000). This is consistent with the idea that given a lack of balance sheet data on intangibles, firms may not be able to appropriate the full return on intangibles, which may lead to an under-investment in intangible capital. Furthermore, the current accounting treatment of intangibles influences measures of firm performance in a way that is not readily verifiable by outsiders, thereby exacerbating information asymmetries and raising the cost of capital (Hunter *et al.,* 2005).

3.4 The scope for misallocation of intangible capital is significant

37. In a situation where a new firm accesses the market for ideas (Path 2, Figure 5), mechanisms for allocating intangible capital are particularly relevant. For example, most start-up companies in the biotech industry – which manage to avoid acquisition by larger firms – concentrate on research activities and license their results to large, incumbent pharmaceutical companies who have a comparative advantage in clinical testing and commercialisation of new products. A key issue in this regard, however, is the extent to which the market for ideas can achieve allocative efficiency in such trades. Indeed, it is quite rare for intangibles to be traded in an organised market (Gans and Stern, 2009). This increases the scope for a

misallocation of intangible capital within economies, making it more difficult to realise their growth potential.

3.4.1 Market mechanisms for allocating intangibles efficiently are limited

38. Efficient market outcomes tend to be associated with transparent environments where there are opportunities to trade with a wide range of potential transactors (*i.e.,* markets are thick), thereby creating the pre-conditions for effective matching (see Roth, 2008). However, arrangements for trading intangible assets – such as the secondary market for patents and licensing agreements – are not particularly conducive to generating efficient outcomes.

39. In the United States, for example, sales of patent rights in secondary markets – *via* patent auctions or specialised intermediary organisations – have increased in importance over decent decades, with 13.5% of all US patents reassigned at least once between 1980-2001 (Serrano, 2010). However, the characteristics of the patent market do not augur well for an efficient allocation of resources. It is unclear, for instance, to what extent transactions in the secondary market allocate patent to more productive uses. Indeed, it is argued that the secondary market for patents is primarily driven by the dynamics of patent assertion within the IT sector, whereby non-practicing entities (NPEs) purchase patents with a view to extracting rents by asserting them against firms that use ideas to produce economic output (Federal Trade Commission, 2011; Eisenberg and Ziedonis, 2010), an issue discussed in more detail in Section 4.[16] Moreover, unlike in some other markets, the prices of transactions in the secondary market for patents are not disclosed to the public and this lack of transparency tends to exacerbate existing information asymmetries, undermining the development of a more liquid market. Partly because of this, facilitating transactions in the market for patents is costly and difficult.[17]

40. The more common mechanism for trading patents is *via* licensing. This generally occurs through a licensing agreement, whereby the legal owner of an intellectual property grants a firm the right to exploit their intellectual property (IP) right in exchange for financial compensation or access to other IP (Jennewein, 2005). Licensing agreements can provide a cost-effective means of acquiring high quality intangible assets, with some estimates suggesting that licensing costs can account for less than one-tenth of a company's implied internal R&D costs (Jennewein, 2005).

41. Despite its appeal, the allocation of intangibles *via* licensing entails potential efficiency costs since the details of the license are negotiated in a bilateral environment where each party agrees to refrain from contacting other potential market participants for a certain period of time (Gans and Stern, 2009). In this instance, the absence of a multilateral environment entails efficiency costs given the risk that the quality of the match will be poor and the lack of a transparent price discovery process to reveal the "fair" price of the patent. Existing studies point to significant transaction costs in licensing associated with search costs for finding a licensee, fear of opportunism in negotiations and lack of valid enforcement of intellectual property (Gambardella, 2008). Indeed, that a significant portion of patents offered for licensing are not actually licensed – holding the characteristics of patents constant – is often cited as indirect evidence of the significant transaction costs inherent in marketing intangibles through licensing agreements.

16. Still, NPEs may promote market liquidity in the secondary market for patents (McDonough, 2007), which provides a mechanism for failing and bankrupt firms to extract value from their intangible investments. An ability to salvage value in the event of bankruptcy is desirable to the extent that it makes intangibles more conducive to collateralisation and may lower the cost of capital.

17. For example, the cost to perform due diligence on a large patent portfolio can exceed USD1 million while qualified patent brokers typically charge commissions of 20-25% (Eisenberg and Ziedonis, 2010).

3.4.2 Reallocating intangibles when knowledge is tacit is even more problematic

42. While the market for patents and licensing agreements provides a means to acquire codified and legally protected intangibles, firms cannot obtain tacit, human capital-based, or even codified but not legally protected intellectual assets through these channels. This reflects that tacit knowledge lacks separability which in turn undermines its transferability. In order to obtain intangible capital of this nature located outside a company's boundaries, businesses have two main options: corporate takeovers or selective recruitment (poaching) of specialists. But, both of these strategies entail important risks suggesting that the efficient allocation of intangible capital of a tacit nature is further complicated (Jennewein, 2005). For instance:

- a company acquiring an entity in which most intangible assets are human capital-based has to ensure the retention of the employees of interest in the post-acquisition environment. This is a particularly risky proposition given the capital outlays involved and the fact that the acquiring company has no real control of the targeted asset, since it is embedded in individuals. This highlights a potential trade-off between the reallocation of intangibles and the free reallocation of labour.

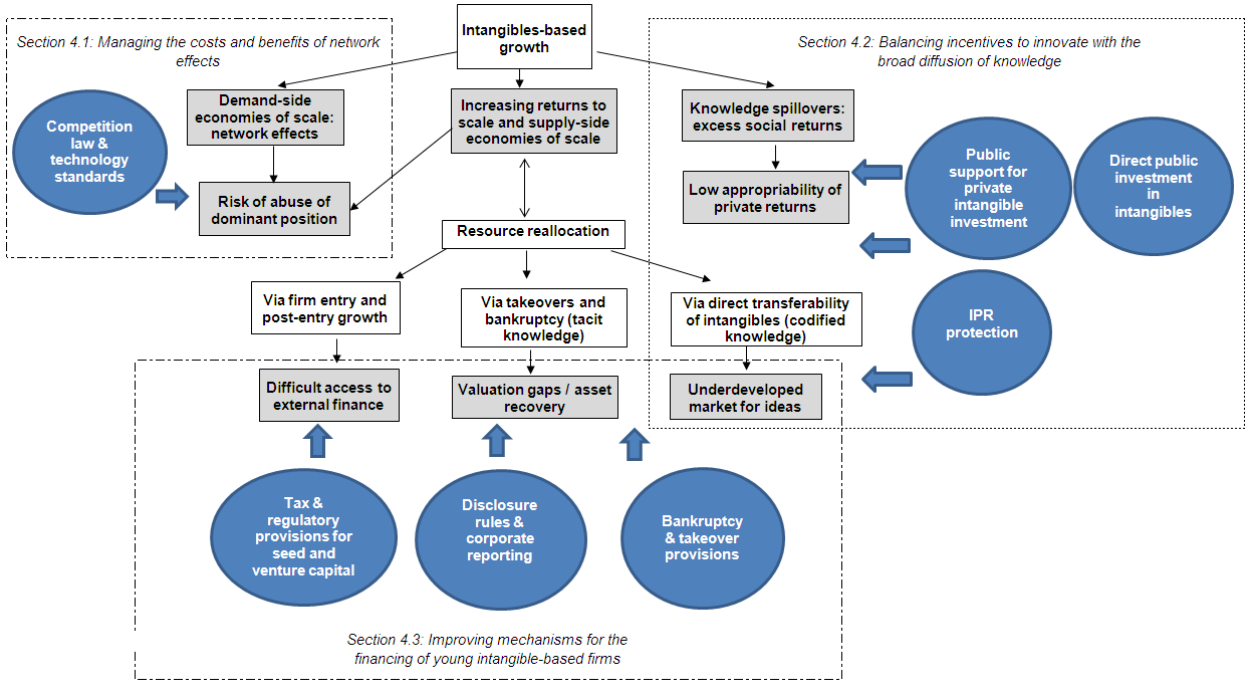
- accessing external sources of intangible capital *via* the selective recruiting of specialists is complicated by the usual obstacles to labour mobility (pension and health care portability) and the fact that recruiting firms must possess at least some internally-generated technological knowledge and competence in order to be able to effectively assess these external sources and to absorb the acquired knowledge (and be sufficiently attractive to targeted workers in the first place).[18] The poaching of highly specialised workers may also be limited through wage-bargaining system arrangements that are sufficiently centralised and co-ordinated among firms to prevent workers from appropriating the entire benefit from on-the-job training (Bassanini and Ernst, 2002). Finally, binding non-compete covenants – clauses in employment contracts that expressly prohibit individuals from competing with their former employers – will further restrict the selective recruitment of specialised labour. Indeed, empirical evidence suggests that across US states, stricter enforcement of non-compete covenants is associated with lower rates of entrepreneurial start-ups, innovation and employment growth (Samila and Sorenson, 2011a).

4. Harnessing the growth potential intangible assets: A review of policy tools and issues

43. The previous sections have identified a number of market failures (summarised in Box 1) which could result in private investment in intangibles falling short of the socially desirable level. These market failures are summarised in shaded boxes in Figure 6 and are separated into three key policy issues which are discussed in turn: network effects and competition (Section 4.1); balancing incentives to innovate with knowledge diffusion (Section 4.2); and the financing challenge for intangible-based firms (Section 4.3). A corresponding set of policy tools are also identified (in circles in Figure 6) to address these market failures. A key question is how the growing importance of intangibles is affecting the suitability of these policy tools, including in areas relevant for the allocation of intangibles, such as the market for ideas. This section provides a brief overview of the possible policy instruments and the nature of the trade-offs they involve.

18. Third party assessments may be of some assistance in this regard.

Figure 6. Main market failures and related policy tools



Notes: The characteristics of intangible assets lead to a number of market imperfections including some operating on the benefit side (network effects and knowledge spillovers) and others that bear on costs (abuse of dominant position, difficult access to external funding, underdeveloped markets and imprecise valuation).

Source: OECD Secretariat.

44. Before proceeding, two caveats are in order. First, while potentially justifying policy action, the identification of a market failure does not, by itself, provide an indication of the economic significance of the related distortions and the size of the corrective action. For instance, the latter may vary according to the structure and scope of markets where specific intangibles prevail and thus the policy prescriptions may vary across types of intangible assets. Moreover, government failure may outweigh the potential benefits of policy action. Second, the effectiveness of specific policy instruments to maximise returns on intangible investment will largely depend on a broader set of conditions being met, especially as regards the ease and efficiency of resource reallocation.[19] The policy settings contributing to appropriate framework conditions are fairly well-known and are briefly summarised in Box 5.

19. Other considerations include a policy framework that is sufficiently stable to enable firms to make investment decisions with reasonable degree of confidence that current policy settings will not be continuously adjusted.

Box 5. The role of framework policies

Framework policies can facilitate the flow of resources to their most productive use, thereby promoting investments in intangibles and innovation. For example:

- Human capital policies can equip workers with the strong (analytical) skills required to adapt to technological change. Carefully designed active labour market policies may aid the job re-skilling process for incumbent workers and reforms to migration, wage-setting and housing policy can raise the mobility of the skilled labour that is complementary to intangible investments.

- Pro-competitive product market regulation (PMR) raises allocative efficiency and total factor productivity, especially in ICT-using sectors which tend to have a fatter right tail of high performing firms (Arnold *et al*., 2011). Less stringent PMR can also have positive effects on managerial practice (Bloom and Van Reenen, 2010), underpinning internal reallocations that are necessary to sustain the innovation process. The removal of trade and investment restrictions promotes more efficient resource allocation (see Caves 1985) and facilitates technology adoption.

- Existing evidence suggests that the effect of employment protection legislation (EPL) on resource allocation and innovation varies with the characteristics of a sector. In turn, this influences specialization patterns, whereby countries with high EPL specialize in secure goods at the end of their product cycle while countries with low EPL specialize in more innovative goods (Saint-Paul 2002; Bartelsman *et al*., 2010).

  - Less stringent EPL promotes job reallocation in sectors with higher firm turnover (Bassanini *et al.,* 2009), firm entry (OECD, 2003a) and allocative efficiency (Hopenhayn and Rogerson, 1993). Moreover, less stringent EPL facilitates disruptive innovations (Box 3) and the development of venture capital (VC) financing, which relies on the aggressive reallocation of resources across the investment portfolio from failing to high-performing ventures (Bozkaya and Kerr, 2011).

  - Conversely, strict EPL may be less relevant in industries characterized by cumulative innovation processes, since innovation-driven labour adjustments are more likely to be accommodated through the skill-upgrading of existing employees than worker turnover (Box 3). Moreover, from the perspective of intangible capital, some degree of employment protection is desirable since it raises firm's incentives to invest in training, thereby fostering the accumulation of firm-specific human capital (Autor *et al*., 2003 and Wasmer, 2006).

- Financial liberalisation – appropriately accompanied by prudential policies – can lead to a more efficient allocation of capital (Galindo *et al.,* 2007), while more developed financial systems can spur the entry of new firms and the post-entry growth of successful firms (Section 3.3).

- Lower corporate tax rates can stimulate innovation by disproportionately benefiting firms closest to the technological frontier (Schwellnus and Arnold, 2008) and facilitate firm entry (Da Rin *et al*., 2011). Aligning the tax treatment of debt and equity financing in corporate income tax systems may eliminate distortions in the allocation of investment across firms and benefit young innovative firms that invest heavily in intangible assets (OECD, 2009b).

- Bankruptcy regimes, with strong exit mechanisms and that do not excessively penalise business failure, can promote the release of resources from inefficient firms and foster the development of the venture capital industry (Armour and Cumming, 2006) and high-risk business start-ups (Jia, 2008).

- Legal systems that clearly assign and protect property rights and robust public institutions that provide strong rule of law and contain corruption can support efficient resource allocation (Haltiwanger, 2011) and raise the returns to innovation.

Policies to cushion the reallocation-related adjustment costs may be warranted, but such policies need to be carefully designed so as not to stifle the reallocation process itself. In this regard, well-designed social safety nets and the portability of health and pension benefits are more effective ways to manage the labour market risk associated with reallocation than stringent EPL, since the former are less likely to undermine resource flexibility and innovation (Bozkaya and Kerr, 2011).

4.1 The role of competition law and standard-setting in preserving competitive pressures

45. One specific challenge for policymakers is to deal with the emergence of supply- and demand-side economies of scale that characterise intangibles by finding the appropriate regulatory tools to preserve both competitive pressures *and* strong incentives to innovate. Competition law clearly plays a central role in preserving market pressures in an environment that tends to generate market power. As discussed below, however, the criteria used to detect anti-competitive behaviour related to dominant position, price-fixing agreements and vertical integration may need to be adapted to better reflect market structures arising from network effects. In addition, the setting of technology standards may play a bigger role in stimulating competition in such markets.

4.1.1 The importance of network effects in the digital economy and the implications for competition policies

46. While network externalities have long prevailed among many tangibles (*e.g.* public utilities), their incidence is becoming more widespread, partly owing to their pervasiveness in the *digital economy*. Indeed, over 20% of GDP growth in advanced economies over the second half of the 2000s is attributed to the Internet-related activities (Manyika and Roxburgh, 2011),[20] which in many cases reflects direct network effects.[21] However, these effects raise concerns of high barriers to entry and innovation, as well as lock-in effects and congestion. Furthermore, practices that could be seen as violating basic competition rules may actually benefit consumers even in the long term, thereby making it more challenging to identify cases of harmful collusion or abuse of dominant position (Varian, 2004).[22]

47. The growing importance of the digital economy raises important questions regarding the desirability of specific market structures associated with technology or software platforms, and the extent to which a robust criteria can be developed to assess cases of abuse of dominant position in such markets. Some of these ideas are discussed in Box 6 but remain very much open issues. One criterion in assessing the risk of abuse associated with economies of scale is the robustness of the incumbent's market dominance. While many types of software applications and databases can be subject to strong network effects, the extent to which these effects are entrenched largely depends on switching costs. Switching costs can be a barrier to competition in many types of client-based services, but their impact is arguably stronger in the case of networks, owing to co-ordination failures. The reason is that for the benefits to exceed the costs, enough users need to be persuaded to switch to a competing network.[23] Another question is under what circumstances should competition authorities force a platform owner to give access to other

20. Facebook and E-Bay are two examples of internet-based companies whose rapid success in recent years is owed essentially to network effects. The case of Google is different, given that its initial rise to market dominance owes more to its superior performance as a search engine than to positive feedback effects. Since then, however, it has developed activities that do benefit from network effects, notably with the Android technology used in smart phones.

21. Direct network effects are distinct from indirect or market-size effects, which correspond to the value of a good being dependent on the availability and variety of complementary goods. For example, the value of a particular type of DVD player does not arise so much from the fact that others have purchased the same player, but from the expanded variety of DVDs that comes along as more people own players.

22. For instance, firms may first have to compete intensively before they gain significant market shares, with substantial benefits accruing to consumers. Furthermore, in sectors characterised by rapid technological progress, the economies-of-scale advantage may be short-lived insofar as competitors can leapfrog to a new technology.

23. Nonetheless, while social or professional networks rests essentially on network externalities, the low access costs give users the possibility to simultaneously join more than one network, suggesting that these arguments should not be overstated. Examples of leading firms in the late 1990s that have since lost their dominant position include Yahoo (search engine) and AOL (internet access provider). In the software business, Wordperfect (word processor) and Lotus (spreadsheet) once dominated their respective markets.

firms. In the case where access is given to third parties, another challenge for competition law concerns the appropriate regulation of access conditions and degree of vertical integration of the platform owner.

4.1.2 Technology standards can help offset the risk to competition from network effects

48. One way to foster the benefits of network externalities while minimising the risk of lock-in effects arising from high switching costs is to favour the setting of *compatibility standards* (Varian, 2004). *Standard settings (e.g. file formats, communication protocols, and interface language)* allow firms to compete within the market instead of for the market, and price competition gains more traction as non-price features become standardised. In this context, the control of interfaces and compatibility standards, among other issues, increases in importance.[24] However, the establishment of standards generally involves horizontal collaboration and discussion between competitors and, thus, may be viewed as going against rules intended to prevent collusion and price-fixing. Another issue is the extent to which authorities should have a say in standard discussions to ensure that choices made do not go against broader consumer benefits. For instance, governments can consider software interoperability as a criterion in their procurement process, although maintaining technological neutrality is important.

Box 6. Third-party access to proprietary technology/software platforms

A specific, though common, type of networks in the digital economy is one built around a technology platform (*e.g.* Microsoft Windows, Sony PlayStations), which can be open or proprietary. Proprietary platforms give owners substantial market power – usually a dominant position – and may reinforce lock-in effects if they deny rival firms' access to key interface and interoperability information. The risk of lock-in depends in this case on the degree of competition between platforms. Since the functionality and value of a platform generally increase with the number of applications available, owners may choose to provide access to third parties, as is often the case. Third party access has a number of implications in terms of price-setting and vertical integration strategies:

- Platform owners typically operate in a so-called *two-sided* market. An owner of an operating system sells the system to users on one side and the right to develop software applications to software developers on the other. The value of the system to users increases with the number of applications and *vice versa*, with both sides of the market being tied by *indirect network effects* (Filistrucchi, 2010). In such a case, the price structure set by the platform owner will depend on the relative willingness to pay for the operating system versus applications (Economides and Katsamadas, 2006). For example, the owner may find that users are prepared to pay a high price for the platform (game console or operating system) if they know they can get a variety of applications. In such a case, the owner will charge a low fee to applications developers for interoperating with the platform, provided this advantage is passed through to end-users. The main implication is that in such markets, pricing below marginal cost need not reflect predatory pricing or abuse of dominant position, which raises challenges for traditional competition policy.

- Platform owners may provide access to third parties and then choose to integrate downstream and start to compete directly with their partners for similar application products. The power to set conditions for interoperability and a privileged access to the technical details of the platform give in such case the owners a competitive advantage over its rivals, which may eventually have detrimental effects on innovation. The owner may eventually choose to deny access to former partners, which creates policy issues regarding regulations governing access to networks.

4.2 Balancing incentives to innovate with the aim of achieving broad diffusion of knowledge

49. The policy toolkit aimed at remedying the multiple market failures associated with knowledge spillovers includes intellectual property rights protection, subsidies to private R&D investment in the form of tax breaks or grants, and direct public involvement in intangible investment, notably through basic

24. A firm taking a strong lead position in a market may still view as desirable to set standards insofar as the expansion in the total market size that this entails more than offset the loss of market share (Shapiro and Varian, 1999).

research and the provision of digital infrastructures. While for the most part these instruments aim at fostering innovation through incentives on the production side, other factors such as initial market size effects and learning-by-doing illustrate the role that demand-side policies can play in facilitating the emergence and diffusion of new technologies.[25]

4.2.1 The evolving role and effectiveness of intellectual property protection

50. The legal means to protect rights on intellectual property embedded in different types of intangible assets include patents (mainly new products and new processes), copyrights (mostly software, databases and artistic creation), trademarks (brand or logo) and design rights. In each case, the primary aim is to preserve incentives to innovate by granting time- and scope-limited exclusive rights over the use of a new product, process, or artistic creation. By pushing firms to introduce new or improved products or services as a means to preserve or gain market shares, competition also plays an important role in fostering innovation. The overarching policy issue is, thus, to find the proper balance between exclusive rights and competition rules so that the application of one does not undermine the effectiveness of the other. Clearly, this has been a long-standing issue. The key question is whether the growing importance of information technology and other intangible-intensive industries has altered the nature of the trade-off and, more broadly, the balance of costs and benefits associated with the instruments used to protect intellectual property. A number of factors suggest that this may be the case, at least for patents and copyrights.

4.2.1.1 The main functions of a patent system

51. In principle, the economic benefits from patents go beyond the improvement in incentives to innovate through stronger appropriability of returns. By providing innovative firms with an alternative to secrecy and by forcing the disclosure of detailed information on novel technology, they also promote knowledge diffusion. Furthermore, as mentioned in Section 3, they provide a market-based mechanism for the direct transferability of ideas, further enabling the separation between the creation of knowledge (invention) and the commercial exploitation. Finally, the ownership of patents can serve as a signalling device, especially by innovative start-ups in need of persuading external investors about the underlying value of their intangible assets. Patents can in this way contribute to the emergence of new firms that can challenge incumbents. Conditions under which patents can be expected to perform well are listed in Box 7.

52. Patents also entail costs. Exclusivity can entail market power for the rights holder, the strength and impact of which is bound to vary across types of goods and industries according to the importance of the protected innovation as an input into other activities, as well as to the availability of alternatives. Patents can also raise transactions costs for follow-on innovators, both in terms of search costs to ensure that they are not infringing patent rights and of legal costs in case of litigation procedures. These can result in static welfare losses that may potentially offset the dynamic gains from higher incentives to innovate that patents are intended to bring.

53. Empirical studies into the extent to which patent systems contribute to innovation and growth have largely focused on the United States. While a strengthening of patent protection encourages businesses to make greater use of the system – as reflected in higher patenting – it is harder to establish whether this results in more innovation as opposed to a diversion towards patented activities (Lerner, 2002; Hall and Ziedonis, 2001). Survey-based evidence suggests important differences across sectors, with patents are more likely to generate an increase in innovation in the pharmaceutical, biotechnology and specific chemical sectors (Arora *et al.*, 2001; Graham *et al.*, 2009). This is consistent with the fact that the

25. Demand-side innovation policies are directed at instances in which markets for innovative products are sufficiently developed (*e.g.* certain renewable energy technologies), but there is a technology with high potential benefit and/or public sources of demand afford opportunities to stimulate innovation to meet societal needs (see OECD, 2011).

boundaries of the innovation may be clearer in these sectors, but also that the invention process is neither particularly cumulative nor highly fragmented (Hall and Harhoff, 2012). This contrasts with IT industries, where it is common to see products made of multiple components, each covered by numerous patents (Federal Trade Commission, 2011)

Box 7. Conditions for well-functioning patent systems

The effectiveness of a patent system in promoting innovation depend on a number of conditions that can be met with varying degrees across sectors and types of technology (Bessen and Meurer, 2008; Hall and Harhoff, 2012):

- *Clarity of the patent notice:* Property rights can only be efficiently and effectively enforced when their boundaries are clearly established and verifiable. The patent notice lays out the set of claims that create the property by setting the scope of the owner's right. Vague and overly abstract claims expose inventors and technology investors to unavoidable risks of (inadvertent) infringement and litigation, the potential costs of which can offset incentives to innovate (Bessen and Meurer, 2008). Defining a set of standards that will achieve sufficient clarity to ensure predictability of a court judgment can be challenging in several domains of technology, in particular software and business methods.

- *Relevance of the disclosed information*: The effectiveness of patents in promoting knowledge diffusion depends on the quality of information disclosed as regards the novelty, as well as on the extent to which the information revealed would have been hard to obtain without the patent. Regarding the latter, the fact that the incentive to patent is likely to be higher when the information about the invention is easiest for competitors to obtain (*e.g.* through reverse engineering) points to relatively small diffusion benefits.

- *Novel character of the subject matter*: The overall quality of patents depends also on the extent to which the subject matter represents not only genuine innovations, but also ones that are not obvious to experts in the field. The proliferation of patents issued on the basis of dubious claims raise transaction costs without benefits in terms of innovation.

- *The nature of the invention process*: The more cumulative is the invention process and/or the more fragmented and diverse are the sources of (protected) knowledge going into a new product, the less favourable will be the impact of patents on the incentives to invest in innovation, again owing to transactions costs (Bessen and Maskin, 2006; Hunt, 2006). Put differently, it is more complex under such conditions to design a patent system that will yield a significant net increase in incentives to innovate (Scotchmer, 1991; Gallini and Scotchmer, 2002).

- *Efficiency of patent enforcement*: Both the design of courts and review mechanisms, as well as the structure of fees and sanctions can have a strong influence on the effectiveness of the patent system. Flaws in the underlying enforcement infrastructure may undermine incentives to innovate in the longer run.

54. The contribution of patents to the diffusion of knowledge is difficult to assess empirically, partly owing to problems in identifying this channel of diffusion independently from other sources of information. Nonetheless, some evidence suggests that the value of patents as a source of information is appreciated differently across countries (Nagaoka and Walsh, 2009) and sectors (Gambardella *et al.*, 2011). Again it is found to be more valuable in pharmaceuticals and chemicals, which may be explained by the long time lag between the release of information through patents and the appearance of the product on the market due to lengthy testing processes (especially in pharmaceuticals).[26]

4.2.1.2 Patents and the market for ideas

55. When the boundaries of property rights are not clearly set, the capacity of the patent system to efficiently allocate new inventions in the market for ideas – *i.e.* inventions before they reach the

26. By contrast, the value of a patent in sectors where products come to the market more swiftly is likely to be less, since competing firms can infer the relevant information from the product, as opposed to the patent.

development and commercialisation stages – is seriously impaired, further undermining investments in intangible assets. This can occur for a number of reasons:

- High uncertainty as regards the risk of infringement can lead to an increase in the number of *ex-post* patent transactions, *i.e.* which take place after a firm has already made genuine investment in the development or commercialisation of a technology, inducing a sharp increase in the incidence of legal challenges.[27] One study has shown that already in the late 1990s, the cost of litigation exceeded the profit from patents in the late 1990s in US industries outside pharmaceuticals and chemicals (Bessen and Meurer, 2008).

- As briefly discussed in Section 3.4, rising legal challenges have been accompanied by increasing activity by non-practicing entities (NPEs or also commonly referred to as *patent trolls*) whose main line of business consists of purchasing and waiting for an opportunity to assert patents against manufacturers. To some extent, NPEs help deepen the market for ideas by acting as patent brokers and enforcers (Chien, 2009).[28] However, a recent examination of the results from litigations prompted by NPEs – which tend to be concentrated in IT industries – finds no evidence of a transfer of wealth from defendants to inventors, but rather indications of substantial deadweight losses (Bessen, *et al.,* 2012) implying that NPEs may inhibit the development of a well-functioning market for ideas.

- In such a context, many firms spend large sums in building patent portfolios so as to strengthen positions in prospective negotiations. Aside from the direct cost that this entails, there is a risk that such demand for patents can give rise to so-called 'patent thickets', obstructing entry in some markets (Canadian International Council, 2011), an issue that may warrant further empirical scrutiny. Recent evidence showing that the value that small firms and/or inventors extract from patents is far less substantial than that obtained by big firms could be taken as an indication of inefficiencies in the market for ideas (Bessen and Meurer, 2008).

- Smaller firms may also be put at a disadvantage by cross-country differences in regimes and dispute resolution mechanisms, which raise costs and uncertainty of trade in specific products. In this regard, the high degree of fragmentation and geographic dispersion of value chains underscores the need for harmonisation of intellectual property systems internationally (Hargreaves, 2011).

27. The irreversible nature of these investments makes the firm more likely to settle a legal dispute.

28. They do so notably by acquiring patents from bankrupt companies, by organising patent auctions and by helping businesses to obtain the rights to use ideas through licensing arrangements.

4.2.1.3 The role of copyrights

56. In comparison with patents, the scope of protection offered by copyrights is significantly narrower in the sense that it protects only the expression of an idea (Farrell and Shapiro, 2004). Technological progress has reduced the cost of reproduction of digital material to such an extent that the effectiveness of copyright in protecting income from artistic creation is compromised, at least in specific segments of the entertainment and publishing industries.[29] Some of the means used in the past to overcome this problem have involved supplementing legal barriers with technological ones (such as with the use of "digital rights management"). More recently, pressures have mounted for authorities to take steps to identify individuals involved in piracy and impose stiffer penalties to those found guilty of infringement. In both cases, the risk is to adopt measures that for the sake of stemming piracy limit or prevent desirable and innovative uses of digital technology, including spillovers and diffusion of knowledge (Farrell and Shapiro, 2004).

57. Considering the long length of protection (decades) that copyright confers relative to patents another related issue is whether it is the appropriate tool for computer software. The main reason is that in the case of software, both the market power and the economic significance can go far beyond what is usually observed in the case of artistic creation. In the case of software, the potentially huge market power stems from the possible inclusion of interface protocols that determine compatibility with other software.

4.2.1.4 The international dimension of IPR protection

58. Given the rapid growth of scientific capability in some emerging economies and the offshoring of R&D, R&D activity is becoming increasingly globalised, thereby creating further challenges for existing IPR regimes (OECD, 2010).[30] Indeed, while the scope of many inventions is global, patent offices are national – or at best, regional – and thus only provide protection in the corresponding jurisdiction. Accordingly, international policy co-ordination to improve global standards with respect to IPR protection is likely to be a necessary ingredient in any future policy architecture for the intangible economy. Since the TRIPS Agreement (Trade-related Aspects of Intellectual Property Rights) in 1994 – which established common standards for patent law in all signatory states and scope for international sanctions against offending states – patent laws have been strengthened worldwide, especially in developing countries (Martinez and Guellec, 2004). Nevertheless, while patent legislation can meet international standards, the lack of enforcement – and associated counterfeiting – remains a point of contention in international discussions between developed and emerging market countries (OECD, 2010).

4.2.2 The role of R&D tax credits and direct subsidies

59. To internalise the effect of knowledge externalities and boost private incentives to invest in innovation, governments have commonly relied on a mixture of R&D tax credits and direct grants. The respective pros and cons of these instruments are well known (Jaumotte and Pain, 2005a; OECD, 2010). R&D tax credits have the advantage of a more neutral allocation of resources – since they do not involve issues of selection of specific projects – but can generate large deadweight losses and may be less beneficial to young firms than direct subsidies, unless the credits are reimbursable. In the case of grants for R&D, additional questions arise as to how priorities should be established and on which sets of criteria funds should be allocated. Recent research suggests there may also be a cyclical dimension to this issue (López-García *et al.,* 2012). For example, to the extent that R&D expenditure diverts resources from current production but only generates future benefits, the opportunity cost of R&D is likely to be lower

29. The music industry has been one of the most deeply affected and has had to rethink its model of distribution.

30. For example, China's share of global R&D spending rose almost fivefold between 1996 and 2007 and future targets for Chinese R&D intensity suggest a continuation of this trend (OECD 2010).

during downturns because there is potentially less revenue to be forgone from normal productive activities than otherwise.[31] All else equal, this implies that R&D investment is potentially countercyclical but the presence of credit constraints can reverse this result: if firms depend on external finance, their ability to borrow in order to fund innovative activity will decline during downturns, due to the drop in current earnings. Accordingly, from a countercyclical macroeconomic policy perspective, there may be a case to further subsidise R&D expenditure in firms more dependent on external financing during cyclical downturns (Aghion *et al*., 2009).[32]

60. Another question is whether such policies should be extended to other intangibles that share characteristics (only partial excludability and non-rivalry) but that are not directly covered. In this regard, the scarce empirical literature on software-related externalities provides little basis for justifying government intervention to increase business investment in software. Indeed, data from the United States and the United Kingdom afford little evidence to suggest that businesses significantly under-invest in software (Stiroh, 2002; Haskel and Wallis, 2010).[33]

4.2.3 The role of organisation alliances and public-private linkages in raising the scope and efficiency of investment in intangible assets

61. Intangible investment is prevalent throughout the innovation process, particularly so in the early stages of basic research, invention and experimentation where sunk costs can be large, and failure frequent. The highly uncertain nature of innovation projects induces private firms to engage into alliances for collaborative R&D so as to share some of the risks. Additional benefits from collaborative research include the possibility for firms to capture part of the knowledge spillovers (which can then be better internalised across collaborating firms), the exploitation of economies of scale in R&D as well as the reduction in the scope for duplication in R&D investments. In fact, the recognition of these benefits has led the competition authorities in many countries to exclude R&D partnership from rules preventing horizontal collusion. Beyond this, one issue is how far governments should go in supporting collaborative R&D and how best to promote effective collaboration, not only among private firms, but also between industry and university or industry and public research organisations.

62. Indeed, co-operation between public research organisations and private industry can stimulate private sector R&D and a key mechanism through which these benefits are realised is through improved information flows between the university and business sectors (Jaumotte and Pain 2005b). For example, the passage of the Bayh-Dole Act in the United States in 1980 – which gave universities property rights to innovations developed under federal funding – triggered a sharp increase in patenting and licensing activity from universities, thereby fostering the development of knowledge markets.[34] Recent research suggests the passage of this legislation increased universities connectedness to industry and produced important local

31. It is important to note that this issue is far from resolved and that there is other evidence to support the notion that R&D is pro-cyclical, even in the absence of credit constraints. For example, if R&D is only partially excludable, there is likely to be only a short window of time for firms to appropriate profits from innovation. This dynamic externality makes firms short-sighted and more inclined to introduce innovations in boom-times in order to extract the highest benefit, resulting in lower-than-optimal R&D spending during downturns (Barlevy, 2007).

32. Similarly, by boosting firms' market size in recessions, countercyclical fiscal policy can raise investment in productivity-enhancing long-term projects, particularly in sectors that that rely more on external financing or which display lower asset tangibility (see Aghion *et al*., 2009).

33. In addition to creating policy conditions conducive to software development, policy can influence the qualitative characteristics of software, particularly publicly-procured software (*e.g.* software integrity, interoperability and accessibility). But, such concerns stand apart from the issue of optimal business investment in intangibles.

34. The Bayh-Dole Act triggered a wave of similar legislation in other OECD countries, including Austria, Denmark, Germany and Norway (see OECD, 2003b).

economic benefits (Hausmann 2010) and, within universities, faculty responded to stronger royalty incentives by producing higher quality innovation (Lach and Schankerman, 2008). However, the benefits which arise from the assignment of IPR protection to university researchers need to be assessed against the potential costs to scientific progress and knowledge spillovers, given the cumulative nature of scientific research and the importance of researchers being able to access and build-upon their colleagues research (Foray and Lissoni, 2010). Moreover, to the extent that shifting IPR protection to university researchers blurs the usual divide between publicly (or at least risk-free) funded basic research and risky appropriable private research, an under-provision of basic fundamental research may result if not designed carefully.

4.3 Improving mechanisms for the financing of young intangible-based firms

63. The attribution of property rights on intellectual assets is necessary to facilitate the transfer of innovative ideas through market-based mechanisms. At the same time, addressing the market failures that create barriers to external sources of funding for intangible-based firms can help ensure that their incentives are not excessively skewed towards the transfer of innovative ideas before development and commercialisation. Some relevant policy tools include disclosure rules in corporate reporting to increase the scope for intangible-backed lending as well as tax and regulatory provisions affecting seed and venture capital. Finally, rules governing the status of intangible assets in the case of bankruptcy may play a role in preserving the value of intangible assets, though there is very limited information on this issue.

4.3.1 Building a capital market for intangibles through improved disclosure mechanisms

64. The development of a robust capital market for intangibles will be challenging, particularly given the setback to securitisation markets during the recent financial crisis. Nevertheless, a broad set of proposals concerning the role for public policy is emerging, including the creation of government-sponsored enterprises to jump-start and regularise a secondary market for intangible-backed securities (see Jarboe, 2008). While such proposals are controversial, policymakers can also assist this process through a number of more modest initiatives (Jarboe and Ellis, 2010), to aid transparency and pricing, including:

- Standardised valuation methodologies: intangibles are currently valued according to a number of different methodologies, which greatly reduces transparency and heightens perceptions of risk.

- Greater recognition of intangibles in accounting standards: for example, only intangibles purchased from outside a company can be included in a company's financial statements in the United States, according to generally accepted accounting practices (GAAP).

65. Efforts to ensure that intangible assets are properly reported are perhaps even more important in the aftermath of the financial and economic crisis, as potential investors may have become more risk-averse and may require fuller information on corporate growth prospects. One obstacle is that incentives for managers to report intangibles as investment in company reports may be working in the other direction. Given the uncertainty of outcome, managers may prefer the option to expense such investment and report a positive surprise profit if they yield a good return (Lev, 2001). To the extent that the incorporation of intangibles into accounting frameworks along the lines of that suggested above is unlikely to be feasible in the near term, there is a case for alternative mechanisms to encourage firms to disclose information on their investments in intangibles (*e.g.* so-called narrative reporting; see OECD, 2008).[35]

66. Even with respect to narrative reporting, progress has been hampered by the fact that very few jurisdictions have introduced guidelines to facilitate such reporting. In principle, policymakers could

35. Frameworks to aid narrative reporting include the Value Chain Scoreboard (Lev, 2001), which aim to link intellectual capital more explicitly with innovation and the value creation process. See OECD (2008) for more examples.

leverage existing reporting frameworks to encourage firms to report on their intangible assets through developing voluntary national guidelines. They might also provide other incentives to disclose, possibly through the tax system. Policy measures of these sorts could help to improve the comparability and usefulness of intangibles reporting for investors and analysts, although they would not address comparability issues across national boundaries. A more concerted global dialogue on intangibles disclosure – whether private-sector or public-sector led – could be beneficial.

4.3.2 Specialised financial intermediaries to facilitate growth of intangible-based firms

67. A key barrier to the growth of many intangible-based start-up firms is the inability to obtain external finance (Section 3.3). In some countries, this financing gap of young entrepreneurial firms is partly bridged by highly specialised financial intermediaries such as venture capitalists (VCs) or business angels (BAs), which address informational asymmetries by intensively scrutinizing firms before providing capital and monitoring them afterwards (Hall and Lerner, 2009).[36] Moreover, these intermediaries play an important role in improving the functioning of the "market for ideas", to the extent that they help facilitate more efficient matching between start-up firms and incumbent firms, especially regarding licensing agreements.

68. Econometric studies, based on variation in VC supply that is exogenous to the arrival of entrepreneurial opportunities, tend to find that VC has a sizeable positive impact on innovation (Kortum and Lerner, 2000) and economic growth (Samila and Sorenson, 2011b).[37] For the United States, estimates suggest that, on average, a dollar of VC funding is three to four times more potent in stimulating patenting than a dollar of traditional corporate R&D, typically funded out of retained earnings (Kortum and Lerner, 2000).[38] Furthermore, recent evidence highlights the positive effects of angel funding on the survival and growth of new business ventures (Kerr *et al.,* 2012).

69. Significant cross-country differences exist in the supply of seed, early stage and venture capital investments (Figure 7).

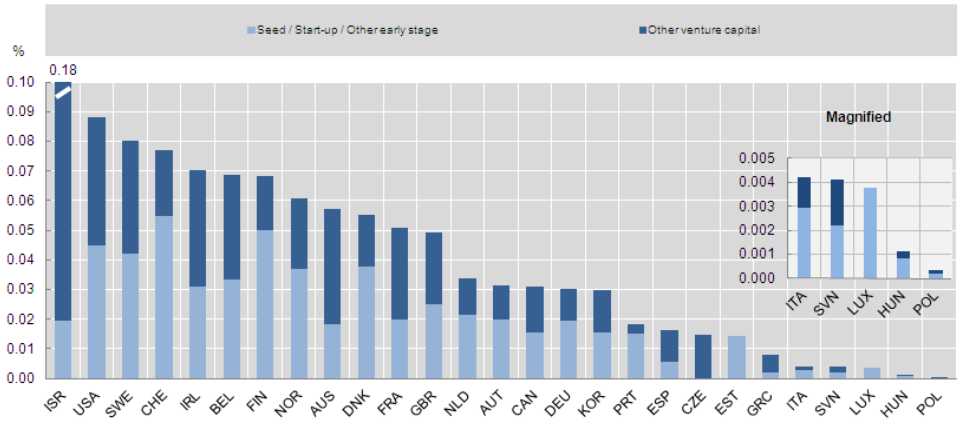
36. VCs focus their investment at the later stage of hi-tech ventures and, during periods of financial stress, tend to increasingly reallocate their portfolio toward later stage investments where the risks are lower. By contrast, BAs are entrepreneurs that invest more broadly and are becoming an increasing source of equity capital for seed and early stage investments (Wilson, 2011). Personal funds or donations from friends and family are a particularly important source of finance for start-up firms and there are concerns that reduced access to lines of home equity in the United States may adversely affect entrepreneurial start-ups.

37. VC funding and innovation are endogenous. Both VC and innovation are likely to be driven by a third unobserved factor, such as the arrival of technological opportunities, meaning that innovation could trigger VC and *vice-versa*.

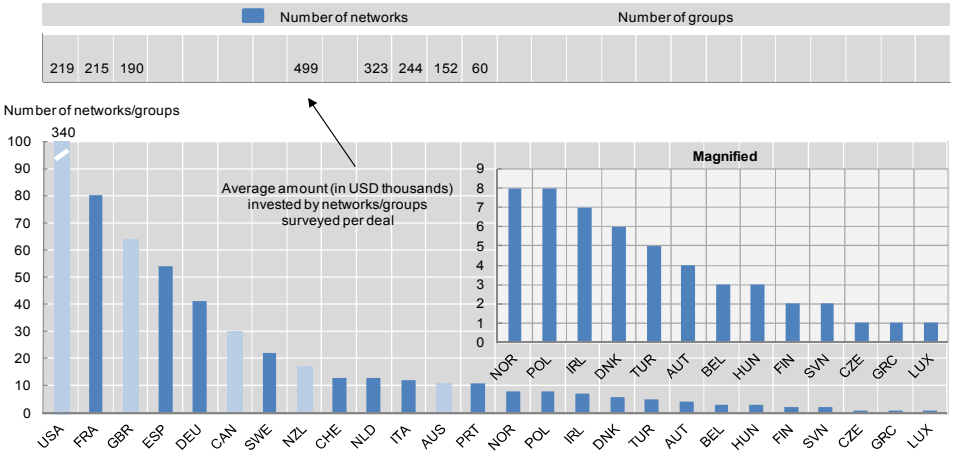
38. This implies that VC, despite only averaging less than 3% of corporate R&D from 1983 to 1992, is responsible for a much greater share – perhaps 10% – of US industrial innovations in the decade.

Figure 7. Investment by alternate funding mechanisms, 2009

A: Venture capital investment as a percentage of GDP



B: Business angel networks/groups



Source: OECD Science, Technology and Industry Scoreboard (2011)

70. This raises the question as to whether cross-country differences in public policy settings exacerbate some rigidities in the financing of intangibles. While labour market regulations and the broader entrepreneurial environment can influence the supply of seed capital (see Box 5), a number of other policy areas may also matter, including:

- Tax arrangements: the extent to which the tax system favours debt financing over equity financing is important, but evidence from a small sample of countries also points to a potential role for differences in the tax treatment of seed financing in terms of tax deductions on investments, tax relief on capital gains and special provisions concerning the roll over or carry forward of capital gains and losses (Wilson, 2011).

- Public investment funds and co-investment funds (*i.e.* public matching of private equity investments): an important issue in this regard is the extent to which these funds crowd-out private sector activity, though the public sector may also play an important role in providing the infrastructure for the learning phase of the VC industry (Lerner, 2009).

- Regulations governing the types of institutions that can invest in VC, such as pension funds, and the viability of exit strategies available to VCs (*e.g.* initial public offerings).

- Bankruptcy arrangements: limited cross-country evidence suggests that the design of bankruptcy procedures matters (Box 3) though this analysis is only based on very limited aspects of bankruptcy provisions, such as personal bankruptcy law. More data is required to understand how bankruptcy provisions affect seed capital and the incentive to invest in intangibles.

5. Conclusion

71. The importance of intangible capital – *i.e.* assets that have no physical or financial embodiment – has been rising in OECD and emerging economies. Accordingly, this paper explores the growing importance of intangible assets as a potential source of innovation and productivity gains, and the contribution of efficient resource allocation to this process. Realising the growth opportunities implied by intangible assets depends on the ability to reallocate labour and capital to their most productive use, which is determined by the design of framework policies. The redeployment of tangible resources takes on heightened importance given the inherent difficulties in allocating intangibles efficiently. Indeed, the characteristics of intangible assets create market imperfections, which hinder the allocation of new ideas to where they can be developed most efficiently.

72. While a number of policy instruments are typically deployed to address these market failures, the paper also explores how the growing importance of intangible assets is affecting the suitability of these policy tools. In turn, a number of policy issues are identified, spanning the financing of start-up firms, the treatment of intangibles in corporate valuation and accounting frameworks, competition policy in the digital economy and the role of intellectual property rights frameworks in rapidly growing domains such as information technology.

73. The analysis from this paper suggests that future research on these issues could be organised around two overarching research themes: the policy determinants of investments in intangibles and innovation and the way policies shape the impact of intangibles on growth. In both cases, the analysis could rely on a more intensive review of concepts and evidence and, where appropriate, original empirical analysis.

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