Introduction and overview: Supporting investment in knowledge-based capital

Achieving higher and sustained growth is essential for OECD economies. Business investment in knowledge-based capital (KBC) is increasing and is already a significant source of growth. But KBC is poorly measured and its many policy implications require further assessment. This chapter provides an overview of the OECD's recent work on KBC and, specifically, how KBC pertains to resource allocation and innovation, tax policy, competition policy, measurement, global value chains, knowledge networks and markets, corporate reporting, and "big data".

Today, the importance of growth can barely be overstated. The protracted nature of the global crisis, sluggish macro-economic conditions in many OECD economies, weak labour markets and burgeoning public debt all increase the importance of finding new sources of growth. Furthermore, rapidly ageing populations, combined with natural resource constraints, mean that the future of growth in advanced economies will increasingly depend on productivity-raising innovation. This book draws together the latest evidence and thinking on the role of knowledge-based capital (KBC) in growth and the policy opportunities available to governments.

The rise of knowledge-based capital

What is knowledge-based capital?

Knowledge-based capital comprises a variety of assets. These assets create future benefits for firms but, unlike machines, equipment, vehicles and structures, they are not physical. This non-tangible form of capital is, increasingly, the largest form of business investment and a key contributor to growth in advanced economies.

One widely accepted classification groups KBC into three types: computerised information (software and databases); innovative property (patents, copyrights, designs, trademarks); and economic competencies (including brand equity, firm-specific human capital, networks of people and institutions, and organisational know-how that increases enterprise efficiency) (Corrado, Hulten and Sichel, 2005). Table 0.1 sets out the different forms of knowledge capital and how they affect output growth.

Business investment in knowledge-based capital is increasing

Historically, business investment in KBC was not accurately measured in national income or corporate accounts (Box 0.1). However, beginning in the early 2000s, and focusing initially on the United States, researchers have applied direct expenditure methods to assess overall business investment in KBC, and then used these measures in growth accounting studies (growth accounting ascribes an economy's growth to increases in the volume of factors used – usually capital and labour – and the increase in the productivity of those factors). Since then, a significant research effort has expanded the number of countries covered by growth accounting analyses.

The research now available shows that most advanced economies have become progressively intensive users of KBC. In the United Kingdom, for instance business investment in KBC is estimated to have more than doubled as a share of market sector gross value added between 1970 and 2004. In Australia, since 1974-75, average annual growth of investment in KBC has been around 1.3 times that of investments in physical assets such as machinery, equipment and buildings (Barnes and McClure, 2009). And in Japan, the ratio of investment in KBC to GDP has risen throughout the past 20 years (Fukao et al, 2008). In the United States, the country with the longest time series, research shows business investment in KBC rising almost continuously for at least 40 years (Figure 0.1). Indeed, in both the United States and a number of other countries for which data are available, the business sector is now seen to invest as much, or more, in KBC as in traditional tangible capital (Figure 0.2).

Table 0.1. Classification of the forms of KBC and their effects on output growth

Type of KBC asset	**Mechanisms of output growth for the investor in the asset**
Computerised information	
Software	Improved process efficiency, ability to spread process innovation more quickly, and improved vertical and horizontal integration.
Databases	Better understanding of consumer needs and increased ability to tailor products and services to meet them. Optimised vertical and horizontal integration.
Innovative property	
Research & Development	New products, services and processes, and quality improvements to existing ones. New technologies.
Mineral explorations	Information to locate and access new resource inputs - possibly at lower cost - for future exploitation.
Copyright and creative assets	Artistic originals, designs and other creative assets for future licensing, reproduction or performance. Diffusion of inventions and innovative methods.
New product development in financial services	More accessible capital markets. Reduced information asymmetry and monitoring costs.
New architectural and engineering designs	New designs leading to output in future periods. Product and service quality improvements, novel designs and enhanced processes.
Economic competencies	
Brand-building advertisement	Improved consumer trust, enabling innovation, price premia, increased market share and communication of quality.
Market research	Better understanding of specific consumer needs and ability to tailor products and services.
Worker training	Improved production capability and skill levels.
Management consulting	Externally acquired improvement in decision making and business processes.
Own organisational investment	Internal improvement in decision making and business processes.

Source: left column, Corrado, C.A, Hulten, C.R and Sichel, D. (2005), *Measuring Capital and Technology: An Expanded Framework.* in C. Corrado, Haltiwanger, J. and Sichel, D. (eds), *Measuring Capital in a New Economy*, National Bureau of Economic Research and University of Chicago Press.

Box 0.1. Treating spending on knowledge-based capital as investment

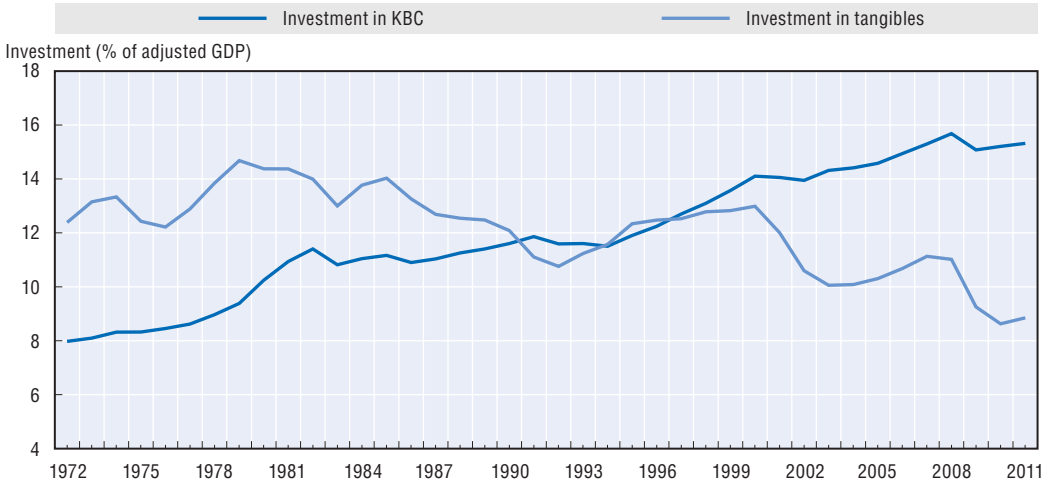
When businesses invest to integrate databases and organisational processes, spending on hardware typically only represents some 20% of total costs. The remaining costs are for organisational changes such as new skills and incentive systems. Most of these costs are not counted as investment, even if they are as essential as the hardware. Treating spending on different forms of KBC as investment accords with the views of many in the business community who attribute fundamental aspects of corporate success to spending on such things as marketing, data, design and business process re-organisation.

Both firm and national income accounting have historically treated outlays on KBC as intermediate expenditure and not as investment. By accounting convention, if an acquired intermediate good contributes to production for longer than the taxable year, the cost of the good is treated as investment. Evidence suggests that the different forms of KBC should be treated as investment from an economic viewpoint. Research from the United Kingdom has estimated the productive lives of specific types of KBC as follows: firm-specific training (2.7 years); software (3.2); branding (2.8); R&D (4.6); design (4); and business process improvement (4.2) (Haskel, www.coinvest.org.uk). New OECD research shows that firms expect investments in organisational capital to last on average 4 to 6 years in services, and between 7 and 10 years in manufacturing.

Spending on software and mineral exploration is currently treated as investment in the national accounts, and a number of countries have capitalised, or are in the process of capitalising, R&D. However, the growing literature on KBC suggests that, conceptually, other types of KBC could be treated as investment.

The growth of business investment in KBC is also more than a story about research and development (R&D). For example, in France, between 1995 and 2010, business spending on R&D remained unchanged at 1.9% of value added. But spending on non-R&D-related KBC increased from 7.4% to 10.6% of value added. Many other countries present a similar pattern. Overall, private R&D stocks generally represent no more than 20-25% of total private stocks of KBC.

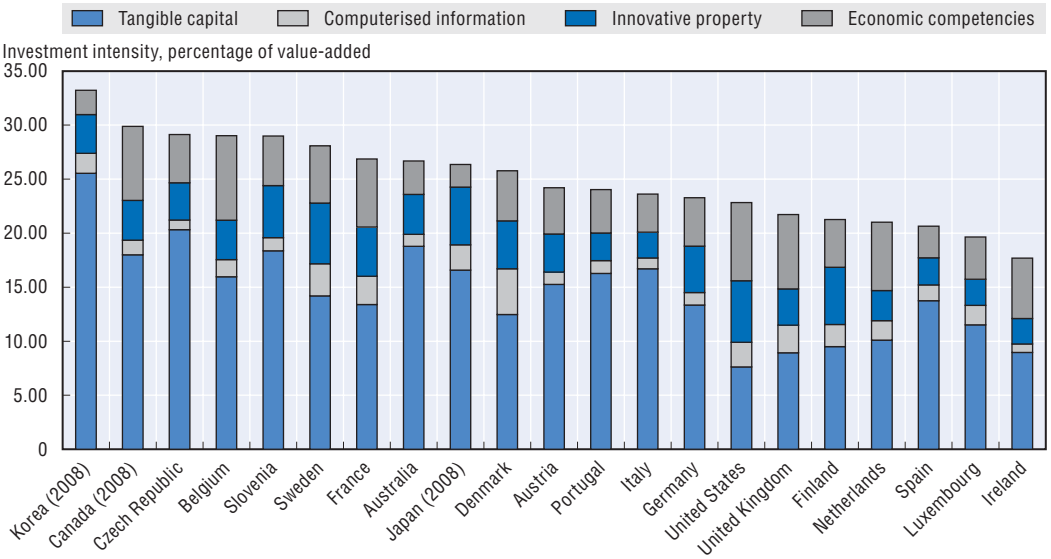
Figure 0.1. Business investment in KBC and tangible capital, United States, 1972-2011 (% of adjusted GDP)



Note: Estimates are for private industries excluding real estate, health and education.

Source: Unpublished update on Corrado, C.A. and C.R. Hulten (2010), "How do you Measure a 'Technological Revolution?", *American Economic Review: Papers & Proceedings 100* (May 2010): 99–104.

Figure 0.2. Business investment in KBC and tangible capital, 2010 (% of market sector value added)



Note: Figures refer to the market economy, which excludes real estate, public administration, health and education, with the exception of Korea, where figures refer to the whole economy.

Source: Based on INTAN-Invest (www.intan-invest.net, KBC investment for EU27 and United States), OECD Main Science and Technology Indicators (www.stastats.oecd.org, Korea, Luxembourg and Portugal market-sector value added and Korea tangible investment), National Accounts from Eurostat (http://ec.europa.eu/eurostat, Austria, Denmark, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Spain and Sweden tangible investment), Australian Innovation System Report (2012, KBC investment), National Accounts from the Australian Bureau of Statistics (www.abs.gov.au, value added and tangible investment), the Japanese Industrial Productivity (JIP) Database (www.rieti.go.jp/en/database/JIP2011/ all data for Japan), Chun et al. (2012) (Korea KBC investment), and Baldwin et al. (2012, all data for Canada), accessed June 2013.

Many emerging economies are also increasing their investments in KBC

Emerging economies account for an increasing share of global investment in innovation (Box 0.2). Business investment in KBC has become a priority in many emerging economies. Policies usually focus on education and R&D, coupled with efforts to develop linkages between multinational enterprises (MNEs) and local firms and in some cases with measures to strengthen intellectual property rights (IPRs).

Box 0.2. Estimating business investment in knowledge-based capital in China, Brazil and India

Hulten and Hao (2011) measure investment in KBC in China. Recent economic reforms in China aim to raise income by capturing more value added via technology. This will require large-scale investment in KBC. Moreover, certain features of the economic transition in China require the creation of particular forms of KBC. For instance, the privatisation of state-owned enterprises requires investments in organisational capital and new business models.

Severe data constraints hamper measurement of KBC in China. Nevertheless, the authors estimate that investments in KBC were equivalent to 7.5% of GDP for the total economy in 2006, increasing from 3.8% in 1990. Spending on R&D accounts for only 18% of total investment in KBC; this suggests that narrowly focused innovation indicators will ignore much of total spending on innovation.

China's rate of investment in KBC is comparable to estimates for France and Germany, but behind those of Japan, the United Kingdom and the United States. However, it is uncertain whether this investment will translate into technological leadership. Half of KBC investment in China goes to just two categories: software and architectural and engineering design. Both are tied to investments in tangible capital (ICT and residential structures). A more focused measure of organisational and product/process innovation might exclude them. In this case, the adjusted KBC investment rate for China would only be 3.6% of GDP (2006). This is well below the corresponding adjusted rate of 8.6% for the United States, or 6.8% and 6.6% for Japan and the United Kingdom, respectively. Furthermore, in China, the ratio of investment in KBC to investment in tangible capital is around 0.3. By contrast, in Finland, France, the United Kingdom and the United States this ratio is near to, or above, 1.

World Bank (2012) estimates that business investment in KBC in Brazil averaged around 4% of GDP between 2000 and 2008. This is not much below investment in tangible assets, which varied between 4% and 9% of GDP over the same period. Business investment in KBC has also been increasing, from 3% of GDP in 2000 to 5% in 2008, although investment in tangible assets has risen more rapidly. In India, business investment in KBC in 2007 was recently estimated at 2.7% of GDP. Around 30% was contributed by R&D (Hulten, Hao and Jaeger, 2012).

Why is business investing more in knowledge-based capital?

There are a number of possible explanations for the growing intensity of business investment in KBC:

- With rising educational attainment, OECD economies have accumulated a larger stock of human capital. The stock of human capital in turn enables and complements the production and use of KBC (for instance, patents are a means of securing the intellectual property associated with innovations emanating from human capital).
- Many products are themselves becoming more knowledge-intensive. For instance, in the automotive sector, it is estimated that 90% of the new features in cars have a significant software component (innovative start-stop systems, improved fuel

injection, on-board cameras, safety systems, etc.). Valuable trade secrets now lie in the electronic controls that regulate the operation of motors, generators and batteries. Hybrid and electric vehicles require huge volumes of computer code: the Chevrolet Volt plug-in hybrid uses about 10 million lines of computer code. And a major part of the development costs for entirely new vehicles is also software-related (while manufacturers guard the exact figures closely, estimates of around 40% are not uncommon).

- In a context of global integration of markets and deregulation, sustained competitive advantage is increasingly based on innovation, which in turn is driven, in large part, by investments in different forms of KBC. For instance, levels of patenting, R&D, information technology (IT) and management quality have risen in firms more exposed to increases in Chinese imports (Bloom, Draca and Van Reenen, 2011).

- The fragmentation and geographic dispersion of value chains – as well as the increased sophistication of production processes in many industries – have raised the importance of KBC, in particular organisational capital (Wal-Mart's computerised supply chains, Merck's multiple R&D alliances).

- Businesses have made major investments in new information and communication technologies (ICTs). These have required complementary investments in forms of KBC such as new business process skills.

- New ICTs may make some types of KBC more valuable to firms. For example, when consumers can buy on line, rather than face to face, a brand and a reputation for reliable service gain in importance. For instance, although at least one Internet bookseller offers lower prices than Amazon 99% of the time, Amazon retains its large market share because of its reputation for customer service (Brynjolfsson and Smith, 2000).

Knowledge-based capital is essential to investment and growth

Aggregate business investment in KBC is positively correlated with income per capita. As a share of GDP, the business sector in higher-income economies invests proportionally more in KBC (although this correlation does not establish a causal relationship). And recently gathered data suggest that, at least in the early phase of the global economic crisis, business investment in KBC either grew faster than, or did not decline to the same extent as, investment in physical capital.

Growth accounting studies covering various periods show a positive relationship between business investment in KBC and macroeconomic growth and greater productivity. For instance, it is estimated that between 1995 and 2007 at least 33.7% of labour productivity growth in the United States was due to investments in KBC. And over the same period, across fourteen EU countries, investment in KBC is calculated to have accounted on average for at least 19.9% of labour productivity growth (Corrado, Haskel, Jona-Lasinio and Iommi, 2012). In Canada, GDP and annual labour productivity growth would likely have been 0.2 percentage points higher between 1976 and 2000 if KBC had been included in the national accounts as investment (Baldwin, Gu and Macdonald, 2011).

Growth accounting, however, does not explain what causes growth. Nor does it explain the complementarities between the different types of KBC. Econometric methods

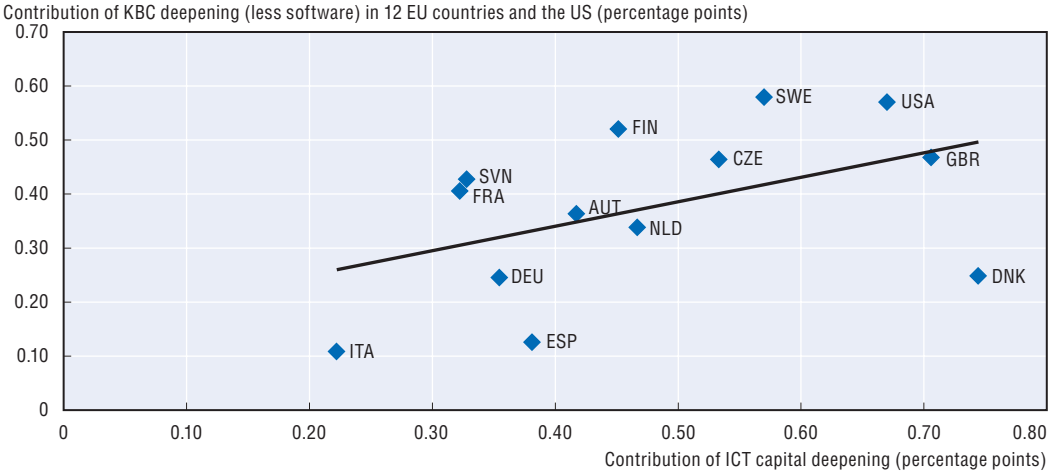
have therefore been used to reveal the positive, and significant, impacts of various forms of KBC – such as R&D, the use of data analytics and management practices – on productivity:

- Countries differ significantly in the extent to which the business sector invests in R&D. These differences are closely linked to productivity performance at the macro level (see **Chapter 1**). R&D not only enlarges the technological frontier, it also enhances firms' ability to absorb existing technologies. Micro-econometric studies often find private rates of return to R&D in the range of 20-30%. This is generally higher than the returns to physical capital, which is consistent with the higher risk associated with KBC.
- With respect to data as an economic asset, research shows that firms in the United States that base significant decisions on data analytics have levels of output and productivity 5-6% higher than would be expected given their other investments and use of information technology (Brynjolfsson, Hitt and Kim, 2011).
- Managerial quality also affects firm productivity and varies widely across OECD countries. This dispersion affords significant opportunities for productivity growth in some countries. For instance, as shown in **Chapter 1**, raising managerial quality from the median level (roughly corresponding to New Zealand in the sample) to the level of the United States could increase average productivity in manufacturing by as much as 10%.

There are also important complementarities between ICT capital investment and organisational capital, another form of KBC (see Figure 0.3). This is because firms typically need to adopt ICT as part of a wider – and more costly – set of mutually reinforcing organisational changes to obtain the greatest benefit. The link between organisational capital and ICT is particularly significant because cross-country differences in aggregate growth in OECD countries largely depend on the performance of ICT-intensive sectors and because better management practices can raise the productivity of ICT capital (van Ark, O'Mahony and Timmer, 2008). In fact, at least half of the US-Europe difference in labour productivity growth between 1995 and 2004 has been attributed to superior management practices in the United States (Bloom, Sadun and Van Reenen, 2012).

An economy that facilitates business investment in KBC is also likely to provide an environment supportive of advanced manufacturing, a major policy concern in many OECD economies. For instance, in Australia in 2005-06, spending on KBC in manufacturing stood at almost 65% of tangible investment, but in the services sector, it only reached 50%. In Germany, manufacturing accounts for nearly 50% of all investment in KBC, a share much higher than manufacturing's contribution to GDP. Furthermore, sustainable competitive advantage often comes from a complex, and often challenging, integration of different types of KBC (such as when firms integrate simulations of product designs and models of workplace organisation with large computerised data sets so as to introduce products more quickly and efficiently).

Figure 0.3. ICT investment and KBC are positively correlated, 1995-2007



Source: Corrado, C. A., J. Haskel, and C. Jona-Lasinio (2013). "Knowledge Spillovers, ICT and Productivity Growth", Mimeo (July). Paper presented at the 4th ICTNET workshop (London, April 2012), the 2nd World KLEMS meeting (Cambridge, Mass., August 2012), and ZEW (Manheim, Germany, May 2013).

Inherent properties of KBC are growth-enhancing

Two properties of KBC have particularly positive implications for growth. First, unlike physical capital, investments in many forms of KBC – R&D, organisational change, design – yield knowledge that can spill over to other parts of the economy. That is, firms that do not invest in KBC can only be partially excluded from benefits created by firms that do. For this reason, policy must provide adequate incentives for private investment in KBC.

While it is difficult to estimate knowledge spillovers, empirical studies focused on R&D have generally found them to be quite widespread. Research at the country level has also identified spillover effects from design, brand equity, organisational capital and training (although industry-level analysis is needed to consider these findings definitive) (Corrado, Haskel and Jona-Lasinio, forthcoming). Furthermore, new research shows a stronger positive correlation between KBC investment and MFP growth than between tangible capital investment and MFP growth (see **Chapter 1**). MFP rises faster when workers use more KBC than when they use more tangible capital. This suggests knowledge spillovers from KBC.

Second, KBC can spur growth because the initial cost incurred in developing some types of knowledge – often but not exclusively through R&D – does not need to be incurred again when that knowledge is used again in production. Indeed, once created, some forms of KBC – such as software and some designs – can be replicated at almost zero cost (they can also be used simultaneously by many users - this is known as "non-rivalry"). This can lead to increasing returns to scale in production, the property that makes ideas and knowledge an engine of growth. Scale economies of this sort can also be reinforced by positive network externalities. These occur when the benefit from a network rises with the number of users. Such externalities are particularly prevalent in the KBC-intensive digital economy (where, for example, the value of a platform, such as Apple's Operating System, increases with the number of users of the platform).

It should be added however that while R&D exhibits properties of partial excludability and non-rivalry, other forms of KBC may have a smaller impact on growth (and have also been less studied). For instance, firm-specific human capital and much of brand equity are highly excludable and rivalrous.

Policy analysis and conclusions

Framework conditions need to fit the realities of the knowledge economy

Because business investment in KBC underpins much of the knowledge economy it is affected by many areas of policy. As overall business investment in KBC increases, and because of KBC's intangible nature, some policy settings require readjustment. Framework conditions provide the fundamental economic context for investment in KBC and for the efficient reallocation of resources to new sources of growth, including those based on KBC.

It is essential for policies to be well suited to this new situation and to conform to good practice in such areas as taxation, entrepreneurship, competition, corporate reporting and intellectual property. The same holds for policies that enable the exploitation of data as an economic asset. The rise of KBC also amplifies the importance of policies towards education and training. Attention must likewise be given to complex regulatory issues that address data privacy and security. Indeed, as new technologies based on KBC develop, new regulatory challenges are likely to arise.

Many current policy settings, as well as systems of accounts (both corporate reports and national statistical accounts), are best suited to a world in which physical capital predominates. Getting these framework conditions right, while a challenge, is essential for growth in the 21st century and can be relatively inexpensive in fiscal terms. More than new government spending, smarter and better-focused rules and incentives for businesses should be the first priority for many countries.

Policy should facilitate efficient resource allocation, which is positively correlated with KBC use

As emphasised in **Chapter 1**, the allocation of economic resources to their most productive uses is a critical determinant of growth. The principal reallocation mechanisms are firm turnover (entry and exit), shifts in resources across firms and reallocation within firms. Reallocation is a frequent phenomenon in OECD countries: on average, about 15-20% of all firms and more than 20% of jobs are created or destroyed each year. However, the efficiency of resource allocation varies considerably from country to country. Countries that are more successful at channelling resources to the most productive firms also invest more in KBC.

To develop and commercialise new ideas, firms also require a range of tangible resources to develop prototypes, develop marketing strategies and eventually produce at a commercially viable scale. New OECD evidence reveals important cross-country differences in the extent to which labour and capital flow to innovative firms. For example, the degree to which labour flows to patenting firms in the United States and Sweden is estimated to be twice as large as in Italy. And countries with more stringent regulations in product and labour markets tend to invest less in KBC.

Efficient labour adjustment is also important

By raising labour adjustment costs, more stringent employment protection legislation (EPL) slows the reallocation process. However, by contrast, employment protection also raises workers' commitment and firms' incentives to accumulate firm-specific human capital. In line with this trade-off, evidence on the impact of EPL on innovation and productivity is somewhat mixed. Nevertheless, **Chapter 1** highlights that EPL has important effects on the form of the innovation process. For instance, new OECD evidence shows that in environments of greater technological change, stricter EPL lowers productivity growth by reducing firms' willingness to experiment with uncertain growth opportunities. Countries with stringent EPL tend to have smaller innovative sectors associated with intensive ICT use, and MNEs tend to concentrate more technologically advanced innovation in countries with weaker EPL. And in sectors with significant reallocation needs – measured by job layoffs, firm turnover and ICT intensity – reallocation is more efficient under less stringent EPL. Stringent EPL is also associated with lower R&D expenditure in sectors with higher rates of patenting.

An environment supportive of entrepreneurship, trade and investment is critical

Entrepreneurial activity is essential to the process of reallocating labour and all forms of capital to their most productive uses. However, entrepreneurial dynamics vary from country to country. In particular, the size of entering and exiting firms tends to be smaller in the United States than in Europe. Successful young firms also tend to expand more quickly in the United States, where firm productivity within industries also tends to be more dispersed (with more productive firms likely to account for a larger share of employment). One interpretation of these findings is that entrants in the United States engage in more experimentation and "learning by doing". Cross-country differences in entrepreneurial activity tend to be largest in new and high-technology sectors, where the use of KBC is likely to be most intensive.

Investment in KBC is also found to be positively correlated with debtor-friendly bankruptcy codes. Bankruptcy regimes that severely penalise "failed" entrepreneurs, whether by more readily forcing liquidation or by limiting entrepreneurs' ability to start new businesses in the future, are likely to reduce the willingness to take risks and thereby limit the supply of new ideas. Across countries and over time, more debtor-friendly bankruptcy codes are associated with greater intensity of patent creation, patent citations and faster growth in innovative industries (Acharya and Subramanian, 2009).

Liberalising barriers to international trade and investment also stimulates aggregate productivity by increasing knowledge diffusion and technology transfer across borders and by encouraging more efficient resource allocation (indeed, because, as noted earlier, investments in some forms of KBC are easily scalable, having a larger market size is beneficial). Recent evidence from a sample of European firms shows that the removal of product-specific quotas following China's WTO accession triggered a significant increase in R&D, patenting and productivity (Bloom, Draca and Van Reenen, 2011). And as **Chapter 1** reports, increased exposure to trading partners' R&D stocks (a proxy for the stock of foreign knowledge) from the level of Spain (around the OECD average in 2005) to the level of Canada (the 75th percentile) could boost patents per capita by around 20% in the long run.

As knowledge is partly embodied in, and can spill over from, imported intermediate goods, reductions in tariffs on intermediate inputs are associated with significant productivity growth in downstream manufacturing sectors. Across the services sector in OECD countries, more stringent restrictions on foreign direct investment (FDI) are

associated with lower allocative efficiency. Indeed, the analysis in **Chapter 1** suggests that lowering restrictions on FDI from the relatively high levels of Poland to those of Germany could increase aggregate productivity by around 2%.

Good conditions for the financing of KBC-intensive firms are also needed

It is widely held that young entrepreneurial firms face a financing gap. This gap is partly bridged by specialised financial intermediaries such as venture capitalists and business angels who scrutinise firms before providing capital and monitor – and sometimes mentor – them afterwards. Many early-stage investments occur in KBC-intensive firms. Indeed, for a sample of OECD countries and over a number of years, there is a positive correlation between aggregate business investment in KBC and the size of the venture capital sector (Figure 0.4). Countries with more developed seed and early-stage VC are also more effective at channelling capital and labour to young innovative firms, while a number of studies show that the supply of venture capital can have a positive, sizeable and independent impact on innovation and economic growth (Kortum and Lerner [2000]; Samila and Sorenson [2011]).

Nevertheless, countries differ significantly in the supply of seed and early-stage finance. This raises the question of whether differences in policy settings exacerbate rigidities in the financing of investments in KBC. A number of policy areas matter here, including: tax arrangements (tax deductions on investments, tax relief on capital gains and special provisions concerning the rollover or carry forward of capital gains and losses); regulations governing the types of institutions that can invest in seed and early-stage venture capital, such as pension funds (venture capital activity in the United States increased significantly following the removal of restrictions on pension fund investments in 1979); the availability to venture capitalists of viable exit strategies (e.g. initial public offerings); and bankruptcy arrangements (regimes that provide strong exit mechanisms and do not excessively penalise business failure can foster the development of VC).

Policy makers often attempt to nurture the market for seed capital through a range of direct and indirect supply-side policy initiatives. Indeed, most OECD countries have some type of government equity finance programme, such as direct public VC funds, "funds of funds" and co-investment funds, whereby public funds match those of private investors. In Europe, over half of all early-stage venture capital finance is provided by publicly supported co-investment funds. Such programmes, especially funds of funds and co-investment funds, have grown in importance over the past five years. While fiscal incentives are less common, 17 OECD countries use tax incentives of some sort. Evidence on the impact of supply-side policy interventions for early-stage finance is relatively scarce, and mainly relates to the performance of public VC funds. Government-supported VC firms risk coming under pressure to consider not only financial returns, but also policy goals relating to specific sectors, regions and social groups. However, empirical evidence suggests that government funding is most effective when disciplined by private VC management and pursues commercial objectives.

Demand-side policies can also be important in fostering early-stage equity investment. For instance, new OECD evidence which explores the determinants of VC investment in the clean technology sector suggests that regulations that aim to create a market for these technologies are associated with a higher level of VC investment, while fiscal incentives for investment in these technologies are ineffective. This likely reflects the frequent changes in the availability and generosity of such measures and further underscores the importance of a predictable policy environment for the financing of innovative ventures.

Figure 0.4. Business investment in KBC and the size of the venture capital industry

Selected OECD countries

Source: KBC estimates from sources in Figure 0.2. Venture capital data from the 2007, 2009 and 2011 editions of OECD's "Science, Technology and Industry Scoreboard", OECD Publishing, Paris, doi: http://dx.doi.org/10.1787/20725345

While far from a mature phenomenon, there have been some relatively recent innovations in KBC-based lending and investment. For instance, royalty-based financing has been used in the pharmaceuticals and biotechnology sectors. And one major publishing company funded an expansion of its business through a deal secured by its rights to the works of composers. In the United States, royalty-based financing is estimated to have been worth some USD 3.3 billion in 2007-08 (Ellis, 2009). Other transactions have been based on prospective revenues from products still at a pre-commercial stage of development. While still rare, KBC is also used as loan collateral. Governments can facilitate such developments in various ways, from monitoring the broader array of securities laws and regulations and how they affect KBC-based financing, to ensuring a robust market for intellectual property and institutional arrangements that minimise uncertainty as to ownership claims for KBC (Box 0.3).

Box 0.3. KBC as financial security: Recent developments and policy opportunities

The development of intellectual property as a source of loan collateral is part of a process of long-term economic transformation (Cuming, 2006). Historically, immovable property was the most valuable type of property, and mortgage laws were developed as financial systems emerged. With the rise of manufacturing, legal systems were reformed to permit the use of machinery and inventory as security. The increasingly central role of intangible assets in modern services-based economies will require new rules governing the use of intangible property as collateral. The problem is that intellectual property has distinctive valuation risks that affect the attractiveness of its use as collateral. These risks include the fact that: some intellectual property rights have limited life spans; a patent right might be made worthless as a result of novel innovations achieved by others; an intellectual property right can be lost through failure to pay renewal fees; some intellectual property rights only have potential value (for instance, a new software that has not yet been commercialised); some intellectual property may have limited marketability beyond its current ownership because its value is contingent on being combined with other assets; trademarks cannot generally be treated as independent collateral; and there may be uncertainty about the existence of copyright, which does not require registration.

…/…

Box 0.3. KBC as financial security: Recent developments and policy opportunities *(continued)*

However, there have been innovations in recent years in intangibles-based lending and equity investment. For instance:

- Royalty financing arrangements are increasingly used as sources of securitisation. The deals take a variety of forms. Some use existing royalty streams (the so-called "Bowie Bonds", issued in 1997, were backed by the stream of royalty payments generated by the catalogue of David Bowie's music). In 2006, XOMA Corporation, a human antibody therapeutics company, obtained a loan facility with Goldman Sachs' Specialty Lending group, secured by the latter's rights to payments from sales of three of the company's brand-name drugs. Other transactions have been based on prospective revenues from products still at a pre-commercial stage of development.
- In 1999, Citizens & Farmers Bank in Virginia issued the first M•CAM-insured intangible asset collateralised loan to the manufacturer of specialty infant formula bottle liners (M•CAM is a financial services firm specialising in intangible assets). This transaction set the precedent for a programme that offered intangible asset collateral insurance through a partnership between Bank of America, SwissRe and M•CAM.
- A 2007 survey in the United States showed that 18% of small high-technology companies in New England had used patents as collateral to obtain financing (Venkatachalam, 2007). The music publishing company Boosey and Hawkes funded an expansion of its business through a deal secured by its rights to the works of composers.
- Between 1997 and 2007, the share of secured syndicated loans collateralised by intangible assets in all secured loans rose from 11% to 24% in the United States (Loumioti, 2011).

Various areas of policy and institutional development could help promote an environment conducive to intangibles-based financing. These include:

- Regulations on corporate financial and accounting disclosure that help to reduce vagueness in identifying and quantifying internally generated intangible assets;
- The development of international valuation standards for intangible assets, through processes that engage the many relevant entities, from ratings agencies to large investors.
- Monitoring of the broader array of securities laws and regulations and how they affect intangible-based financing (possibly in unintended ways).
- Policies that facilitate a robust market for intangible assets, such as licensing, sales and auctions, to allow for their liquidation when necessary.

Institutional arrangements that minimise uncertainty as to ownership of intangibles. Uncertainty can be significant and have more than one source. In the United States, with respect to patents, legal claims covered by state-level laws can lead to geographic differences in court decisions (Jarboe and Furrow, 2008).

Government efforts to facilitate the development of patent litigation insurance (e.g. preventing fraudulent products and promoting financially sound products). For example, the Danish Patent and Trademark Office has encouraged the creation of patent litigation insurance for SMEs.

Government loan and loan guarantee programmes that might include provisions for purchasing intangible assets. The programmes might also be designed to explore with banks how to use facilities to finance intangibles-based firms. In China, for instance, at the end of 2008, the Beijing Intellectual Property Office created a programme to help SMEs borrow against their intellectual property.

The efficiency of resource allocation affects employment outcomes from business investment in KBC

Given the current state of data availability on KBC, drawing linkages to employment outcomes is not straightforward. But a number of observations are relevant. Firstly, as Chapter 1 shows, important cross-country differences are apparent as regards impacts on employment of increases in the patent stock. For example, a 10% increase in the firm-level stock of patents – one part of KBC – is associated with about a 2% increase in employment in firms in the United States, but only 0.6% in Japan and 0.4% in Finland. In other words, good framework conditions will help the KBC-intensive firms that can create jobs to do so.

Furthermore, because business investment in KBC is rising, new firms are more intensive users of KBC than in the past. At the same time, young and high-growth firms make a disproportionate contribution to employment growth. Previous OECD work has shown that young firms account for a substantial share of radical innovation. A new OECD project demonstrates that young firms are also an important source of employment growth. The project, called DYNEMP, currently covers thirteen countries and uses countries' business registers to quantify the extent to which firms with different characteristics (in terms of age, size and sector of activity) contribute to job creation and destruction, and how firm entry, growth and exit affect employment. Early results show that during the period 2001-11 businesses less than five years of age accounted on average for 18% of total employment but generated 47% of all new jobs created. Furthermore, during the financial crisis, the majority of jobs destroyed generally reflected the downsizing of large mature businesses, while most job creation was due to young small and medium-sized enterprises. While policies to foster job creation must consider the needs of firms of all sizes, these data indicate the importance of a policy context that enables entrepreneurship. Future research is needed to establish at the micro-level the relationships between young job-creating firms and their KBC investments.

In addition, while more evidence is needed, the environment for investment in KBC is also likely to play a role in determining which countries retain or move into the high-wage segments of different industries. For example, in 2006, the iPod accounted for 41 000 jobs, of which 14 000 in the United States and 27 000 elsewhere. But US workers, largely engaged in forms of KBC such as design, R&D, software and marketing, earned a total of USD 753 million, while those abroad (almost double their number), mostly engaged in manufacturing of parts, components and their assembly, earned USD 318 million (Linden, Dedrick and Kraemer, 2009).

Policy makers should take a broader view of innovation

A policy message that derives from many chapters in this book is that policy makers need to adopt a view of innovation that is broader than R&D. Forms of KBC, such as data, new business processes (Box 0.4) and design (Box 0.5), also drive innovation and value creation and may be affected by specific barriers and policies. One implication of this broader perspective might be a renewed emphasis on programmes such as technical extension services that facilitate the diffusion of various forms of KBC to firms. Historically, such programmes played a major role in diffusing new agricultural technologies. Extension programmes in manufacturing, some with a broader focus than technology, have also been extensively evaluated.

In adopting a policy perspective that goes beyond R&D, well-designed support measures are needed, including: frameworks that foster collaboration to innovate, for instance between firms and public research organisations; and well-crafted direct support that facilitates KBC investments in areas of highest social return (such as through innovation prizes and competitively awarded grants). Demand-side policy, which has typically received less attention than supply-side policy, could also support KBC investments in ways that simultaneously help to meet public needs (this is particularly so for innovation-oriented competitive public procurement).

Beyond the essential attention to framework conditions, public policies to increase business investment in KBC must of course be based on evidence that businesses would otherwise under-invest in KBC. Firms' ability to internalise fully the returns from investments in KBC varies depending on the type of asset. The strongest evidence for private under-investment exists for R&D-related spending. But positive externalities – which could lead to socially suboptimal investment – also exist for design and other forms of KBC (many businesses find their designs copied, a sign that some spillover of value is occurring). There is a need for more evidence on the scale of such positive externalities.

A wider perspective on innovation's drivers may require the redesign of some long-standing innovation programmes. For example, most OECD governments operate programmes that facilitate business access to research or technology-related advice and information, often from universities and public research organisations. These schemes – such as innovation vouchers, know-how funds and technical extension services – tend to focus on technological information and typically create links to academics in science, technology, engineering and mathematics (STEM) disciplines. Work on KBC suggests that an exclusive focus on STEM disciplines is too narrow. In fact, businesses require information and advice relating to many forms of KBC and interact with academics for a variety of reasons. In the United Kingdom, for instance, nearly a third of all academics in the arts and humanities are engaged with business in some way, as are nearly half of academics in the creative arts and media (Hughes, Kitson, Probert, Bullock and Milner, 2011). As well as knowledge related to STEM disciplines, businesses may want assistance with marketing, sales and support services, as well as human resource management, logistics and procurement. This suggests that a move from STEM to STEAM, as some researchers have proposed (the "A" refers to "Arts") would be appropriate.

Policy stability – keeping uncertainty to a minimum – is also important. As described in **Chapter 1**, new OECD evidence shows that in countries that have often reversed R&D tax policy, the impact of R&D tax credits on private R&D expenditure is greatly diminished.

Establishing targets for innovation policy has both advantages and disadvantages, but if governments do use innovation targets – such as the Lisbon Agenda's 3% of GDP guideline for national R&D spending – these should include the wider innovation indicators provided by KBC.

Box 0.4. Business process innovation: An example of knowledge spillovers in the airline industry

Southwest Airlines has introduced many significant innovations in the airline industry, such as boarding passengers without assigned seats and frequent-flyer programmes. For decades after the company's creation, in 1971, Southwest consistently achieved the lowest average cost per seat-mile among US airlines. Its stockmarket return has also been one of the highest of all S&P 500 companies. While these innovations were central to its success, many were not patented. Other airlines have replicated Southwest's innovations – including RyanAir, Easy Jet and Go in Europe as well as Air Asia in the Far East – often on the basis of passive or easily accessed knowledge flows (from travelling on Southwest planes to participation in "best practice" events organised by Southwest). Southwest also developed key innovations by learning from others. For instance, Southwest sent staff to the Indianapolis 500 to observe pit crews fuel and service race cars because the pit crews performed the same functions as aircraft maintenance crews, but faster. New ideas gleaned in this way and from other sources eventually contributed to a 50% reduction in Southwest's aircraft turnaround time.

Source: Criscuolo, C., Haskel, J. and Slaughter, M. (2005), Global Engagement and the Innovation Activities of Firms, NBER Working Paper 11479 (www.nber.org/papers/w11479).

Box 0.5. Design: A form of KBC that drives innovation and growth

A design is a plan or representation of the look, function or workings of a product or system. Product design affects functionality and the consumer's attachment to the product. Beyond physical appearance, design is often integral to all stages of the business process, from manufacture, brand development and marketing to after-sales service (in a global context, design can help to differentiate products to meet the requirements of different local markets). The impacts of design are not limited to physical products. For instance, the design of graphical user interfaces is increasingly important. Design also plays a major role in services, such as online purchasing or airport check-in. There is substantial quantitative and qualitative evidence that design plays important roles in innovation and firm performance and that overall business spending on design is large. For instance:

- One study of the United Kingdom suggests that spending on design might almost equal business spending on R&D (NESTA, 2012).
- A number of world-beating products owe at least part of their success to different facets of design. For tablet computers and smartphones some of the most prominent intellectual property conflicts in recent years have focused on design.
- Research published in 2010 indicated that the iPhone had then added around USD 30 billion to the value of the Apple Corporation, only 25% of which was attributable to patentable technology stemming from R&D. Much of the rest was attributable to Apple's innovations in design, marketing and management (Korkeamäki and Takalo, 2010). Incorporating design into the early stages of new product development has been shown to result in stronger corporate financial performance (Gemser, Candi and van den Ende, 2011).
- Design can allow firms to pull away from cost-based competition (for example, design enabled Sony to charge a 25% higher price for its Walkman than competitors) (Czarnitzki and Thorwarth, 2009).
- Design competencies can help companies in traditional industries such as textiles, apparel and furniture to succeed. Italy has long had a successful furniture industry largely based on small and medium-sized firms with competitive advantages in design.

…/…

Box 0.5. Design: A form of KBC that drives innovation and growth *(continued)*

- 67% of exporters in New Zealand have identified design as central to their commercial success (Gertler and Vinodrai, 2006).
- In 2007, almost half of businesses in the United Kingdom believed that design contributes to increased market share and turnover (Design Council, 2007). And in 2004, among firms in the United Kingdom that saw design as integral to their business, nearly 70% had introduced a new product or service in the previous three years (compared to just 3% of companies for which design played no role) (Design Council, 2004).
- Design expenditure has been shown to have a positive association with Dutch firms' sales of new products. (Marsili and Salter, 2006).

Industrial design filings have risen strongly in recent years. The World Intellectual Property Organization (WIPO) estimates that design filings grew by 16% worldwide in 2011, after 13.9% growth in 2010. Much of this growth reflects increased design filings in China (WIPO, 2012).

The Europe 2020 Flagship Initiative – Innovation Union includes design among its ten priorities. Further afield, China, India, Korea and Singapore have all enacted design policies and consider design to have strategic economic importance.

Appropriate tax treatment of KBC can stimulate investment and growth in cost-effective ways

Chapter 2 focuses on the structure of corporate income tax regimes and how they affect incentives for investment in KBC and tax revenues. Evidently, many tax policies affect innovation and growth, as described in previous OECD publications such as *Tax Policy Reform and Economic Growth* (2010). However, the work in **Chapter 2** focuses on new effective tax rate indicators and an assessment of the effects of corporate income tax on KBC investment decisions of multinational enterprises (MNEs). A key message is that the tax treatment of not only R&D expenditure but also returns to R&D must be taken into account in assessing the overall scale of tax relief for R&D and the design of R&D tax incentives.

Whether through R&D tax credits or special tax allowances, many OECD countries offer significant tax incentives for business spending on R&D. The number of countries providing tax incentives for business spending on R&D, and the generosity of such measures, is rising. Indeed, in some countries R&D tax incentives are the principal policy instrument used to foster innovation. For instance, in Canada in 2010, the R&D tax credit accounted for around 70% of all public support for business R&D. Ensuring that such resources are used cost-effectively is clearly essential.

MNEs typically operate as integrated global businesses and are able (within the limits of the law) to plan their tax affairs to take advantage of differences in tax rates and regimes across tax jurisdictions. Notwithstanding tax rules designed to protect the tax base in many countries, MNEs are often able largely to avoid corporate income tax on returns to R&D, for example by using offshore intellectual property holding companies. A particular difficulty for tax authorities is to establish arm's-length prices for transfers of KBC within a MNE. There are obvious risks, for instance, that managers of an MNE may attempt to mis-represent the value of patents transferred to an offshore company in order to minimise the firm's global (host and home country) tax burden. Also, owing in part to pressures to provide internationally competitive tax treatment, countries are often

reluctant to impose "controlled foreign company" (CFC) rules that would tax on a current basis (rather than deferred or exempt basis) royalty income received by offshore holding companies of resident MNEs.

Owing to limited data, it is difficult to estimate the global scale of profit shifting to no-/low-tax countries through MNE tax planning involving KBC, but the magnitudes involved appear to be significant. For example, the potential annual revenue cost from income shifting by US-based MNEs may be as high as USD 60 billion, with possibly half of this due to aggressive transfer pricing of KBC-related transactions (Gravelle [2009]; Clausing [2011]).

Conventional methods for assessing effective tax rates on investment in many forms of KBC largely ignore the international dimension of tax regimes and the tax planning behaviour of MNEs. **Chapter 2** reports the OECD's work to develop a new model for assessing the overall tax burden on R&D and for understanding how domestic and international tax policies influence business decisions to undertake R&D, where to hold KBC (such as patents) arising from successful R&D, and where to undertake production exploiting KBC. Key empirical findings from the new model are that:

- In many countries, overall tax relief for R&D (particularly that of MNEs) may be greater than governments intended when they first designed tax incentives for R&D expenditure.
- No-/low-tax rates and favourable tax regimes encourage MNEs to locate economic ownership of KBC (and receipt of income in the form of royalties) in offshore holding companies. In addition, limited taxation of foreign royalty income tends to encourage the use of KBC in foreign production and particularly in host countries with relatively low corporate tax rates. Such location decisions could have a number of negative consequences for the domestic economy: the country providing tax incentives for R&D might collect little tax on the commercialisation of the subsidised R&D; if KBC is held offshore and used in foreign production, there may be an important loss of domestic spillovers from R&D (e.g. knowledge gained from embedding KBC in production technology); and domestic employment may be negatively affected by tax policies that encourage the use of KBC in foreign production. Furthermore, global output may also be lower if investments are made in KBC not where they are most productive but where the tax arrangements afford the highest post-tax profitability.
- Compared to MNEs, "stand-alone" R&D performers (firms that are not part of a MNE group, and thus without foreign affiliates to engage in cross-border tax planning) may be placed at a competitive disadvantage. The absence of a level playing field may make it more difficult for such firms to compete with MNEs, which may inhibit knowledge creation. Yet such firms may have particular strengths as R&D performers (e.g. in creating radical innovations).

The analysis provides a case for targeting R&D tax credits to SMEs, in particular those that are not part of a multinational group. Such an approach is further supported by OECD analysis reported in **Chapter 1** which shows that the productivity impacts of fiscal incentives for R&D are unclear, possibly because they may favour incumbents at the expense of more dynamic young firms. If countries do not choose to target R&D tax credits, they may decide instead to consider steps to curtail profit shifting by MNEs so as to level the playing field (without reducing innovation activity). Forthcoming OECD

work on base erosion and profit shifting (BEPS) will provide a collaborative framework for developing appropriate reforms to international tax systems.

The analysis also points to the potential benefits of international co-operation to limit unintended tax relief for R&D (and its use in production) stemming from cross-border tax-planning, and possible inefficiencies arising from R&D support through tax credits and patent boxes.

Industries founded on knowledge-based capital create challenges for competition policy

Because competition is a key driver of innovation and growth, it is an important factor in the development of KBC-intensive sectors. **Chapter 3** addresses the question of whether competition policy is fully applicable in KBC-intensive markets and, if it is, whether it needs to be adjusted to account for differences between KBC-intensive markets and other kinds of markets.

Chapter 3 gives particular attention to the functioning of the "digital economy" (an umbrella term to describe markets focused on digital technologies that typically involve the trade of information goods or services via electronic commerce). The digital economy has brought new, rapidly expanding industries and business models. Indeed, never before have leading firms grown so large so quickly, and new businesses are challenging incumbents in novel ways. Claims of dominance and abusive or otherwise restrictive practices are frequent and have led to major legal disputes. Simply understanding how competition operates in the digital economy can be difficult.

Features of the digital economy that are especially significant for competition include: rapid change and constant innovation; the prominent role of IP in business strategies; economies of scale for information products; interoperability issues (given that many high-technology products are composed of complex systems of components that need to interface with each other and, in some cases, with external networks); and the importance of networks and the effects of network economies. Furthermore, many markets in the digital economy are global in scope. This can lead to jurisdictional or territorial difficulties. For example, in a given market it may be difficult to identify a physical entity that is legally representative of the party responsible for suspected anticompetitive behaviour. Moreover, an anticompetitive practice may affect several jurisdictions, thereby raising the question of which agency should take enforcement action.

When companies in the digital economy become very successful, many, even thousands, of other businesses may depend on their products or platforms. An example is Apple's iPhone and the thousands of software companies that have developed iPhone applications. As such companies can have huge market valuations, competition authorities may be tempted to focus on competition issues specific to individual platforms. However, unlike other sectors, the most meaningful competition in the digital economy may take place between platforms, which can be created by companies with very different business models. For example, Apple, Google, and Microsoft all compete in the market for mobile phone operating systems. Apple does not license its Operating System (OS) to handset manufacturers but reserves it for its own brand. Google offers handset manufacturers free licences to the Android system, while Microsoft licenses its mobile OS but charges users a fee. In such contexts, competition *among* platforms may be more important to innovation and consumer welfare than competition *within* platforms. It is important therefore that competition policy properly account for inter-platform competition.

Beyond the digital economy, it is clear that competition is central to innovation, even if discussion continues on the precise circumstances under which it has the greatest effect. OECD studies show that one of the most effective ways to boost business R&D is to eliminate unnecessarily anticompetitive product-market regulations (PMR). Indeed, the effect on business R&D of reducing these regulations could be greater than what has been achieved by reinforcing IPRs or by granting subsidies for private R&D. New OECD evidence – reported in **Chapter 1** - shows that a modest reduction in PMR in the energy, transport and communications sectors – corresponding to Germany's reforms in 2005, or the difference in regulation between Australia and Austria in 2008 – could result in a 5% increase in the stock of business R&D and a 3% rise in patents per capita in the long run. Product-market reforms can also increase incentives for firms to incorporate foreign technologies. Product-market regulations also affect the ability of successful firms to attract the complementary tangible resources needed to implement and commercialise new ideas. For example, as described in **Chapter 1**, reducing the stringency of regulations on business services from the high level in Italy to the OECD average (i.e. France) could raise the extent to which labour and capital flow to innovative firms by around 30% and 60% respectively.

While there is no clear consensus on the degree of competition that generates the most innovation, support is accumulating for the idea that the relationship is similar to an inverted "U", with moderate levels of competition stimulating more innovation than low or high levels. The great majority of enforcement activity by competition authorities occurs in relatively concentrated markets with low levels of competition that are likely to become less competitive in the absence of enforcement. The inverted-U theory implies that enforcement actions increase innovation by moving markets closer to moderate levels of competition. Effective enforcement of competition law stimulates innovation by protecting and encouraging competition in markets where there is the greatest potential for innovation to increase.

For knowledge-based capital, protection of intellectual property rights are a key framework condition

Various chapters of the book raise the issue of intellectual property rights (IPRs). IPRs afford legal protection of rights to intellectual property embedded in different types of KBC. These rights include patents (mainly new products and new processes), copyrights (mostly software, databases and artistic creation), trademarks (brand or logo) and design rights. Table 0.2 summarises the forms of KBC that can be protected by different types of IPR across OECD member countries (although the scope of protection varies from country to country. For example, patents can be used to protect business methods in the United States, but nowhere else).

The exact size of the IP marketplace is difficult to estimate, because most transactions are based on confidential agreements. However, trade statistics suggest that growth in the value of technology royalty payments is well above the growth rate of GDP. In the United States, active corporations reported gross royalty receipts of USD 171 billion in 2008, up from USD 116 billion in 2002 (see **Chapter 6**).

Table 0.2. The protection of knowledge-based capital by intellectual property rights

Type of investment	Legal forms				
	IPR				Other (trade secrets, contracts, etc.)
	Patents	Copyright	Design rights	Trademark	
Software	X	X	X		
Databases		X			X
Research & development	X		X		
Artistic originals		X	X		
Design	X	X	X		
Market research		X		X	X
Business process	X	X			X
Training					

Source: Clayton, UK Intellectual Property Office (unpublished).

The increasing importance of markets for intellectual property has also given rise to companies whose main activity is the monetisation of IP, principally through licensing. As **Chapter 6** describes, US data for this sector indicate total revenues of USD 20 billion in 2010, a 4% nominal increase from 2009, at a time of widespread economic contraction. Figures for individual EU countries indicate particularly high growth rates: in Germany, revenues of these businesses increased in current price terms by nearly 25% in 2010.

The primary aim of IP is to preserve incentives to innovate and to disclose innovation-related information by granting exclusive, but time-limited and scope-limited, rights to the use of a new product, process or artistic creation. In the case of patents, inventors are granted the right to prevent others from using their invention in exchange for public disclosure of technical information about the invention. Such public disclosure can be important for further technological advances, as follow-on innovators may learn from the patented invention. More broadly, IPR systems aim to encourage the creation of knowledge-based assets, create conditions for exploiting those assets, facilitate the diffusion of knowledge and ideas, and enable markets for funding innovation (for instance when patents serve as collateral or signals/certifications for investors).

However, there are now widespread concerns about the efficiency of IPR systems (Box 0.6). A number of OECD countries have begun comprehensive reviews of their IPR regimes, and debates on IPR have assumed new prominence in the economics press.

Box 0.6. Intellectual property rights - current policy concerns

There are significant differences countries' IPR regimes. Nevertheless, a number of themes recur in current policy debates:

- Fears, particularly in the United States, over the possible erosion of patent quality (notably the accuracy of the patent claim and whether the patent is genuinely novel or non-obvious). OECD data indicate that patent quality across the OECD area has eroded steadily over the last decade (with "quality" measured by indicators of patent family size, patent generality and whether the patent represents a breakthrough invention) (OECD, 2011). Deterioration in quality may in part result from patent offices being overwhelmed by the growing number of patent applications. Technological advances in areas such as computer programmes and telecommunications, as well as the growth in applications from emerging economies, have driven strong growth in patenting activity.

…/…

Box 0.6. Intellectual property rights - current policy concerns *(continued)*

- The rise of overlapping webs of IPRs, so-called "patent thickets". These may obstruct entry in some markets.
- The growing problem of so-called "patent assertion entities" (PAEs). PAEs are firms that do not make, own or provide their own products or services. Instead, they purchase patents and file resource-consuming lawsuits against companies alleged to have infringed those patents. They now bring the majority of US patent lawsuits, but are much less active in Europe. Examination of the impact of litigations prompted by PAEs – which tend to be in IT industries – has found evidence of a loss of social welfare and reduced innovation incentives.
- The extension of the patentable domain into the area of business methods. Overly broad patents, it is feared, could retard follow-on innovation, limit competition and raise prices through unnecessary licensing and litigation.
- Concerns over the effects on innovation and competition of specific operational features of patent systems such as patent disclosure notice (how well a patent informs the public of what technology is protected) and patent remedies (judicially awarded damages that should replicate the market reward that the patent holder loses because of patent infringement).
- In an ever more integrated global economy, the need to move to greater mutual recognition and compatibility of intellectual property systems internationally (for instance to ensure that examination decisions in patent offices treat local and foreign inventors equally).
- Concerns that while appropriate protection of copyright is crucial, digital technology makes enforcement extremely difficult. There are also fears that in an era of routine copying of text, data and images, copyright law may hinder the emergence of new kinds of Internet-based firms. It may also make scientists and other researchers reluctant to use text- and data-mining techniques.
- A broader concern that SMEs can face capacity constraints in their ability to negotiate intellectual property systems. Capacity-constrained SMEs may be particularly affected by cross-country differences in regimes and dispute resolution mechanisms.

The complementarity of patent protection and competition is highlighted by new OECD evidence of a positive relationship between the strength of patent regimes and the number of patent applications per capita, but only in countries with sound competition policies (see **Chapter 1**). Similarly, increases in patenting have a stronger association with MFP growth when anticompetitive product market regulations are lower, as it is easier to bring new ideas to market and exploit knowledge spillovers when barriers to entry are low. In sectors with higher patenting intensity, lower barriers to firm entry are also associated with higher allocative efficiency. However, while strengthening IPR increases the number of patents, it is unclear whether this reflects increased innovation or simply more widespread use of patents.

In addition to patents, the OECD's work on KBC also draws attention to the importance of design rights. Design rights protect aspects of a product's appearance (rather than its function). Differences across countries in the propensity to register design rights may reflect different legal traditions, culture and design rights systems. For instance, France and Germany have historically had more registration of designs than the United Kingdom (Moultrie and Livesey, 2011). Compared to the United Kingdom, Germany appears to be more aware of design-related intellectual property. The cost of enforcement also appears to be lower, and there is a general perception that courts will protect design rights. Infringement of design rights in the United Kingdom is dealt with

under civil law and, in contrast to Germany, does not include criminal sanctions. With its strong and relatively inexpensive legal enforcement, Germany also has many private initiatives to protect design. France has a simplified registration process for products with short product cycles.

Internationally, little systematic is known about the relative efficacy of different frameworks to protect design rights and provide incentives for investment in design. More analysis is needed to understand how differences among firms in terms of design registration affect differences in their economic outcomes. Much design investment is undertaken by small firms with comparatively limited capacities to enforce their design rights, a situation aggravated by the fact that the value of most individual design rights is relatively small. It would be important to understand how policy can enable designs to be monetised effectively, especially by small firms.

Governments must invest in better measurement of innovation, investment and growth

Chapter 4 focuses on the measurement of KBC. While KBC is central to growth, the development of international comparative data is in its infancy. Measurement of investment in KBC is rife with assumptions that require further testing and empirical refinement. Government support for proper measurement of KBC is needed to improve understanding of the sources of employment and productivity growth and the design of evidence-based policies. As **Chapter 4** describes, achieving consistent and high-quality estimates of investment for the assets that compose KBC will require sustained effort over many years. In this, there are several key challenges, opportunities and areas of progress, as briefly outlined here.

- In recent years, a number of international initiatives have estimated investment in KBC. Efforts to harmonise national-level estimates have led to the publication of comparable macro-level data under the INTAN-Invest umbrella for the EU27 countries plus Norway and the United States. At present, 34 OECD and non-OECD countries have reported estimates of aggregate investment in KBC based on a common framework.

- Uncovering the role of KBC in growth requires greater understanding of the investment behaviour of individual firms and industries. Efforts have been made to obtain industry-level estimates of KBC for 17 countries. While these initiatives provide policy-relevant information, they need to be scaled up and their comparability enhanced.

- A number of KBC-related assets have been overlooked in past definitional and measurement work. These forms of KBC – such as firm-specific training and design – are not included in official statistics. Plans exist to produce international measurement guidelines for design by 2014.

- The measurement of organisational capital (see Table 0.1) involves several assumptions. A main assumption relates to the share of management time used to effect lasting changes in a firm's productivity. In this connection, an experimental methodology proposed by the OECD has gone beyond a focus on managers, identifying the tasks of any employee that contribute to the long-term functioning of the business. As **Chapter 4** describes, this novel focus suggests that firms' investments in organisational capital may be almost twice as large as previously thought.

- The importance of organisational capital also depends on the number of years over which firms reap its benefits. The OECD has found that organisational capital is much longer-lived than previously thought. Firms expect such investments to yield benefits for on average 4 to 6 years in services and 7 to 10 years in manufacturing.
- Measurement of innovative property has progressed steadily in recent decades. However, for R&D there are a number of official data collections and distinct measurement approaches. The OECD has recently provided guidelines to facilitate international harmonisation and benchmarking.
- Measuring KBC by focusing on the cost of inputs, such as R&D, ignores the value of the output of R&D. To address this, measures of the "quality" of firms' innovative property – in particular the technological and economic value of patented inventions – have been constructed by the OECD using information contained in patent documents. Such indicators are generally comparable across countries and over time.
- Obtaining consistent industry-level depreciation rates for R&D investments has proved challenging, and there is no commonly agreed methodology. In the past, estimated R&D depreciation rates ranged between 12% and 29% for the business sector overall, and between 11% and 52% for specific industries. OECD work using patent renewal data suggests that R&D may be much more long-lived than previously thought, with an aggregate 8% annual depreciation.
- Assessing how KBC relates to productivity and growth also requires more refined information on asset prices, so as to accurately capture the quantity of the assets purchased. For instance, in countries and fields where specialised researchers are in short supply, an increase in R&D expenditures may simply reflect the higher salaries that firms might have to pay to retain researchers, rather than an increase in the number of scientists hired.

If measurement systems fail to keep up with changes in the knowledge economy, policy debate may focus on a few, easier-to-measure, indicators that do not reflect the rich variety of mechanisms that exist for producing, exchanging and using KBC.

Knowledge-based capital helps to capture value in global value chains

Chapter 5 examines the role of KBC in business engagement in global value chains (GVCs). The development of GVCs has changed the nature of global competition. Economies and firms no longer only compete for market share in high value-added industries. They increasingly compete for high value-added activities in GVCs. The value created in a GVC is usually unevenly distributed among its participants. The distribution of value is found to depend on the ability of participants to supply sophisticated, hard-to-imitate products or services. Increasingly, the supply of such products or services stems from forms of KBC such as brands, basic R&D and design, and the complex integration of software with organisational structures. Policy makers in OECD and many emerging economies understand the need to develop KBC so as to enter higher-value segments of GVCs. As the Secretary General of the China Industrial Overseas Development and Planning Association has remarked, "Our clothes are Italian, French, German, so the profits are all leaving China…We need to create brands, and fast."

The much-studied example of the iPhone shows how KBC can determine the geographical pattern of value creation in a GVC. The largest share of the value created by the iPhone accrues to providers of distribution and retail services in the United States and to Apple, mainly to its innovations in design, marketing and supply-chain management. For each iPhone 4 sold, at a retail price of USD 600, Apple earns around USD 270, while Korean firms supplying core components earn USD 80, and Chinese enterprises that undertake the assembly earn USD 6.5, a mere 1% of the total value.

New OECD research reported in **Chapter 5** also shows that a country's KBC is significantly and positively correlated with its export specialisation, particularly in industries that are skill-intensive and source many inputs from abroad. In other words, the more a country invests in KBC, the more likely it is to develop a comparative advantage in international trade in such industries. Among the different forms of KBC, the category "economic competencies" seem to have the largest impact on these results. Economic competencies are also among the types of KBC that are hardest to replicate. They include firm-specific skills such as management, brand equity and organisational processes and structures. Such forms of KBC are usually firm-specific, non-tradable and built up through in-house accumulation over time. Toyota provides an example of hard-to-replicate organisational capital. It excels as a global car manufacturer, owing in part to a deeply entrenched process of continuous incremental innovation – or *kaizen* – rather than radical innovation. It is estimated that Toyota implements around a million new ideas a year, most of them from workers. Other car manufacturers have found this system extremely difficult to duplicate, even though they have the financial resources to do so.

Knowledge networks and markets are growing, and better evidence must be generated for policymaking

As **Chapter 6** shows, rising investment in KBC and the unprecedented accumulation of information and IP rights have driven a widespread search for mechanisms to help individuals, businesses and organisations navigate increasingly complex innovation systems. Knowledge networks and markets (KNMs) comprise the set of systems, institutions, social relations, networks and infrastructures that enable the exchange of knowledge and associated IP rights. KNMs provide services ranging from facilitation of search and matching with relevant counterparties, to evaluation, implementation and enforcement of agreements. **Chapter 6** thus examines a range of innovation-specific institutions and policies relevant to the accumulation and use of KBC, and which are complementary to broader framework conditions (such as tax and competition policies).

There are several types of KNM and a number of approaches to classifying them. For instance, KNMs are typically thought of as being intended to facilitate the transfer of disembodied knowledge. But within this function, one may find KNMs ranging from searchable registers and repositories of existing data and information, to platforms for sourcing new solutions to *ad-hoc* problems and challenges (such as platforms for identifying consultants to assist with new R&D projects). Standard economic statistics are only beginning to encompass the market for ideas. In some countries, corporation tax data on licensing incomes provide evidence on the growth of knowledge markets that complements the picture emerging from a wide range of *ad hoc* studies and data on international transactions in IP. New statistical data on specialist IP firms and intermediaries show that the value of their services is relatively small in comparison with the investment made in KBC, but appears to be increasing. Comparison between the United States and European countries suggests that European markets are significantly less developed.

Several KNMs respond to challenges and opportunities arising from open innovation strategies adopted by firms. Survey data reveal that business innovation strategies are typically linked to specific approaches for knowledge sourcing and collaboration. Open sourcing strategies are not exclusive to R&D-active firms, but these firms typically exhibit a different pattern of collaboration as compared with other firms. A more complete description of business innovation strategies requires further evidence on how internally developed knowledge is used by other parties (an issue not addressed in most official surveys). The transfer of knowledge, even through the most "open" and "free" mechanisms, is critically dependent on the existence of enforceable IP rights, because these mitigate the risk that knowledge will be misappropriated.

As Chapter 6 describes, the IP marketplace has witnessed some important recent developments, including the emergence of patent assertion entities (sometimes known as "patent trolls") (see also Box 0.5). Government-sponsored IP funds, typically involving patents, are another addition to the range of intermediaries operating in the IP market place and to the portfolio of policy instruments being considered by public authorities. Their stated rationale differs across countries, although they have the common objectives of improving the valorisation of IP, addressing patent thickets and providing innovation actors with a defence against disruptive litigation. But the case for this type of instrument is by no means uncontested. The use of public funds to invest in IP titles and the alignment of this practice with international treaties should be scrutinised (if implemented at all).

Employee flows – such as flows of researchers and recent graduates - are crucial for accumulating and using KBC. As **Chapter 6** describes, understanding of the impact of institutions and regulations on job mobility, knowledge transfer and business innovation is still incomplete. New data sources will likely need to be combined with traditional measures to gain further insight on policy relevant aspects of knowledge transfer through people. Limited evidence exists, for example, on the legal enforcement of contractual practices restricting a former employee's ability to work for a competitor or set up a new business. Evidence presented in **Chapter 6** suggests that enforcement practices for such agreements vary significantly across OECD economies. A number of countries and regions place restrictions on the enforcement of non-compete agreements, a practice which some observers have linked positively to entrepreneurship and innovation in specific sectors. However, the impact of these agreements is likely to vary across economies with different labour market institutions and innovation systems.

Knowledge markets, in particular those involving intellectual property rights, are particularly complex objects of policy analysis. The concept of KNMs is probably too broad to be usefully considered as a single, all-encompassing object of analysis. A wide range of approaches, using diverse data sources and multi-disciplinary research strategies, are needed to fully grasp the implications of policies in this area. For each type of knowledge network or market, policy makers should concentrate on identifying original causes of market failure and evaluating the appropriate mechanisms for dealing with them.

Better corporate reporting of KBC should be encouraged

As described in **Chapter 7**, corporate reporting has been a subject of vigorous debate in recent years, and views diverge on how to enhance its quality and usefulness to investors, analysts and financial institutions. While attention has focused on integrated reporting and environmental, social and governance (ESG) reporting, better reporting of corporate spending on, and benefits from, KBC is also important to the broader debate on improving the quality of corporate reporting.

Nevertheless, in terms of practice, corporate reporting of intangibles appears not to have changed significantly in recent years. Indeed, despite the fact that the value of many of the world's most successful companies resides almost entirely in their KBC (or "intangibles", the term used in the accounting profession), corporate reports provide only limited information on this. Privately held companies have no obligation to report on KBC, nor do publicly held companies, except when recognition is required in the context of mergers and acquisitions.

Some evidence suggests that industrial sectors more dependent on external finance grow faster in countries with higher-quality corporate disclosure regimes (Rajan and Zingales, 1998). And in sectors more reliant on external finance, R&D expenditure as a share of value added also grows faster in countries with higher-quality corporate disclosure (Carlin and Mayer, 2000). In addition, enhanced disclosure of KBC, in a manner that is consistent across companies and countries, could have a positive impact on corporate performance by improving internal controls and risk management, raising the quality of strategic decision making and increasing overall transparency for shareholders and other stakeholders.

Given that the prevailing accounting standards do not generally require recognition of KBC (except in specific cases), reporting depends almost entirely on management's interest to disclose this information, most often through narrative reporting. As a result, KBC is often described qualitatively and generally not assigned any financial value.

As **Chapter 7** describes, a variety of approaches to the collection and disclosure of KBC data exist. Some have been developed by governments but most by the private sector (e.g. the Intangible Assets Monitor and the World Intellectual Capital Initiative). However, implementation is voluntary and has not been widely taken up.

While most market participants see the value of enhanced disclosure of KBC, the question of how this should be achieved remains contentious. Corporate reporting requirements have grown significantly in complexity and length in recent years. The overall volume of information reported needs to be reduced and presented in a manner that best reveals value-adding assets and processes. There are a number of steps governments might take to improve the current situation:

- Policy makers can support disclosure through recommendations and guidelines or by backing private-sector initiatives. To date, few OECD governments have introduced guidelines on this topic. As a result, company reporting follows different frameworks, which limits comparability and consistency.
- Progress could also be made by establishing expenditure classifications – i.e. standards for reporting KBC on companies' profit and loss statements – that would promote consistency in data collecting and reporting. This would require the development of standards for reporting spending on KBC to become a part of the Generally Accepted Accounting Principles (GAAP). New and globally accepted classifications would allow firms to categorise in a consistent way the items of KBC-related expenditure that are currently treated as intermediate expenditures of undefined type.
- Policymakers could establish support mechanisms to facilitate reporting. Such measures might include support to young enterprises, for instance through coaching for data collection and reporting.

- Governments might introduce frameworks for auditors that would provide more assurance about disclosure of KBC. Currently, auditors lack a framework to provide an opinion on KBC that cannot be recognised in financial statements.
- Policy makers can also engage in international co-ordination with a view to cross-country comparisons of companies.

Better policy can help create economic value from data

Chapter 8 examines the growing role of data as an economic asset. The explosive growth of the Internet and particularly of digital technologies such as mobile networks, remote sensors and applications such as smart grids, has created vast fields of information, often loosely referred to as "big data". Data are now processed, shared and transferred around the clock and across the globe. As **Chapter 8** describes, global data creation is projected to grow by 40% a year, compared with 5% yearly growth in worldwide IT expenditure. Combined with powerful data analytics, "big data" offers the prospect of significant value creation, social benefits and productivity enhancement. For instance:

"Big data" could be used throughout health-care systems – from clinical operations to payment and pricing of services and R&D – with estimated potential total savings of more than USD 300 billion for US health care by 2020 (MGI, 2011). Additional benefits could be had from innovations such as the formulation of timely public health policies using real-time data, for instance by assessing epidemiological trends based on the public's web-search behaviour.

- In public utilities, "smart-grid" technologies can generate large volumes of data about energy consumption patterns. Globally, it is estimated that the use of data-driven smart grid applications could cut more than 2 billion tonnes of CO_2 emissions by 2020 (GeSI, 2008).
- In the transport sector, the ability to track the location of mobile devices makes it possible to monitor traffic to reduce congestion and save commuter time, and to provide new location-based services. Overall, estimates suggest that the global pool of personal geo-location data is growing by about 20% a year. By 2020, such data could provide USD 500 billion in value worldwide in the form of time and fuel savings (MGI, 2011).

In addition to being a data source, the public sector is also an important data user. By fully exploiting public-sector data, governments could significantly reduce their administrative costs. Examining Europe's 23 largest governments, one source estimates potential cost savings of 15% to 20%, with the potential to accelerate annual productivity growth by 0.5 percentage points over the next decade (see **Chapter 8**). Additional benefits could be achieved by improving access to public sector information (PSI).

"Big data" is a relatively new theme on the policy agenda, and optimal policy has not yet been determined. However, it is clear that to unlock the potential of big data OECD countries need to develop coherent policies and practices for the collection, transport, storage and use of data. These policies must address issues such as privacy protection, open data access, infrastructure and measurement. It is also clear that there are mismatches between the supply of and demand for skills in data management and analytics (data science). Employees will be needed who can combine expertise in computer science, data analytics, experimental method and other disciplines.

Business investment in KBC amplifies the importance of appropriate human capital policies

Human capital is a key underpinning of KBC. For instance, software, which represents a large share of R&D spending, is essentially an expression of human expertise translated into code. Over half of all R&D spending goes to wages for researchers and technicians. And patents are a legal device for securing the intellectual property associated with innovations emanating from people's ideas. The rapid evolution of different parts of the KBC-intensive economy inevitably generates skills shortages. For instance, research in the United States suggests a shortfall of some 1.5 million managers and analysts with adequate understanding of the business benefits of data (MGI, 2011). As the recovery gains momentum, skills shortages may increase. To the extent that workforce skills can rapidly adjust, so as to complement new technologies, aggregate growth will be enhanced without greatly exacerbating income inequality.

In a context of highly constrained public finances, and in countries where educational attainment is already high, efforts to improve the quality of education will often be a priority. Particularly important are policies that balance skills supply and demand efficiently (the OECD's *Skills Strategy* sets out a comprehensive assessment of good practice in this area).

Partnerships between public bodies and private businesses provide an opportunity to foster and deploy KBC-related skills. A supply of skilled workers is necessary but not sufficient. Curricula must produce workers that businesses want to hire. Employers can help take responsibility for workforce development within their sectors and develop solutions to meet rapidly evolving needs. For instance, in the United Kingdom, Jaguar Land Rover has created a network from among a range of universities to deliver tailored courses in science and engineering for its staff, as part of the company's Technical Accreditation Scheme. The aim is to provide Jaguar's employees with access to "the best courses from the best sources".

KBC has profound implications for earnings inequality, creating a significant policy challenge

One of the challenges associated with the rise of KBC is earnings inequality. OECD analysis finds that skill-biased technological change is the single most important driver of rising inequalities in labour income (OECD, 2011a).

A KBC-based economy rewards skills. But it is not just an occupation's skill level that determines its substitutability by technology. Whether an occupation involves routine or non-routine tasks also matters (Autor, Levy and Murnane, 2003). For instance, high-skill jobs can be displaced if they involve routine tasks. And some low-skill jobs, such as those of janitors and drivers, involve non-routine tasks that have been hard to replace. However, technological change is progressively increasing the number of non-routine tasks that can be performed by machines and software. Driverless cars, for instance, will soon become widely affordable, and are already licensed in a number of states in the United States.

A KBC-based economy may also reward investors (who ultimately own much of the KBC) over workers (in the United States, for instance, wages as a share of GDP are at an all-time low). Furthermore, rising investment in KBC can create winner-takes-all opportunities for a tiny few. Digital technologies allow small differences in skill, effort or quality to yield large differences in returns, in part because of the size of the market that

can be served by a single person or firm. For instance, while average incomes of writers of fiction may not have changed greatly in recent decades, a select few can become multi-millionaires. J.K. Rowling is the first author to earn a billion dollars, with income from books, films and video games reflecting the fact that globalisation and digitisation allow words, images and products to be readily obtained worldwide. A related phenomenon is the widening of the distribution of productivity across firms, particularly in sectors with heavy investments in ICT, and where an early success can be ramped up quickly and at low cost (Faggio, Salvanes and Van Reenen, 2010).

Technological change does not automatically lead to a loss of employment. Greater cost efficiency can lead to total output growth. This might create enough employment to offset the reduction in labour needed to produce each unit of output. Significant efforts will clearly be needed to understand more fully the effects of KBC on employment, the demand for skills and the distribution of returns from production.

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