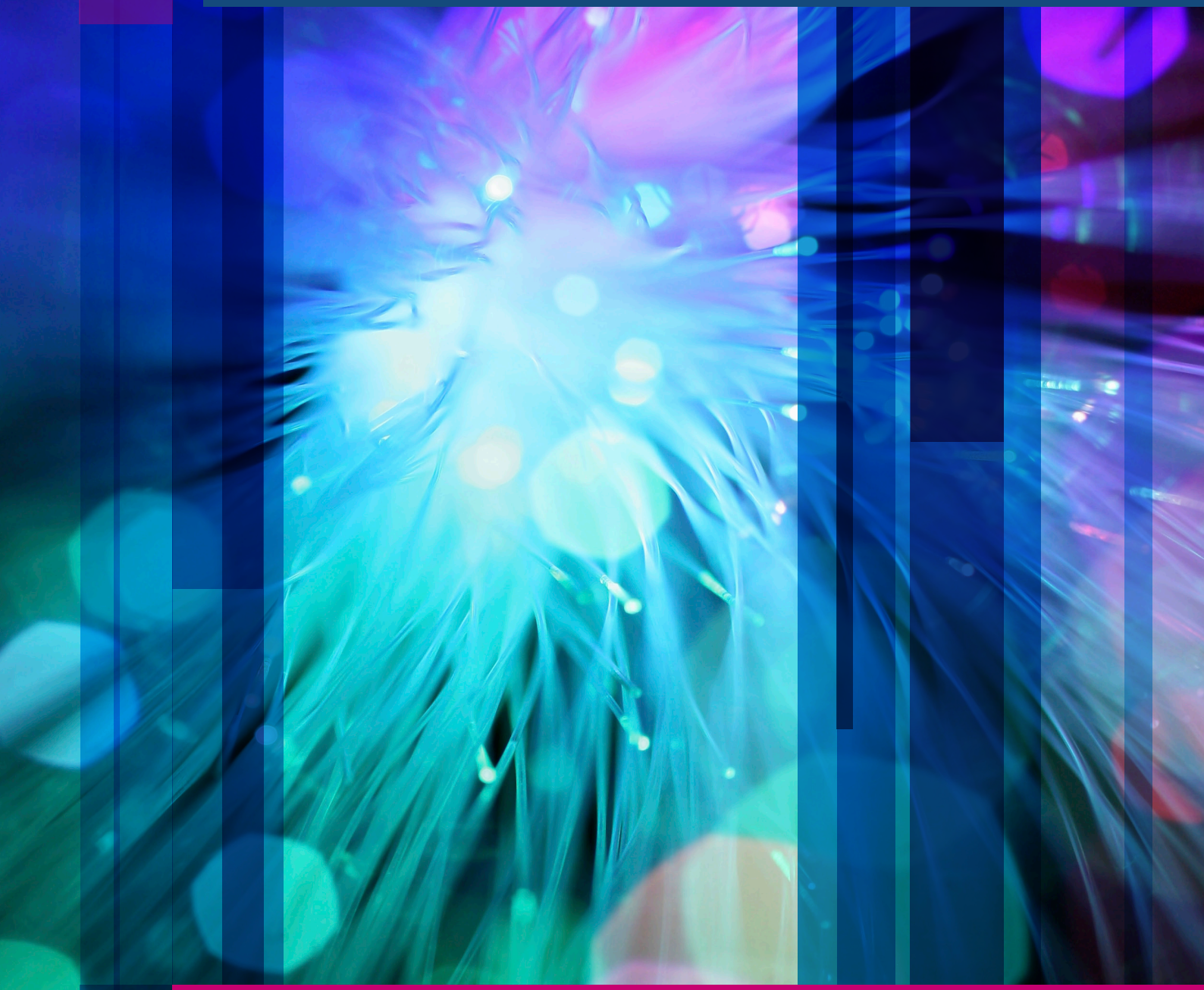
McKinsey&Company



Innovation matters

Reviving the growth engine

Innovation Capital is equivalent to

42% GDP

$14 trillion

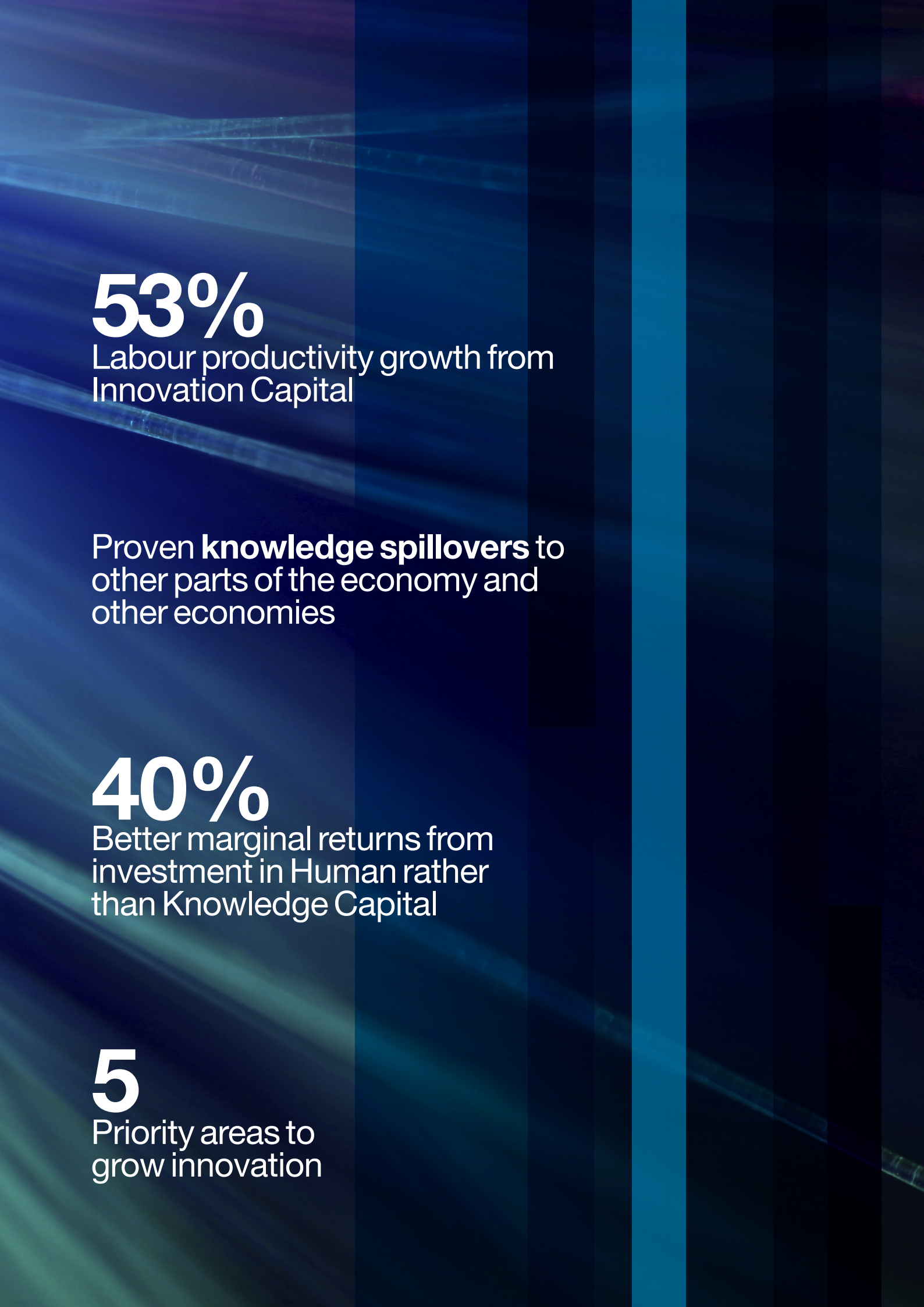
Size of Innovation Capital across 16 analysed countries

4.6%

Annual growth of Innovation Capital

23%

Innovation Capital represented by scientific R&D



53%
Labour productivity growth from Innovation Capital

Proven **knowledge spillovers** to other parts of the economy and other economies

40%
Better marginal returns from investment in Human rather than Knowledge Capital

5
Priority areas to grow innovation

Foreword

For most of the post-war period, productivity in European economies caught up with the US. In 1995 that all changed. As the internet became widespread, US productivity surged even as EU productivity slowed. Hitherto fledgling companies like Facebook, Google and Apple became household names. New start-ups captured the public imagination and traditional businesses, like newspapers and universities started to see the disruption of their long-established business models.

Fifteen years later, in the recovery from the Great Recession, Europe is again lagging. But the comparative picture has changed: as well as the US, China and India are the growth engines. Why did this happen? And what can be done?

As this report documents, at the heart of growth is innovation. But innovation does not come for free. It needs investment by firms in an accommodating environment. This report documents how different countries have made that investment, how it has contributed to growth, and what can be done to foster the process. Different countries will of course choose different routes to innovation and a single innovation size will not fit all. But, as the report shows, some common features of the economic environment will help.

We start by trying to understand innovation in modern economies. To do this, imagine an economy with no innovation. It could of course grow by simply hiring more of same labour, installing more the same machines and produce more of the same goods. This is growth by duplication, a strategy pursued by the USSR that rapidly ran into diminishing returns. Growth by innovation is different, for it relies on new ideas. Those new ideas fashion new goods, develop new business processes and find new ways of serving consumers. Innovation extricates firms and economies from the trap of diminishing returns to Physical Capital by commercialising knowledge or ideas capital.

That commercialisation needs investment. Perhaps the most studied and discussed investment in innovation is R&D. The huge contribution of scientific advance in societies is rightly emphasised, but commercialising new ideas typically needs more than just R&D. Thus this report tries to count the multiplicity of investment in innovation that firms undertake: in software, design, market research, training and new business processes. It also looks at spending by governments on public R&D and tertiary education in science, technology, engineering and mathematics (STEM) subjects.

This inclusive approach to innovation spending allows us to document better the investment underlying innovation. For the years 1995-2008 our data suggest the leading investor in most innovation assets is the US. But other countries excel too: countries like Finland and Sweden have invested heavily in R&D for example and the Czech Republic and Slovenia in ICT. We note too that R&D is not the only innovation investment that countries make: on our definition, it represents 23 per cent of total Innovation Capital built up over the period.

What can be done to encourage such innovation investment? Like all forms of investment, innovation spending needs some certainty and stability around property rights, taxation and the economic environment. But innovation investment raises particular policy issues. Because much of it is knowledge spending, intellectual protection will be crucial. Here a balance needs to be struck between protecting inventors who produce new knowledge so they can appropriate their investments and allowing follow-on innovators to use new knowledge in subsequent stages of development. And governments can also play a role by funding high-quality basic research and disseminating its results widely and by attracting and educating talented people can generate the next wave of innovations. The "innovation infrastructure" is a major contribution to growth and a key capability for firms and countries.

Economic growth is not a zero-sum game; in fact a growing global economy provides opportunities for all countries. Still, the developed economies of the G8 face a real competitive challenge as Asia, Latin America and Africa build their own economies and innovation infrastructures. We cannot predict where any particular innovation will originate, but we have shown in this report that creating a strong innovation infrastructure is crucial to restoring economic growth and vitality to the developed world.

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Executive summary

For the world's major economies, a return to steady growth is essential. But even matching the growth rates of the pre-crisis past will require an unprecedented increase in productivity over the next decade. And one of the most important ways to increase productivity is through innovation. In this paper, we quantify the importance of innovation in driving productivity growth and we set out the actions that governments and societies can take to support innovation. These actions centre on continuous investments that will build a country's "Innovation Capital".

Historically, economic measurements have underestimated the contribution of innovation to economic growth. When businesses invest to integrate databases and revamp business models, for example, the actual Physical Capital investments amount to no more than around 20 per cent of total costs. The remaining costs are for organisational changes and development of employee skills, but are typically treated in both firm and national accounts as expenses rather than investments. But growing literature and a body of opinion suggests the treatment of such investments needs to be wider than just Physical Capital[1].

To address this issue, we introduce the measure of *Innovation Capital*: the value of innovation-related assets that contribute to productivity growth in the economy. Innovation Capital has three components: Physical Capital, Knowledge Capital and Human Capital.

- *Physical Capital* is formed by investments in information and communication equipment and across the countries analysed* represents 16 per cent of Innovation Capital.

- *Knowledge Capital* is formed by investments that build firms' intellectual property and brand equity, including investments in computerised information, R&D and marketing investments, as well as relevant research in universities. It represents 60 per cent of Innovation Capital across the countries we analysed.

- *Human Capital* is formed by investments in building individual or organisational skills that drive productivity growth. This includes public and private investments in tertiary STEM education, employee-based training programmes and investments to develop organisational efficiencies (e.g., redesign of business processes or review of business models more broadly). Across countries analysed it represents 24 per cent of Innovation Capital.

There is a strong correlation between levels of Innovation Capital as a proportion of gross domestic product, and absolute labour productivity growth. Accordingly, Innovation Capital is an important driver of economic growth. In most selected countries it contributes to a significant part of business sector labour productivity growth.

Innovation Capital is also growing in importance, with an annual rise of 4.6 per cent from 1995-2008 in countries analysed, driven by strong growth in Human Capital (5.1 per cent), Knowledge Capital (4.1 per cent) and Physical Capital (5.8 per cent).

Innovation and value creation are driven by a variety of assets beyond R&D alone. In fact, analysis of macroeconomic data suggests that investments in building Human Capital generate higher marginal returns than those in Knowledge Capital. This may be because firms' investments in Human Capital go beyond the development

* *France, Germany, Italy, UK, US, Canada, Japan, Austria, Czech Republic, Denmark, Finland, Netherlands, Russia, Slovenia, Spain, Sweden*

of an employee's individual skills. Many of the resulting intangible assets are firm-specific – such as management, organisational structure, business processes – and are hard to replicate catalysts for translating knowledge into value.

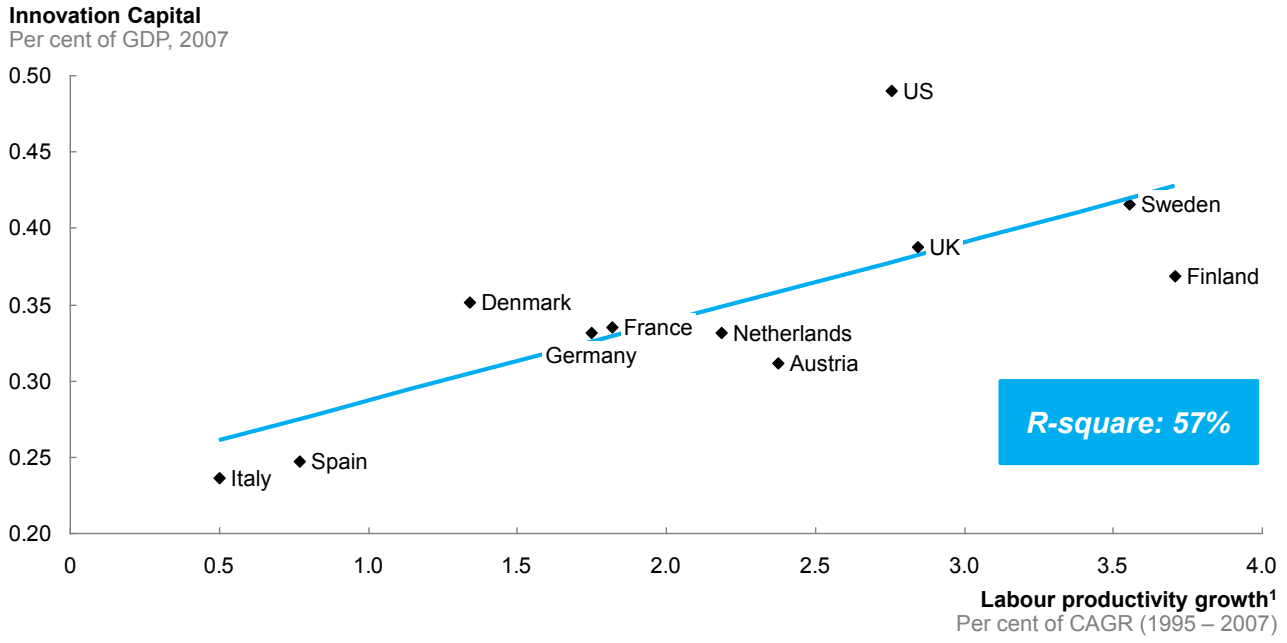
These higher returns do not imply that countries should, or need to redirect all their investments to Human Capital components. Depending on the prevailing economic structure of a particular country, the mix of investment across the components may vary significantly. For example, innovation in countries with a strong manufacturing base will be far more sensitive to scientific R&D investment than in countries with higher penetration of service industries.

In the latter economies, intangible investments in employee and organisational development tend to make a larger relative contribution to economic growth.

This broader view of innovation represented by Innovation Capital also has significant implications for governments and societies, as it affects a number of policies and existing efforts. Many existing policies and measurement systems are well suited for a world in which Physical Capital has primacy. In modern economies, the role of intangible assets has increased dramatically over the last two decades, suggesting that these policies and actions may need updating to reflect this new reality.

EXHIBIT 1

Innovation Capital has a strong correlation with productivity growth



1 2005 real prices

SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis

We believe that building a country's Innovation Capital requires a broad coalition of stakeholders—academics, industry, entrepreneurs, venture capitalists and government—to put in place actions across five priority areas:

Improve the quality of policies to promote innovation investments: discussion of the benefits of adopting a broader view of innovation is ongoing. Measures that would support this, and incentivise investments in the full range of Innovation Capital include:

- Liberalising barriers to international trade of knowledge and foreign direct investment;
- Increasing government incentives to science and R&D, both in terms of tax incentives and also research funds;
- Creating cross-border intellectual property protection systems that increase the efficiency of patent applications, speed up litigation resolutions and make effective trade-offs to allow for follow-on innovations;
- Reviewing of national strategies to accelerate the roll-out of ICT platforms;
- Promoting domestic market competition through overall deregulation of sectors.

Create a flexible environment for talent development and deployment: labour mobility is a crucial enabler to knowledge diffusion and critical for firms to pursue the most productive opportunities. Increasing the speed and flexibility of talent deployment within economies will require the review of employment protection legislation and programmes to balance skills supply and demand.

Encourage entrepreneurial activity: entrepreneurs are a critical force for creating innovation and translating ideas into value. In recent years entrepreneurship has been identified as a major driver of economic growth in both the United States and Western Europe. According to Paul Reynolds (Entrepreneurship scholar and creator of Global Entrepreneur Monitor), participating in new business creation is a common activity among US workers over the course of their careers: "by the time they reach their retirement years, half of all working men in the United States probably have had a period of self-employment of one or more years; one in four may have engaged in self-employment for six or more years". Among other levers removing barriers to entrepreneurship, increasing entrepreneurs' access to capital and scaling entrepreneurial training programmes can generate positive results. In Sweden, for example, the Entrepreneurship and New Business Development Programme provides training and mentorship support to entrepreneurs across multiple universities. This has contributed to the creation of 500 new businesses over the last 18 years.

Develop, shape and adopt disruptive technologies: governments can play a crucial role in the development of advanced technologies, both through the creation and funding of independent research institutes—such as DARPA in the US—and by being early adopters of these technologies. This enables investments in promising but nascent technologies that would typically be neglected by the private sector because of their higher level of risk.

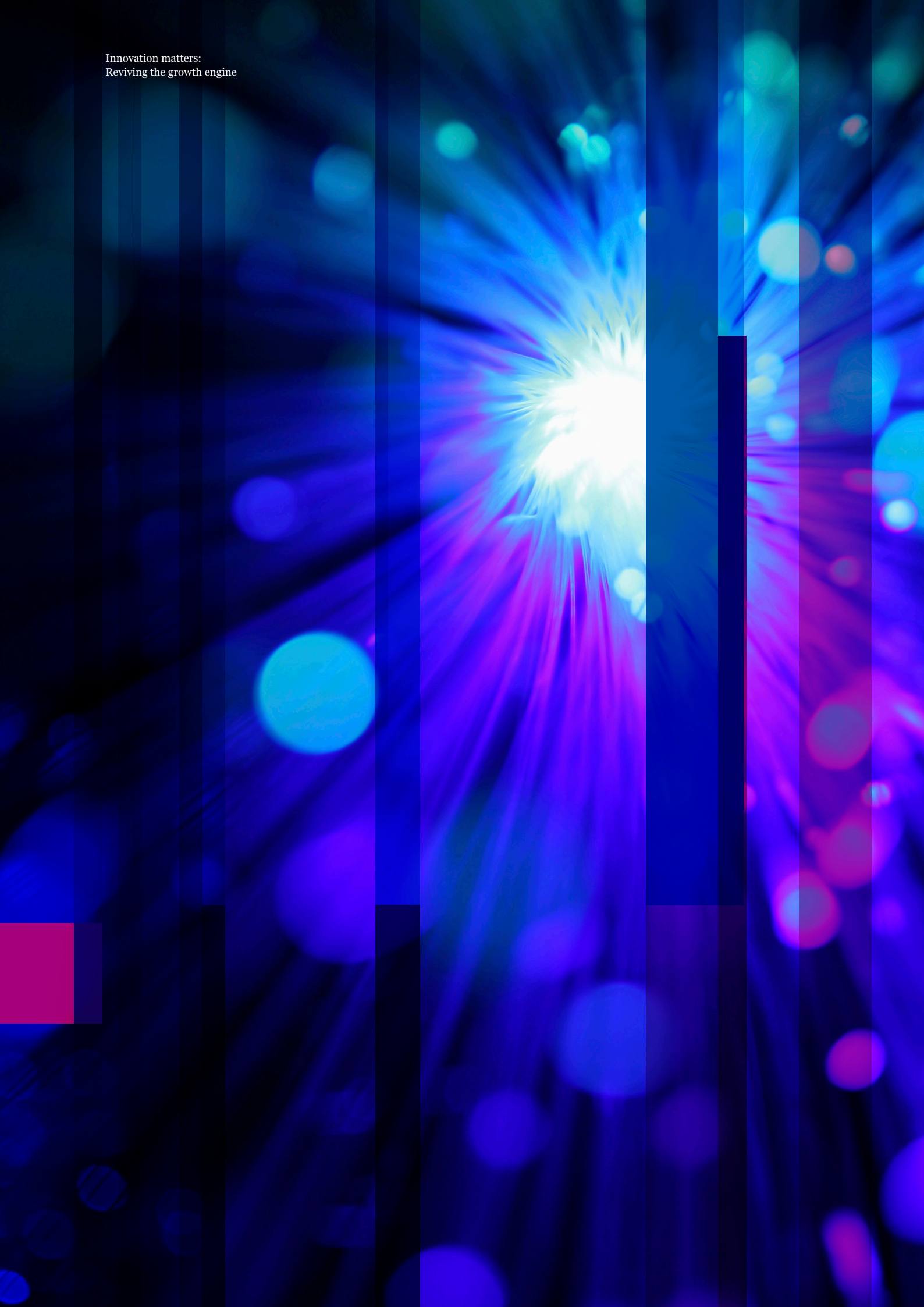
Protecting employability and entrepreneurship, not employment

Many traditional policy interventions in the labour market have attempted to protect the job a worker does by subsidising favoured sectors, imposing firing costs on firms that make jobs redundant or protecting particular industries from foreign trade. In open modern economies changes in industries and jobs are unavoidable and successful policy will have to recognise this. At the same time, new technology has enabled new start-ups that would hitherto have been too expensive. Thus, an important part of modern policy is to help support workers who choose entrepreneurship so that they can create the jobs of the future.

Foster collaborations and ecosystems: increasing collaborations between multiple stakeholders in the ecosystem is critical. One way of doing this is through the formation and development of innovation clusters within countries. Another way is to increase incentives for structured programmes, such as grants for joint university industry research. Our analysis indicates that Innovation Capital correlates well with INSEAD's state of cluster development index and university/industry research collaboration index.

How will we judge whether this report has succeeded? In our minds, there are two proofs of success. The first is that countries begin to use Innovation Capital as a measure. The second is if this work moves debate from insights to action. In other words, if we see more collaboration between governments, entrepreneurs, academics, businesses and other stakeholders to build their own and their countries' Innovation Capital – in a way that increases labour productivity and helps economies move back towards sustainable, responsible growth.

Innovation matters:
Reviving the growth engine



1. Innovation Capital can reignite growth in stagnating economies by driving productivity

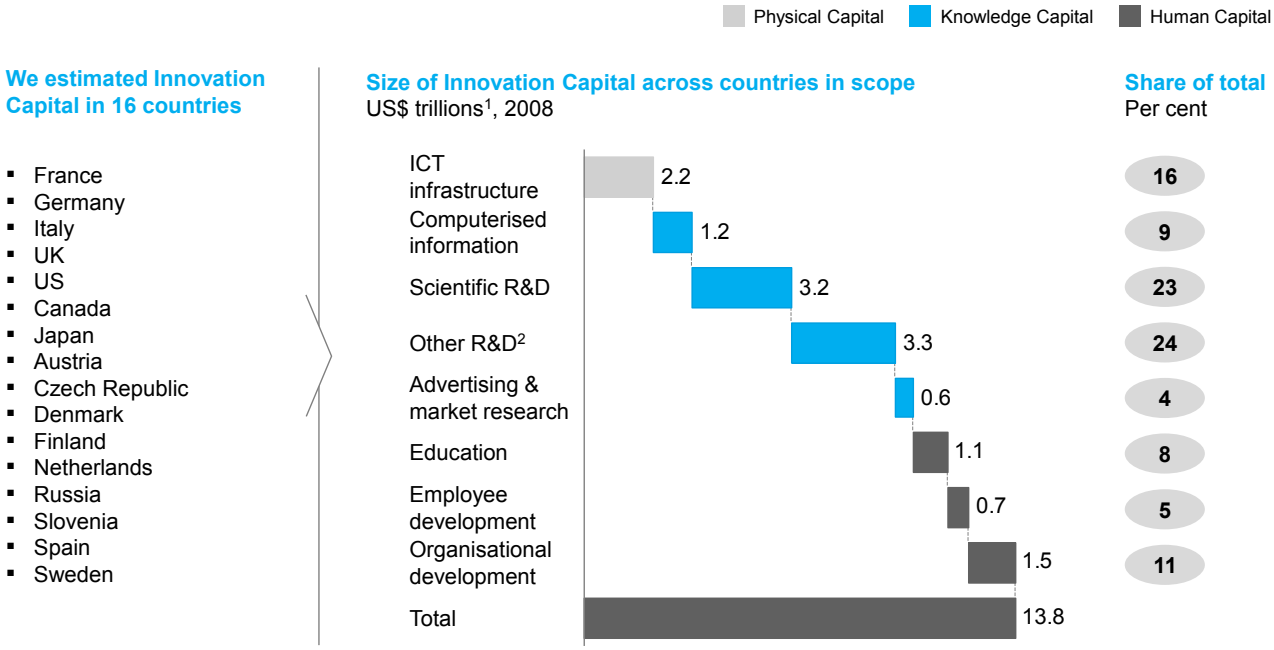
1.1 Innovation Capital is big

Once the full breadth of investments is taken into account, Innovation Capital amounts to US$ 14 trillion across 16 countries. This is equivalent to 42 per cent of their GDP (exhibit 2).

To compute the size of Innovation Capital, we built on work by Corrado, Haskel, Jona-Lasinio and Iommi (2012) and made contributions to their current work[2] by adding new components (please see full methodological note in appendix). Exhibit 3 summarises the complete list of assets that comprise our Innovation Capital measure and the rationale for their inclusion.

EXHIBIT 2

Innovation Capital has several major components



1 2005 real prices and fixed exchange rates
2 Contains research in architectural and engineering design, financial service research, mineral exploration research and creative and artistic originals

SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis

EXHIBIT 3

Components of Innovation Capital

☑ New additions to existing approaches

		Type of assets/spending	Definition	Rationale for inclusion
Innovation Capital	Physical Capital	☑ ICT infrastructure	Private and public investment in ICT infrastructure	New infrastructure built in addition to natural replacement of depleted assets contributes to improvements in business processes
	Knowledge Capital	☑ Software and databases	Private and public investment in gross fixed capital formation in software and databases	Software developed for own use or purchased drive changes in business processes and the way people do business
		☑ Scientific R&D (private and public)	R&D in all sectors minus R&D from mining, software, information and financial industries	Investments drive creation of new products and production processes
		Mineral exploration	R&D in mining and O&G industries	Investments drive discoveries of new reserves, which will then lead to exploration licenses
		Entertainment, artistic and literary originals	R&D in creative industry	Developments drive productions which lead to licenses and copyrights
		New architectural and engineering designs	Estimated as 50% of industry purchased services	Knowledge from new engineering and architectural designs have spillover effects in other innovations
		Product development costs in financial industry	Estimated as 8% of high skilled labour excluding bonus wage bill from financial industries	Development of financial products increases availability of capital to growing businesses
		Advertising and market research	Expenditure on market research and creative work to build brand equity	Developments in brand and knowledge of the market contribute to long-term value for firms
		☑ Venture capital Investment	Venture capital investments in early-stage firms	Venture capital investments contribute to the development of innovative firms and technologies
	Human Capital	☑ Education spend in STEM tertiary education	Cost of tertiary education in STEM	Education investment drives development capabilities required for professionals to innovate
		Employee development	Cost of developing workforce skills to drive changes in business processes	Investments in building workforce skills increase level of innovation in companies
		Organisational development	Management consulting and shares (16%) of management costs dedicated to business innovation	These investments result in improved decision making and business processes

SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis

1.2 Innovation Capital is an important driver of growth

Innovation Capital has been a crucial contributor to economic prosperity in developed economies. It drives productivity improvements and, in turn, overall economic growth.

Analysis of the relationship between Innovation Capital and economic development indicates that innovation directly contributed to 53 per cent of labour productivity growth in the period analysed. These productivity improvements enable us to do more with less; in other words, to create a greater quantity and value of goods and services per hour of labour in an economy. This could include the replacement of manual tasks by automated software or improved 'leaner' organisational processes leading to decreased waste during a manufacturing process.

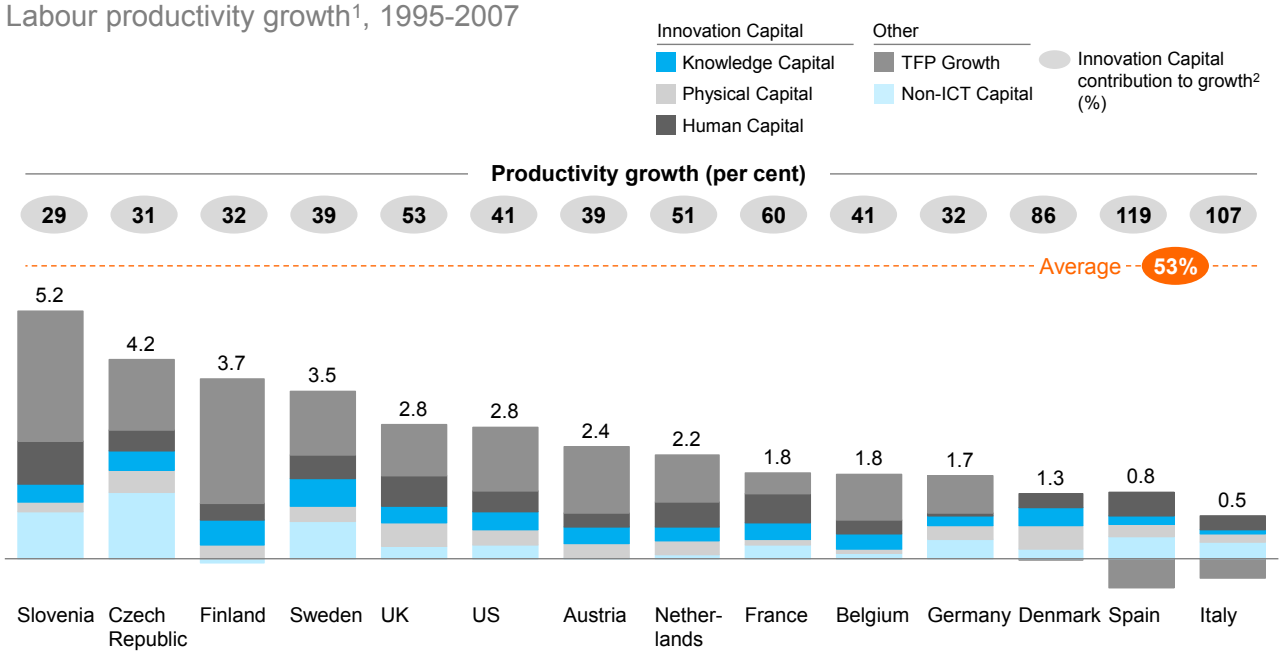
Exhibit 4 shows the breakdown of this impact by contribution factor from 1995 – 2007 across several economies*. We analysed five factors leading to productivity growth: non-ICT capital, ICT Physical Capital, Knowledge Capital, Human

* *Impact from a particular factor is measured as the proportion of business sector productivity growth that is driven by the increase in the relevant types of capital per hour, measured in percentage points. Total factor productivity is then computed as the residual value*

EXHIBIT 4

Innovation Capital investments directly contribute to 53% of productivity growth

Labour productivity growth[1], 1995-2007



1 2005 Real Prices
2 Share of GVA growth in Business Sector driven by Physical Capital, Knowledge Capital and Human Capital; breakdown does not include individual impact of government expenditure

SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis

Capital, and Total Factor Productivity (TFP) (please see full methodological note in appendix). While this analysis shows variation across economies, Innovation Capital investments have clearly been material contributors to productivity growth across the sample countries in the time series measured.

Countries such as Spain and Italy have experienced negative TFP growth . In the absence of this effect, the impact of Innovation Capital on labour productivity growth, for Italy in particular, would have been similar to Germany, Belgium, Austria and Finland, even given the different mix of investments.

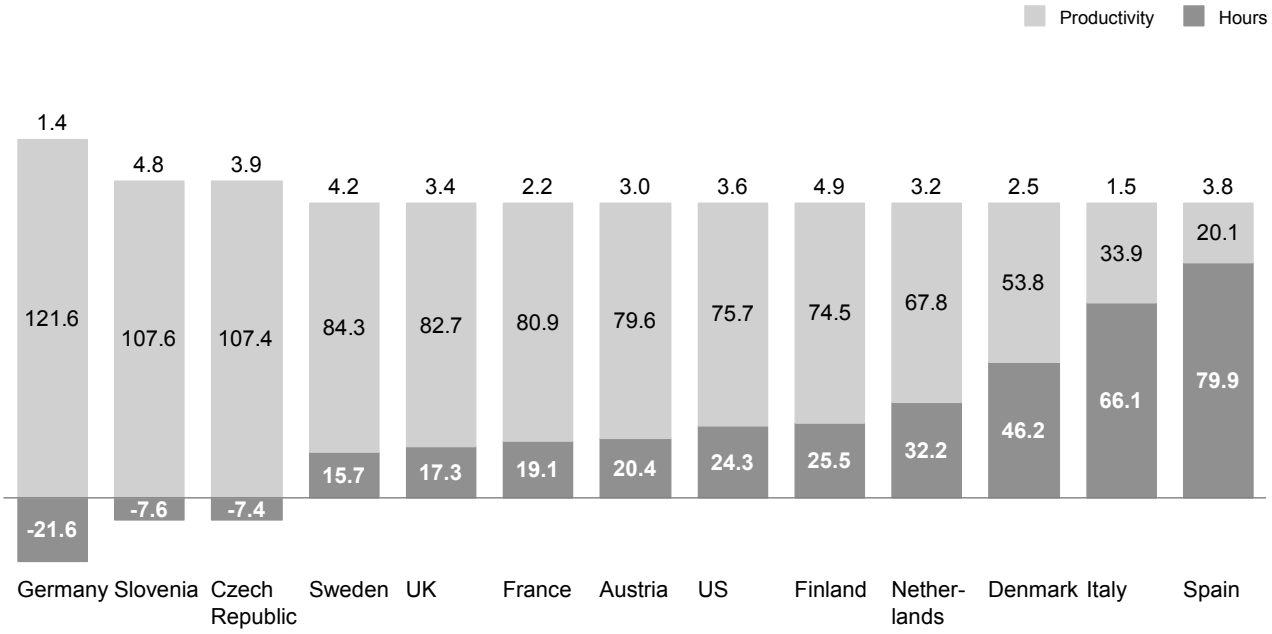
Over the last 20 years the role of productivity –and thus of innovation –as a driver of economic growth has increased in importance. In many developed economies, demographic shifts towards an aging population have limited the extent to which overall growth can be driven simply by an increase in total hours worked—in some cases, the hours worked have actually fallen. Consequently, most business sector growth in developed economies from 1995-2007 was in fact driven by improvements in productivity, not by hours worked (exhibit 5). This analysis shows that Innovation Capital is important. But these, already large, effects might actually understate the impact of Innovation Capital. Why?

Growth from more knowledge comes in two ways, direct and indirect. The direct impact is from firms who invest in knowledge and then appropriate the gains from that investment: perhaps via a patent, or a copyright or trade secret. The contributions in exhibit 4 measure only this direct component. But there is another, indirect effect,

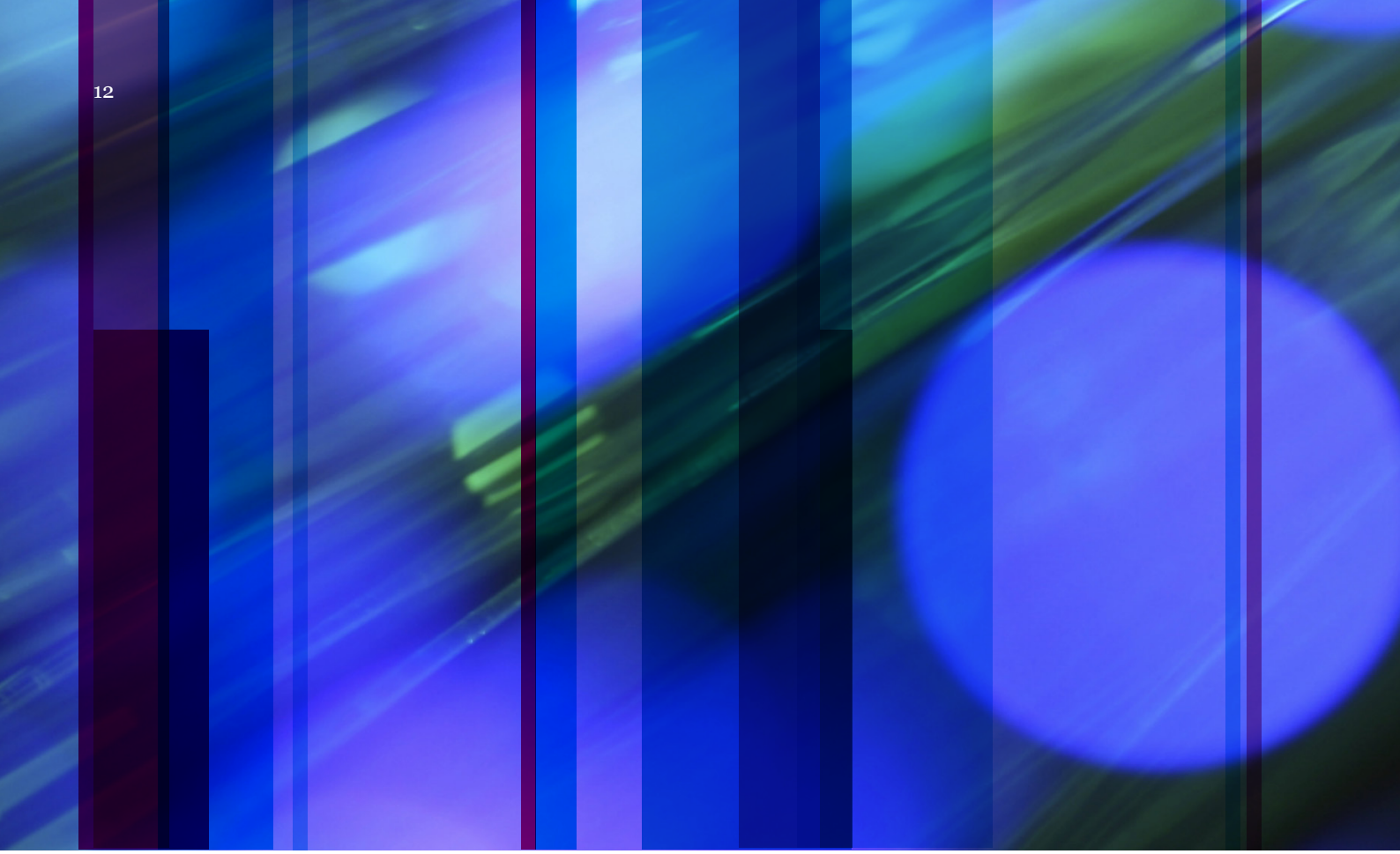
EXHIBIT 5

Most recent business sector growth in Europe was driven by improvements in productivity

Share of business sector GVA growth[1], 1995-2007



SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis



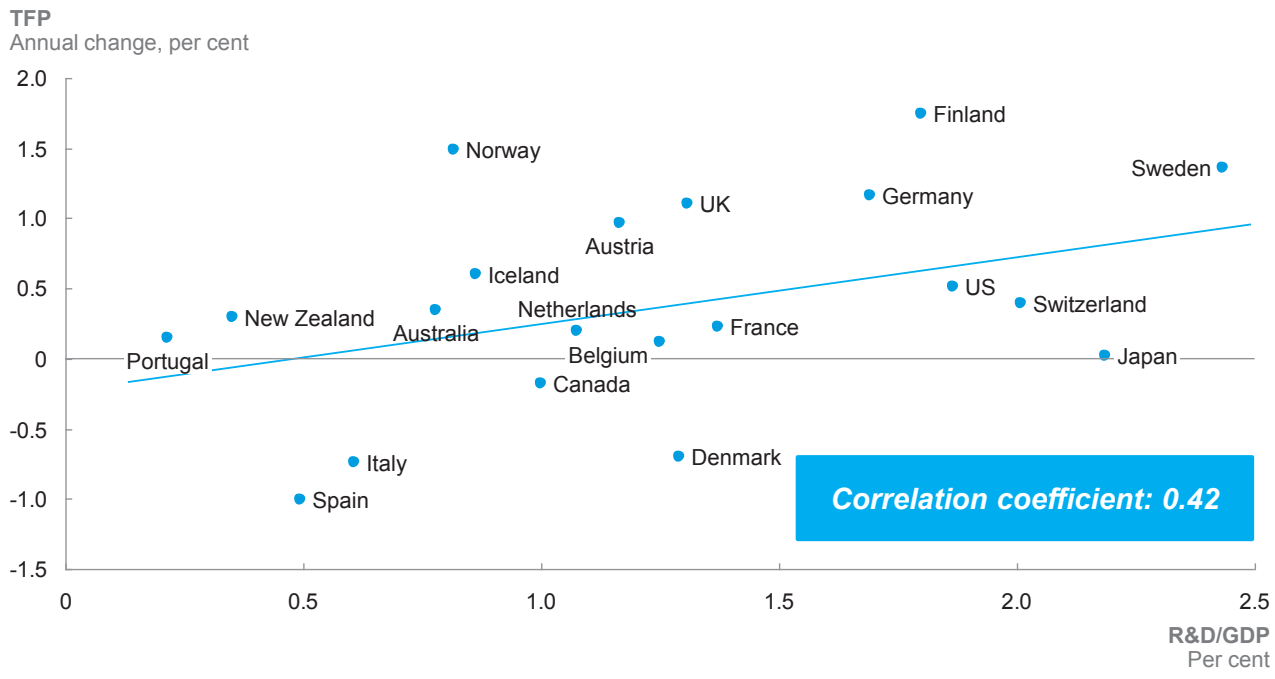
whereby knowledge raises output. This arises from firms who do not themselves invest in knowledge, but instead use the knowledge created by others. Many universities, for example, make new knowledge public for all firms to use. Sometimes institutional design supports free transfer of knowledge, for example, open source software. Or consider Apple's App Store: it creates value for its inventor, and also for a number of external developers who found that it offered a new route to market to make apps both possible and profitable. In short, innovation investments yield returns not only to those making the investment, but also to other parts of the economy.

How can we measure this knowledge "spillover"? Since firms are using inputs built by others, it shows up as new output over and above the new input. In exhibits 4 and 6 this is labelled as total factor productivity (TFP) growth. Of course such gains might be more than spillovers: perhaps sheer blue sky inspiration not based on any investment or spillover from foreign companies. But if such gains do reflect spillovers then we would expect that economies making more intangible investment would show more TFP growth. This is exactly what we see in exhibit 6, where the positive relationship shows that economies who invest more in R&D also have faster TFP growth. Of course knowledge investment is more than just R&D, but this graph suggests that the private investment of knowledge may very well "punch above its weight" in contributing to growth.

EXHIBIT 6

Higher R&D investments correlate with higher growth in TFP, indicating spillover effects from research into the broader economy

Business R&D investment and productivity (1986-2008)



SOURCE: OECD Science, Technology and Industry Scorecard, 2011; OECD Productivity Database and OECD calculations based on Johansson et al. (2012); Corrado et al. (2012)

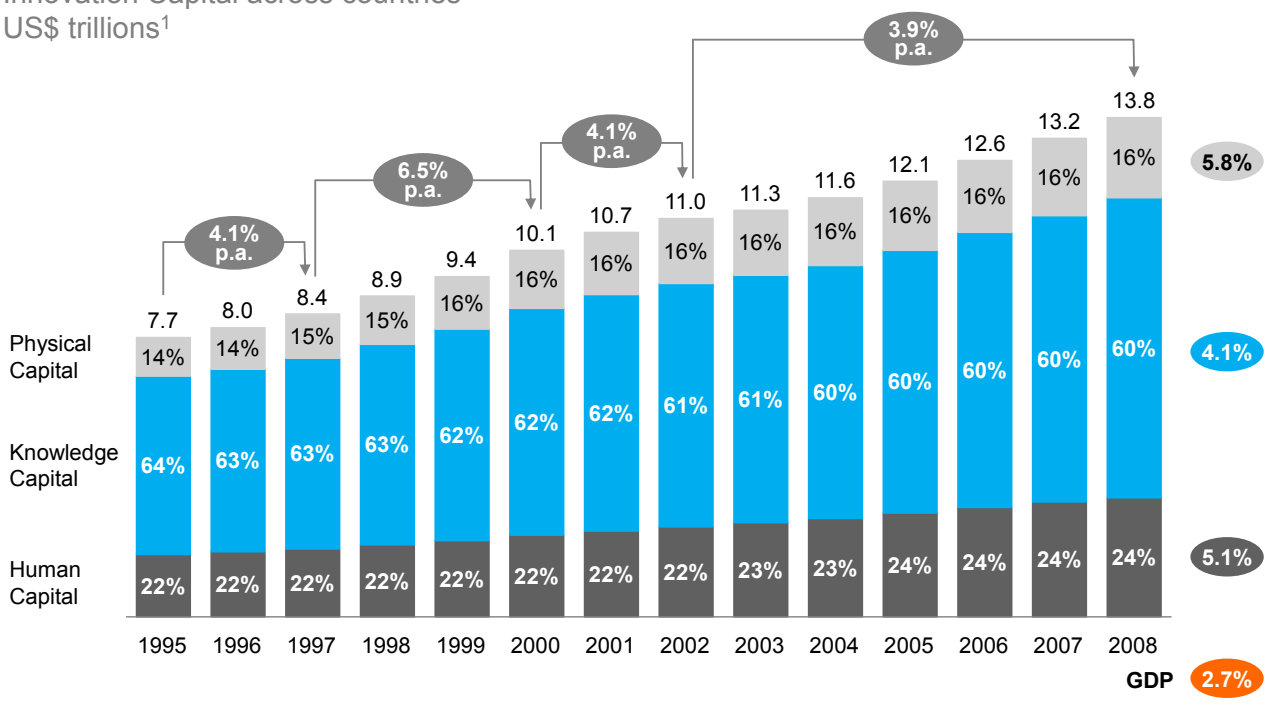
1.3 Innovation Capital is growing

While Innovation Capital is already large it is also growing significantly, showing a 4.6 per cent annual growth, from 1995-2008 in OECD countries analysed. This is driven by strong growth in Human Capital (5.1 per cent), Knowledge Capital (4.1 per cent) and Physical Capital (5.8 per cent) (exhibit 7).

EXHIBIT 7

Innovation Capital has grown at 4.6% CAGR

Innovation Capital across countries
US$ trillions[1]



1 2005 real prices, 2005 fixed exchange rates

SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis

1.4 Innovation Capital size, mix and growth varies considerably across countries

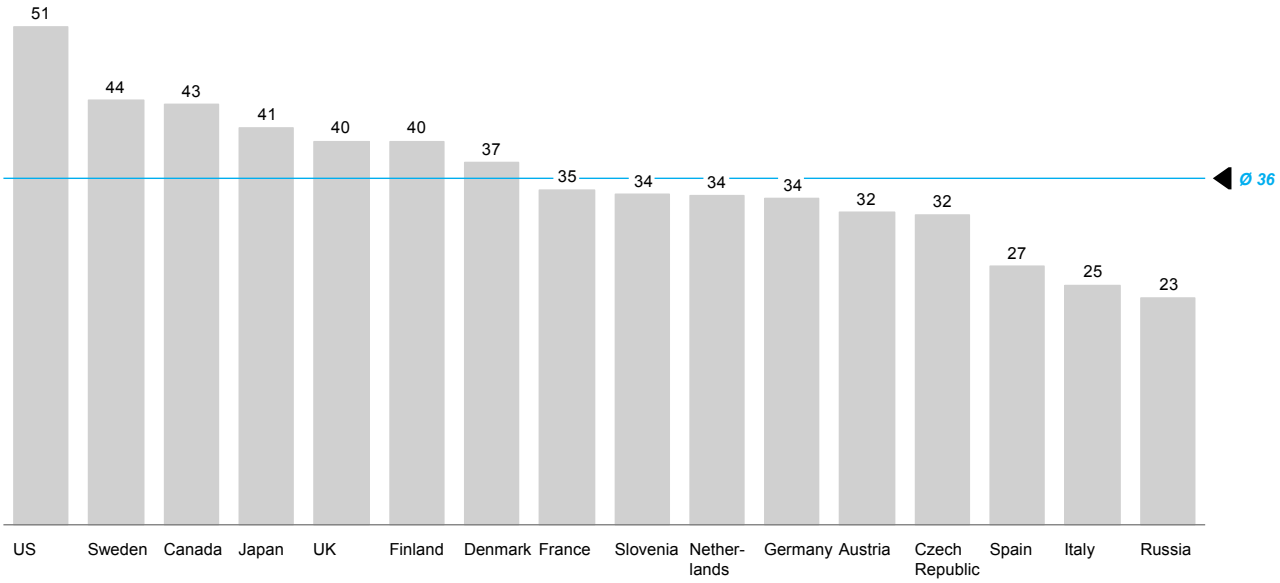
The size and mix of Innovation Capital relative to GDP vary considerably by country, to some extent reflecting their economic structure. Assessing different countries leads to a handful of important insights:

- The US stands out as a powerhouse when it comes to the scale of its Innovation Capital, ranking in the top three for most of the components.
- The UK and Canada also present high levels of Innovation Capital and rank particularly highly in Human Capital components.
- Economies with a substantial manufacturing tradition – such as Japan and Germany – show higher penetration of scientific R&D and design compared to other components.
- Smaller, highly-innovative economies – such as Finland and Sweden – rank well in many of the components, but particularly in computerised information and scientific R&D.
- Italy and Spain show low penetration of Innovation Capital, highlighting opportunities to invest in innovation as a way of supporting growth (e.g., in tertiary education in

EXHIBIT 8

The USA has the highest Innovation Capital as a proportion of GDP among our data set

Innovation Capital,
Per cent of GDP



SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis

Italy) and closing the productivity gap. In Italy, part of the explanation for a lower investment into R&D (scientific and other) may be due to Italy's economic structure, being dominated by micro and small companies (99% companies are below 10 employees). Interestingly, analysis of public investment into R&D suggests that in this area, Italy is fairly aligned to the EU and US.

- A handful of more emerging economies such as the Czech Republic, Slovenia and Russia still show a lower penetration of Innovation Capital relative to their GDP. However, this picture may change in coming years. Slovenia and the Czech Republic, for example, have invested particularly heavily in ICT and branding.

Innovation Capital growth also differed across countries. Spain and Scandinavian countries the highest growth rates (exhibit 10), but these regions had very different starting points. While Spain has one of the lowest Innovation Capital levels in the analysed country set, Sweden ranks second with a stock size equivalent of 44 per cent of its GDP. Interestingly, Germany and Japan's growth rates grew the least among the country set, potentially driven by the concentration of their investments in scientific R&D and their high starting points.

EXHIBIT 9

Innovation Capital as a proportion of GDP varies significantly across individual components and countries

Share of GDP for components of Innovation Capital, 2008
Per cent

Top 3 ranking

	ICT	Computerised information	Scientific R&D	Other R&D	Advertising & market research	Education	Employee development	Organisational development
US	7.6	3.6	11.9	14.1	2.1	4.2	2.5	5.5
UK	6.1	5.3	6.2	7.4	1.8	2.4	2.6	7.8
Canada	5.9	3.1	7.1	10.1	1.4	5.4	0.6	9.9
Japan	7.4	5.1	11.3	10.9	1.2	2.7	0.7	1.8
Germany	5.6	2.4	10.8	5.3	1.4	2.7	2.4	3.3
Finland	7.3	4.0	12.2	5.3	1.3	4.5	1.4	3.6
Sweden	4.4	6.4	15.2	6.4	1.3	3.5	1.8	4.9
Denmark	6.9	6.2	8.4	5.7	1.4	3.1	3.2	2.4
Italy	6.7	2.1	3.8	4.7	1.6	1.8	1.4	2.6
Spain	8.0	3.2	3.6	5.1	1.6	2.6	1.0	1.7
Czech Republic	6.4	2.3	4.8	8.3	3.0	2.1	1.4	3.7
Russia	3.9	0.5	3.3	8.0	0.9	3.0	1.2	2.7
Slovenia	8.0	2.2	5.0	9.1	2.3	2.0	1.7	3.8
Austria	5.6	2.6	9.2	4.1	1.4	3.4	1.9	3.9
France	3.3	4.5	8.2	6.5	1.3	3.6	2.4	4.9
Netherlands	6.9	3.9	5.5	6.2	1.9	1.9	2.3	5.5

SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis

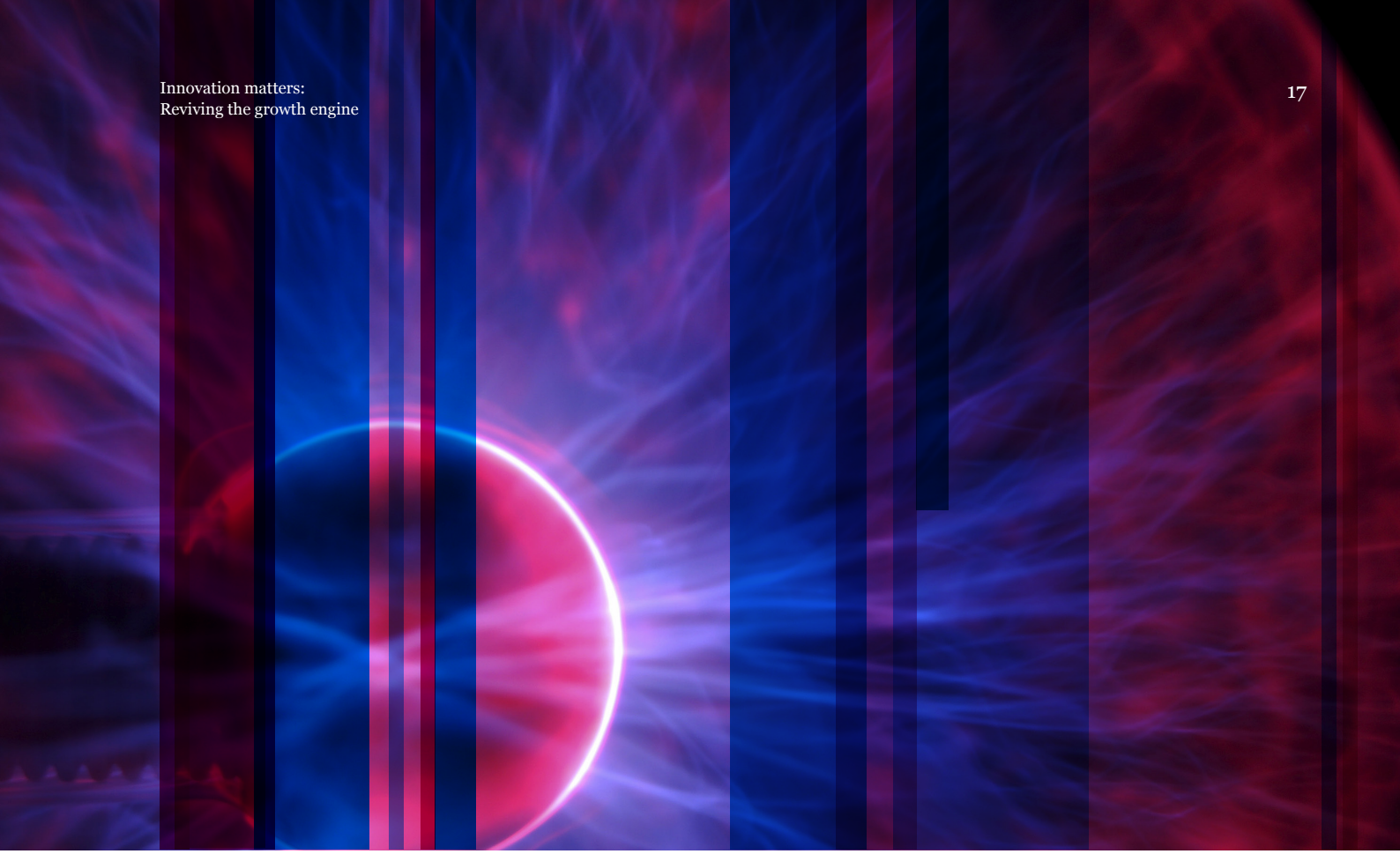
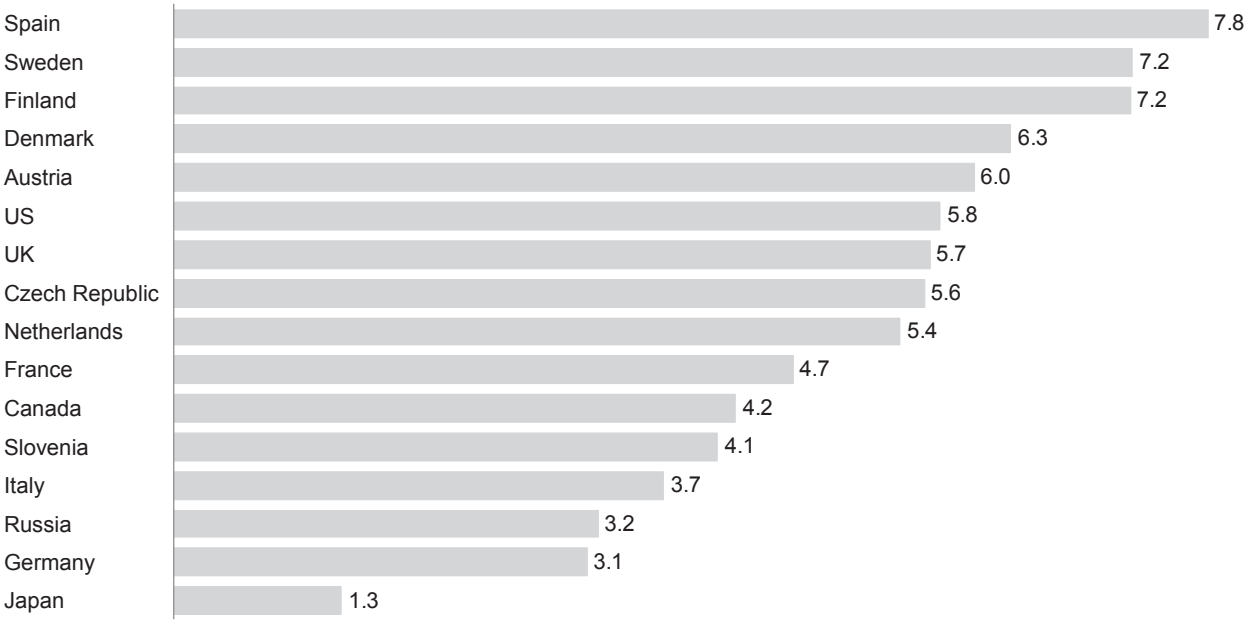


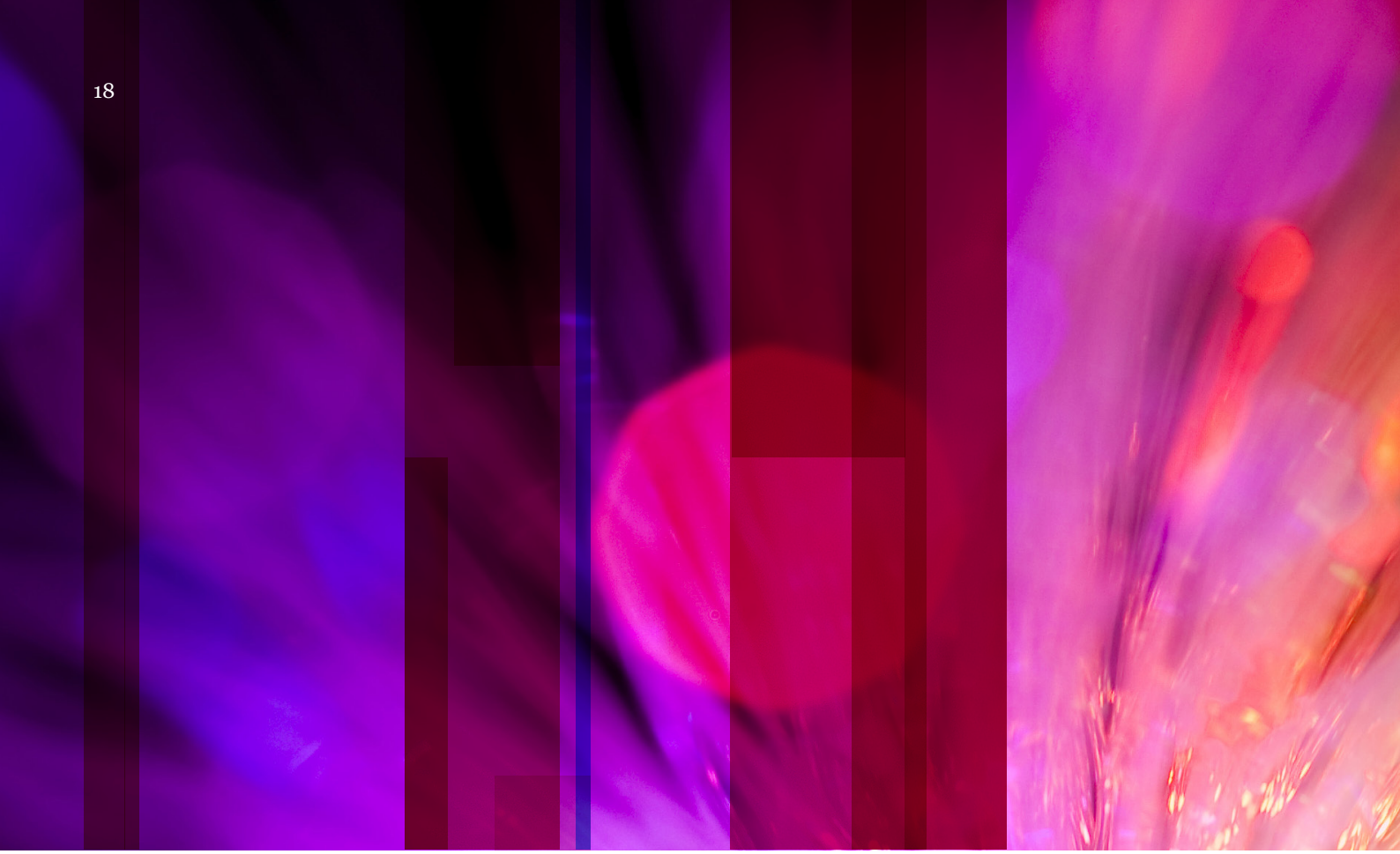
EXHIBIT 10

Spain and the Scandinavian countries have seen the fastest growth rates in Innovation Capital

Innovation Capital growth trend
Per cent CAGR, 1995-2008



SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis



1.5 Investments in Human Capital can yield better returns than in Knowledge Capital

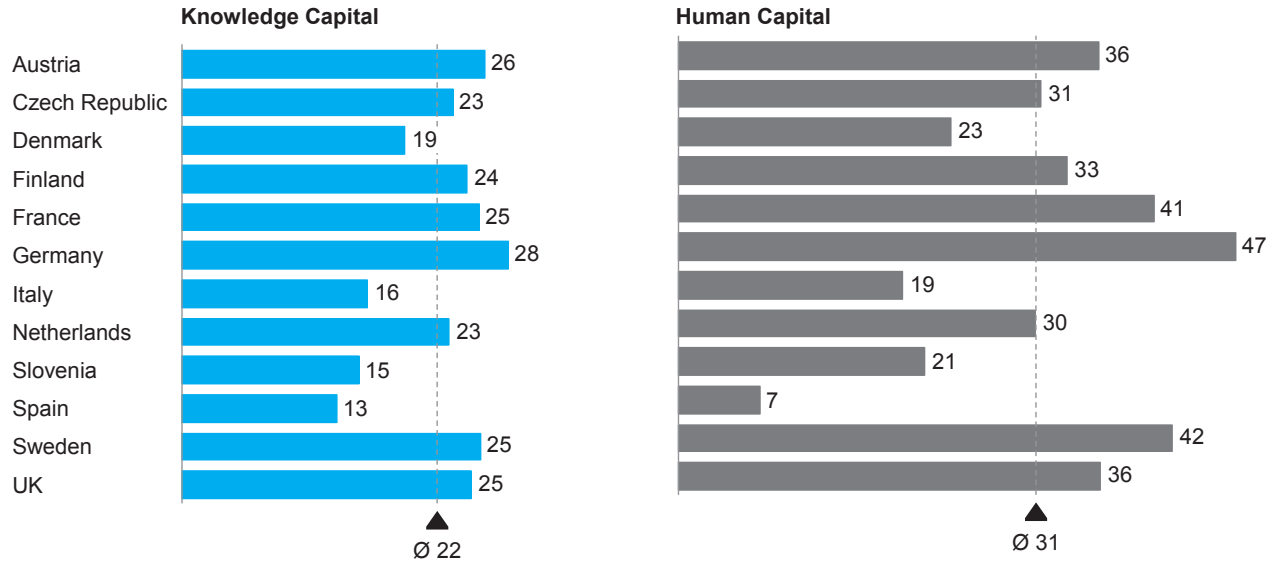
We have shown that Innovation Capital is an important driver of economic growth. In order to look at the relative efficiency of each type of investment, we computed the marginal return on innovation investments. The results show that on average, investments in Human Capital generated higher marginal returns than investments in Knowledge Capital over the same period (exhibit 11).

This higher relative return may appear surprising. However, investments in Human Capital are associated with the development of firm-specific capabilities such as management, organisational structure, business processes and models. These investments result in assets that are hard to replicate. They lead to an important competitive advantage for the firms who build them, thus resulting in higher marginal returns. Moreover, without sufficient investment in Human Capital, any potential gains from Knowledge Capital may be difficult to capture. This is because talent is required to extract the full value of new products and services.

EXHIBIT 11

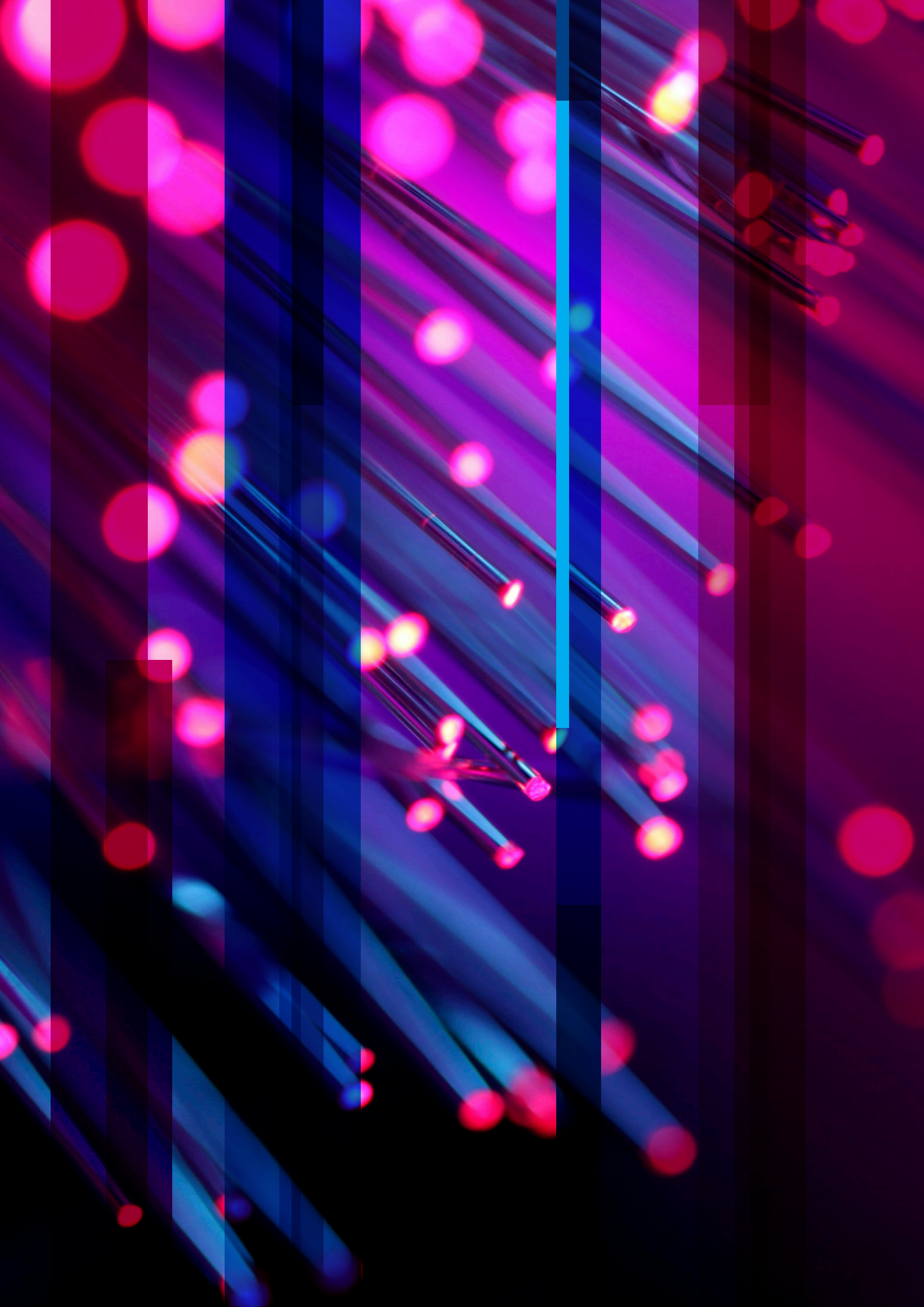
The highest rates of return tend to be in Human Capital components

Marginal return over Innovation Capital components by category[1]
Per cent CAGR for 1995 – 2007



1 Estimated as incremental value in GVA driven by individual components as calculated by the growth accounting method divided by cumulative investments in each component net of depreciation

SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; McKinsey analysis



2. The secret of accelerated Innovation Capital development

This broader view of innovation has important implications for all stakeholders in the innovation ecosystem. From a public perspective, many existing policies and measures are well suited for a world in which Physical Capital had primacy. But in modern economies, the impact of intangible (i.e., Knowledge) Capital on economic growth, has increased dramatically over the last two decades. This suggests that several aspects of countries' innovation infrastructure may need updating.

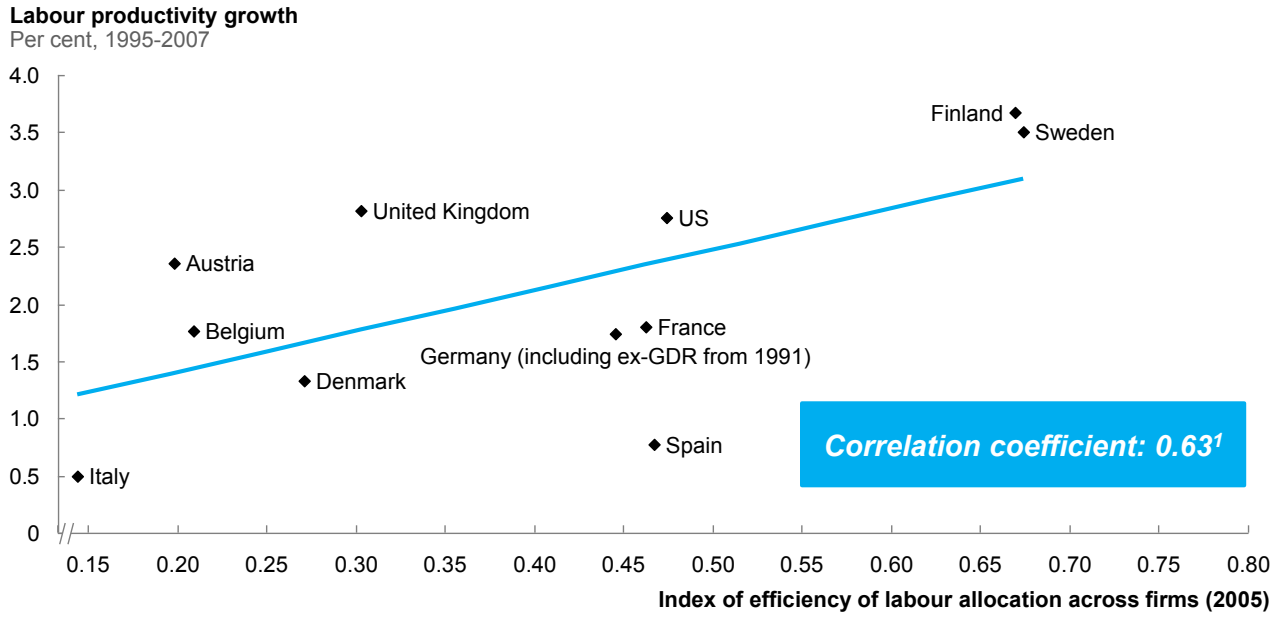
Countries with well-designed innovation infrastructure have put in place concrete actions and policies that facilitate flexible reallocation of tangible and intangible resources across and within firms. In fact, countries with more efficient allocation of resources across firms tend to achieve higher labour productivity growth (exhibit 12).

From a private perspective, corporations have a real role to play in supporting to develop talent and an entrepreneurial culture. This requires longer-term vision and planning – this can be somewhat a challenge for corporate board rooms which typically have a short-term mentality.

In this section, we layout the major components of Innovation Capital and how they can be influenced through a variety of actions (exhibit 13).

EXHIBIT 12

Labour productivity correlates with efficiencies of resource allocation across countries



SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; Andrews and Cingano (2012)

Two messages are immediately clear. First, successful action to promote innovation requires both 'hard' and 'soft' contributions – on the one hand, the alteration of policies or direction of investment; on the other, training programmes and the promotion of innovation clusters to foster entrepreneurship. Second, success on these actions requires a concerted effort across multiple stakeholder groups – not just between government and business, but involving academic and entrepreneurial contributions also.

EXHIBIT 13

Our levers require the involvement of multiple stakeholders and their impact cuts across the dimensions of Innovation Capital

Leading role ● Contributing role ◐

			Major Innovation Capital contribution			Leading stakeholders			
	Category	Actions	Physical Capital	Knowledge Capital	Human Capital	Government	Academia	Corporations	Entrepreneurs
1	Improve the quality of policies to promote innovative investments	▪ Facilitate trade of knowledge and foreign direct investment	✓	✓		●			
		▪ Science and R&D policies that spur innovation		✓		●	◐		
		▪ Effective intellectual property rights protection		✓		●			
		▪ Digital policies enabling robust deployment of ICT	✓			●			
		▪ Promotion of domestic market competition	✓	✓	✓	●			
2	Create a flexible environment for talent development and deployment	▪ Review of employment protection legislation			✓	●			
		▪ Balancing skills supply and demand			✓	◐	◐	◐	
3	Encourage entrepreneurial activity	▪ Eliminate barriers to entrepreneurship		✓	✓	●	◐	◐	◐
		▪ Increase entrepreneurs' access to early stage capital		✓	✓	●	◐	◐	
		▪ Scale-up training programmes in starting a business			✓	◐	◐		◐
4	Develop, share and adopt disruptive technologies	▪ Create institutes and offer funding to research disruptive technologies	✓	✓	✓	●	●	◐	
		▪ Orient government procurement to promote innovation investments	✓	✓		●		◐	
5	Foster collaboration between different parts of the ecosystem	▪ Nurturing the cluster – securing the talent base	✓	✓	✓	◐	◐	◐	◐
		▪ Sustaining the cluster – sowing the seeds of reinvention	✓	✓	✓	◐	◐	◐	◐

How Innovation Capital is embodied in the iPod

Many of the most successful innovations draw upon all three of our Innovation Capital components, combining advances in physical infrastructure, cutting-edge research, and the skills and ideas of highly-capable talent.

The development of the iPod provides a clear illustration of this. While the first mp3 player was developed by German laboratories, it was Apple that turned it into a successful mass market product. What had previously been a niche product came to disrupt not only the portable music player market but many related industries: the iPod transformed the ways in which people sell, find, purchase, and share music.

Part of this success came from the iPod's technical strengths. It could store far more tracks than most existing products, and download them far faster from a desktop. But the strengths of the product went beyond this. The product design – minimalist, with distinctive white headphones – set it apart from the button-heavy black and grey of most other electronic gadgets. And the user experience was more sophisticated than that of most competitors, using a scroll wheel for users to navigate their music libraries, and a relatively seamless link between their purchases, downloads, and the device itself.

Seen through the lens of Innovation Capital, the iPod's development rested upon investments across components. For example:

Physical Capital
- Investments in ICT facilitated the migration of music distribution to online channels. Both the shift towards broadband internet in many developed markets, and Apple's own ICT infrastructure were essential for the end product to take root

Knowledge Capital
- Design investments underpinned the look and feel of the product, which contributed to much the appeal it held with customers
- Investments in advertising enabled the creation of what is now one of the world's strongest brands. While Apple already enjoyed a strong following among designers and developers, it was the iPod that turned it into a broader, consumer brand

Human Capital
- New business and organisational capabilities had to be built, both for manufacturing and distribution. On the latter, Apple had to build capabilities to pull together the latest creative work from the music industry and quickly transfer it to customers
- Finally, none of the above could have succeeded without a strong base in Human Capital – both from investments Apple made itself and from the economies in which it was situated. The development of iTunes, for example, required not simply a strong design concept but the software engineering talent to put it into practice

This example also demonstrates how developing Innovation Capital can lead to follow-on advantages that accumulate over time. In Apple's case, much of the work in building the iPod provided the basis for future advances, which led to the smartphones and tablets that became so influential over the following decade. For companies as well as economies, these medium- and long-term benefits are a further reason to prioritise innovation investment in the present.

2.1 Improve the quality of policies to promote innovation investments

Public policy makers should adopt a broader view of innovation beyond R&D, promoting policies and measures that incentivise and protect all investments in innovation. These policies should be part of an integrated framework that not only fosters a continued increase in investments, but also promotes a flexible allocation of this capital flow to the most efficient uses.

Several policy areas could be addressed:

Facilitate trade of knowledge and foreign direct investment: empirical studies suggest that free and foreign direct investment generate benefits to economies. For instance, a World Bank study of 77 developing countries over a 20-year period indicates that countries more open to international trade and foreign R&D also had higher productivity[3]. This higher productivity can be associated with knowledge spillover to domestic firms supplying the multinationals[4] or from increased quality of exports in the case of developing economies[5], for example. Exposing less productive domestic firms to international competition can however be problematic. On the one hand it can be an important driver to force unproductive firms to improve or to leave the market, thus contributing to national productivity levels. On the other hand, attrition of local industry may result in highly unfavourable trade balances if not offset by effective policies to increase the overall competitiveness of local firms. Accordingly, policy makers need to make strategic trade-offs, developing policies that facilitate trade of knowledge in sectors that matter and foreign direct investments that could help increase productivity of domestic firms through vertical spillover of knowledge.

Effective intellectual property rights protection policies: creation of cross-border intellectual property protection systems that increase the efficiency of patent applications and litigation is an important driver to increase investors willingness to innovate. More efficient and integrated systems will allow investors to avoid delays in bringing new technologies to market and will decrease the overall burden of litigation. Additionally, a broader review of duration and scope of protection should take place. For instance, technologies that require higher development costs and longer development times should receive longer and stronger protection. Protection for other types of advances – such as certain design characteristics – should be carefully eliminated in cases where they have been introduced simply to avoid competition from follow-on innovation.

Science and R&D policies that spur innovation: Governments should continue to support basic research which can be assessed by peer review because most of the impact becomes a public good. Additionally, there is also a case for applied research. This is because economic theory suggests that the private sector is likely to underinvest in innovation as a result of market inefficiencies (e.g., information asymmetry) that discourage investments in new ideas. As such, programmes that stimulate investments in technological advances remain a crucial lever to build a country's Innovation Capital. Governments can use several mechanisms to incentivise private investments, such as tax-breaks or direct subsidies.

Digital policies enabling the robust deployment of ICT platforms: an effective framework to build and deploy ICT platforms is critical to increase other investments in innovation, as it is an enabler to the development and dissemination of new ideas. According to the Information Technology Innovation Foundation (ITIF), the effective deployment of ICT platforms requires countries to excel in four dimensions: competitiveness of ICT infrastructure and policy; international openness to ICT and market competition: the legal environment; and ICT usage[6].

Promotion of domestic market competition: a recent study by the McKinsey Global Institute finds that countries that outperform their peers do not have a more favourable sector mix, but instead have more productive firms across all sectors[7]. William Lewis, the former head of MGI, argues that "there is probably no more important factor to drive economic growth than competitive market places". This means that policies that promote competition are as

important to growth as macro-economic policies. Building on this, the ITIF indicates that countries that are more open to domestic competition make it easier for firms to start businesses, access capital, acquire property, attract talented workers, close or reorient operations and to operate in an environment generally free of corruption[6].

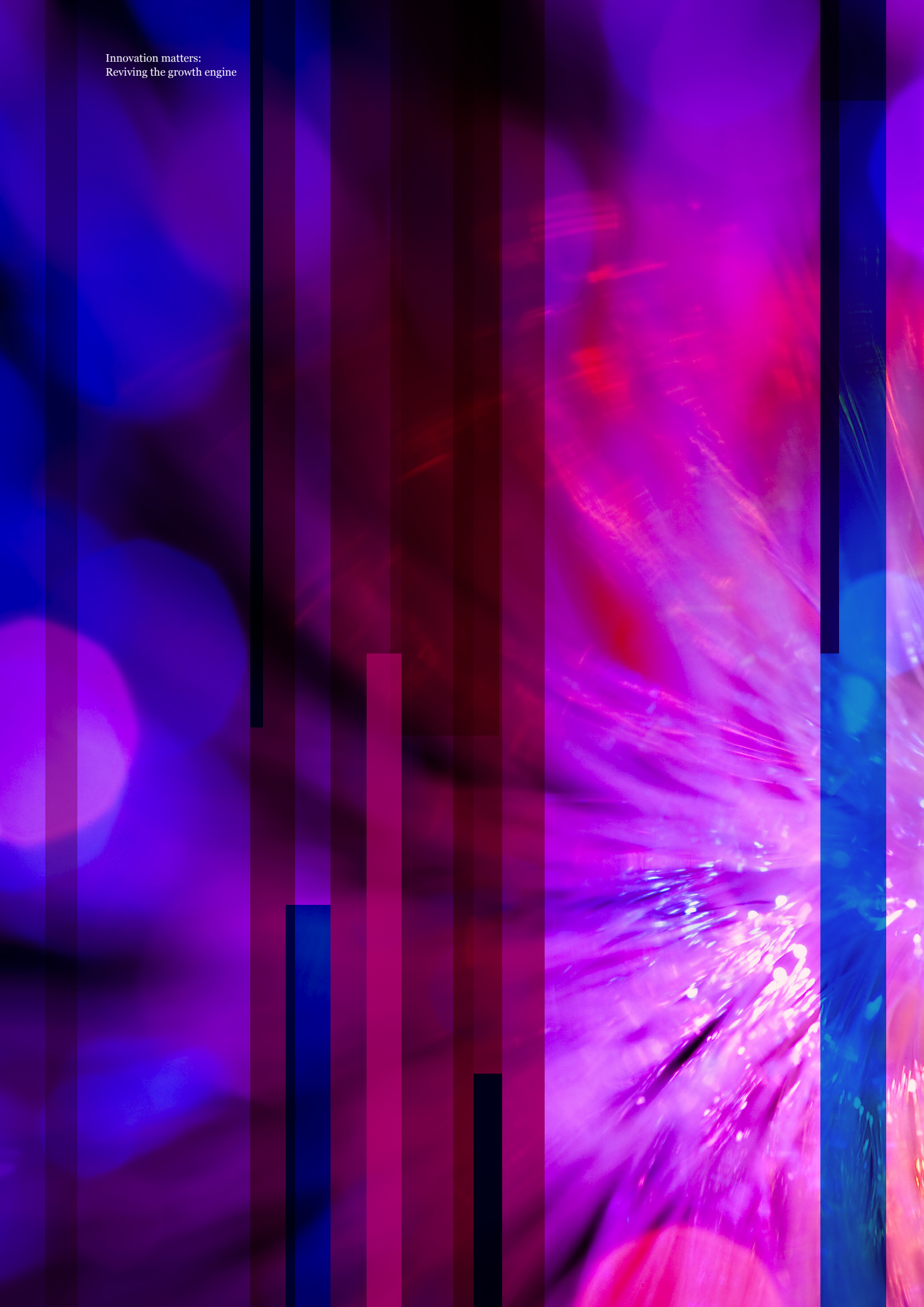
Policy stability – beyond political lifecycles—is also critically important as it increases investors' confidence in making longer-term investments. As an example, a recent OECD study indicates that the estimated impact of R&D tax credits on private R&D expenditure is greatly diminished in countries that have experienced a high number of R&D tax policy reversals. In addition to this, the OECD points out the importance of a well-designed bankruptcy law to guarantee that capital flows quickly from inefficient to more efficient firms.

Government support of R&D

Governments conduct their own research and development, and they can also stimulate such activity in the private sector.

Two policy levers frequently used for this are tax incentives and direct subsidies. Each has its benefits and drawbacks. Tax incentives are relatively easy to put in place and impose only limited administrative costs on both governments and firms. They are typically also sector and firm 'neutral', in that they do not require governments to make selective judgements about the type of R&D to support, or the type of firm to receive help. That said, tax incentives do provide some flexibility if policy objectives are more nuanced – a government can provide specific tax benefits to a particular industry or type of firm. The UK system is an example of this potential flexibility, where the R&D 'tax credit' was introduced for SMEs in 2000, and later via a separate scheme for larger companies.

Direct government subsidies also play a role in promoting innovation. They are arguably most helpful in areas where private enterprise is unwilling to invest, either because research is highly expensive or because it has an unclear path to market in the short term. For these reasons, there is an element of risk for governments here – it is not easy to 'pick winners' in advance. However, recent literature suggests that subsidies over time provide positive returns to governments, with productivity gains resulting both from product and from process innovations as a result of such government support.



2.2 Create a flexible environment for talent development and deployment

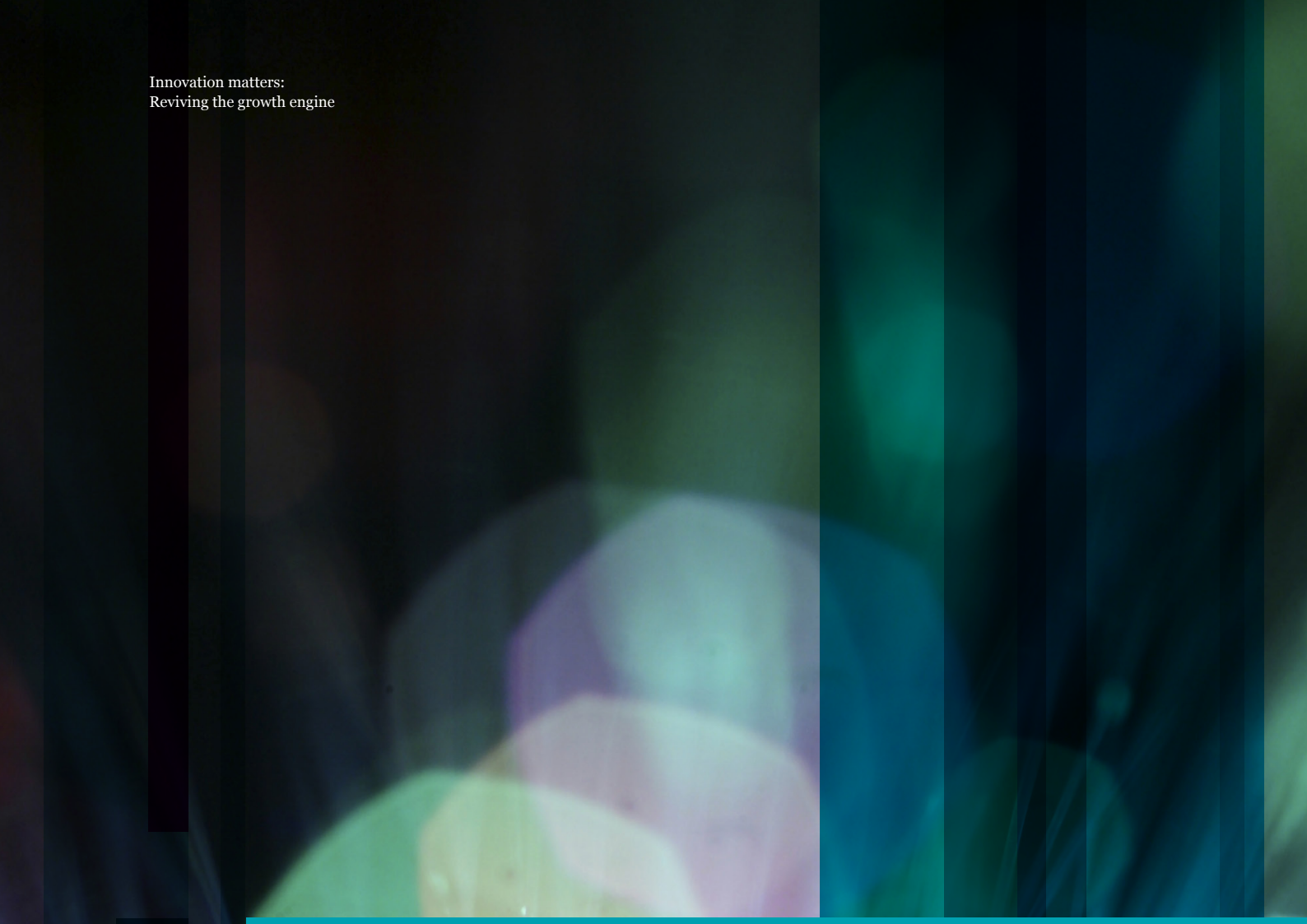
One of the critical determinants for knowledge diffusion and persuance of new opportunities is labour mobility. Encouraging this requires a shift in many countries' labour strategies. Rather than purely protecting employment, strategies should focus on promoting entrepreneurship and employability. This can be achieved by reducing restrictions and costs associated with termination of employment, allied with (re)education programmes designed for superior employability and more effective firm-level processes to reallocate talent to areas with the greatest opportunities.

Review of employment protection legislation: more restrictive employment protection legislation – for example, legislation that requires lengthy consultation periods – tends to increase restructuring costs, and slow the reallocation processes. In environments that are undergoing significant technological changes, more protective legislation decreases firms' willingness to pursue potential growth initiatives.

Balancing skills supply and demand: in an environment of resource constraint, high attainment rates and high wages, improvements in the balance of supply and demand for skills become a critical lever to drive continuous productivity growth. Opportunities clearly exist. For instance, only half of the youths in eight analysed countries* believe their post-secondary studies improved their employment opportunities, while 39 per cent of employers say a skills shortage is a leading reason for entry-level vacancies[8]. The McKinsey Centre for Government has proposed ways to design educational systems that address this paradox (see sidebar).

Active reallocation of resources: the pace of change in our economies is increasing, requiring rapid and constant changes of direction. Companies with higher reallocation intensity offer significantly higher total return to their shareholders[9]. This can be achieved by constant review of business units and proactive reallocation of personnel and investments to high-growth opportunities.

* *Australia, Canada, Denmark, Hong Kong, Singapore, Switzerland, United Kingdom, United States*



Education to Employment: Designing a System that Works, from the McKinsey Centre for Government

In Greece and South Africa, more than half of young adults are out of work. In much of the Middle East, a quarter are; in the United States, the figure is about one in six. At the same time, though, businesses struggle to find the workers they need. Systems to effectively remedy this situation contain a number of elements:

- They enable educators and employers to "step into one another's worlds", for example through enabling employer input on curriculum design or creating opportunities for work experience as part of university courses
- They intervene with students early and intensively to assist in employment; in some cases, by seeking commitment from employers to hire young talent before they are enrolled in a programme
- They make use of new incentives and structures. For example, requiring courses and establishments to publish data on job placements and career trajectories can sharpen a focus on the employability of those enrolled
- In many cases, they make use of technology. A traditional barrier to successful education-to-employment solutions was constraints on the resources of education providers, something that is being supplemented by the Internet and digital technologies

2.3 Encourage entrepreneurial activity

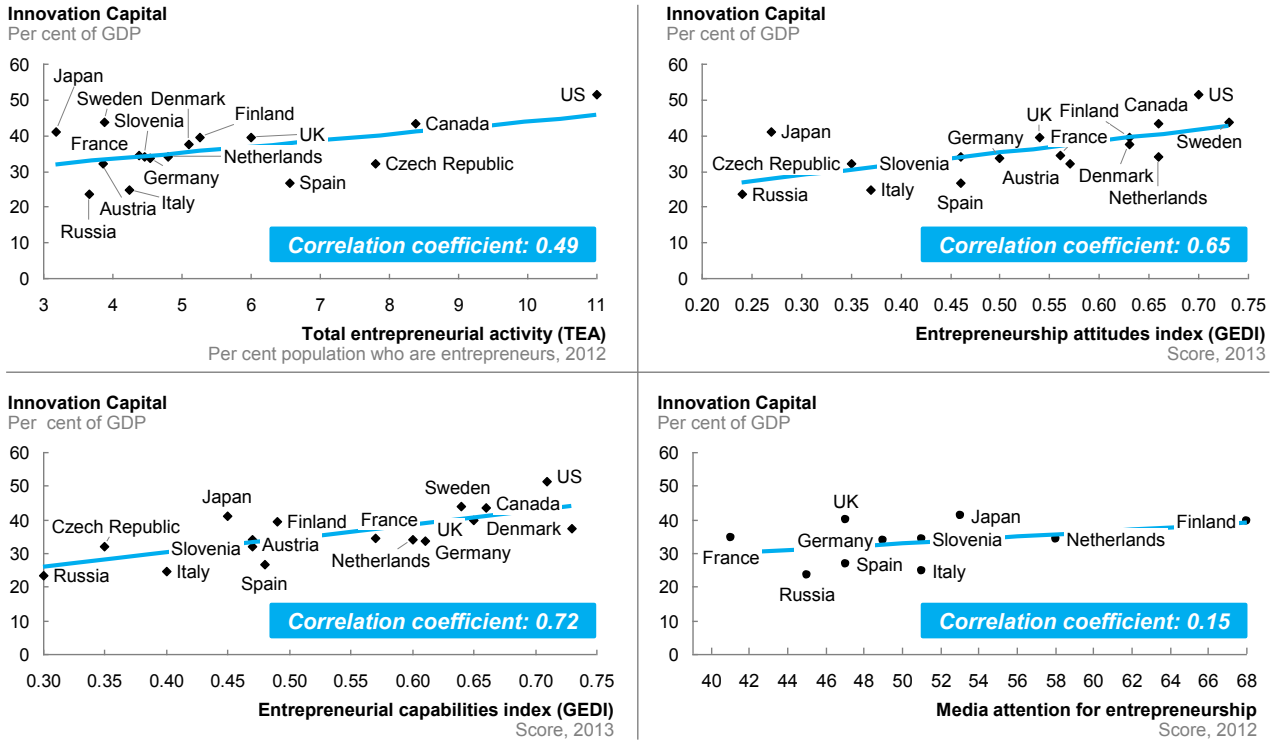
Entrepreneurs are an important force to drive innovation, playing a crucial role in creating and translating ideas into tangible products and services. Indeed, our research shows that Innovation Capital correlates well with many indicators of entrepreneurial activity (exhibit 14).

In the UK, half of the new jobs created by existing businesses between 2002 and 2008 came from just 6 per cent of UK businesses[10]. This corroborates the OECD's Dynemp project research, which demonstrated that firms below five years of age, regardless of their size, accounted for 18 per cent of total employment and 47 per cent of all jobs created across the ten countries analysed. The role of these young firms was accentuated during the financial crisis, when the majority of jobs destroyed resulted from downsizing programmes in large mature businesses.

While the contribution of entrepreneurial activity to economies seems indisputable, creating an environment that nurtures and encourages people to take risks and test new business ideas is challenging. Stringent regulations often make it hard for entrepreneurs to start a business. For example, being penalised

EXHIBIT 14

Innovation Capital is correlated with entrepreneurial activities



SOURCE: Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2012), "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results" available at www.INTAN-Invest.net; GEDI; GEM; McKinsey analysis

for failure understandably reduces people's willingness to leave more secure jobs and open their own businesses. Fostering a national culture of innovation can help to address this. Indeed, countries that have positive attitudes towards entrepreneurship also have higher shares of the working population engaged in such activity.

In addition to this, entrepreneurs also require supporting infrastructure to allow them to thrive, such as access to capital and capability-building programmes. We see three critical actions that countries can put in place to unlock the value of entrepreneurship:

Eliminate barriers to entrepreneurship: review the regulatory framework around creation of new firms to decrease the number of steps and increase the overall automation of procedures to open and close businesses. In addition, redesigning bankruptcy regulations is important. Well-designed legislation allows investors to unlock capital in failed companies without over penalising the personal assets of entrepreneurs.

Increase entrepreneurs' access to early stage capital: access to early stage capital is a critical determinant to entrepreneurial activity. Evidence shows a positive correlation between investments in intangible capital and the size of a country's venture capital sector[1]. The development of the early stage venture capital industry varies across countries and tends to be higher in countries with more favourable tax regimes, lower restrictions on types of institutions that can invest in venture capital (e.g., pension funds), modern bankruptcy legislation and developed capital markets that increase the number of available exit options such as an IPO.

Scale-up training programmes in starting a business: entrepreneurial training is also a proven lever to improve people's overall attitude towards entrepreneurship. Global Entrepreneurship Monitor's (GEM) Adult Population Survey 2008 indicates that people who undergo training in starting a business are twice as likely to be involved in entrepreneurial activity than people who do not receive training (even controlling for selection bias)[11].

Entrepreneurship and Universities: a Swedish Story

Sweden has seen a marked improvement in the quality and quantity of innovative start-ups. This is due in part to programmes to ensure computer literacy in all households, and in part by the success of entrepreneur incubators and skill-building programmes.

The Entrepreneurship and New Business Development Programme (ENP) started in Sweden in 1994 as one of the measures to support firms with roots in universities. The programme offers training, mentorship, supervision and networking opportunities for entrepreneurs intending to start a business. The programme is offered in multiple universities around Sweden and achieves extremely positive results. For instance, an average of 75% of participants start firms during the course of the programme and 3 years later, 75% of the newly started companies have survived. After 3 years, 20% of the surviving companies have more than five employees. Over the last 18 years, over 50 programmes were carried out, resulting in more than 500 new businesses.

Universities are also well connected to innovation activities – Linköping, for instance, is closely connected with two science parks, Mjärdevi and Norrköping, together hosting around 350 companies.

Building formal networks to connect aspiring entrepreneurs to each other and to more experienced entrepreneurs builds their potential to innovate in multiple ways. It exposes entrepreneurs to new ideas. It enables them to form dynamic teams and lets them learn from the experience of those who have succeeded and failed before.

2.4 Develop, shape and adopt disruptive technologies

Governments play an important role in the development of advanced technologies. Through the creation and funding of independent research institutes, for instance, countries are able to develop crucial new technologies that compose the backbone of their economies many years into the future. The internet is a direct outcome of this approach through DARPA.

Create institutes and funding for research on disruptive technologies: in the US, agencies such as DOE, DARPA, NIH and NASA have helped to create leaps in technology. Similarly, government funding of technologies such as the Human Genome Project, early digital networks, biomedical innovations and satellite technology, have created platforms for private companies to start and scale up new product and services.

Disruptive technologies can be supported not only through direct investment but through offering and publicising 'prizes' for successful creations. Such inducement prize contests (IPCs) are an area where governments, research institutes, and private companies alike can act together to foster innovation. For example, the Virgin Earth Challenge, created and financed by Sir Richard Branson, offers $25 million for whoever can demonstrate a commercially viable design to remove greenhouse gases permanently from the earth's atmosphere, and has resulted in 11 finalists vying to prove their technological solutions. Such IPCs are able to promote development of technology in such a way that encourages small teams, startups, and SMEs – in addition to large companies – to develop disruptive solutions.

Orient government procurement to promote innovation investments: governments can also be early adopters of advanced technologies. There is considerable evidence that such government procurement policies can be effective. For example, a study of Finnish innovation found that between 1984 and 1998, 48 per cent of projects leading to successful innovation were triggered by public procurement or regulation[12].

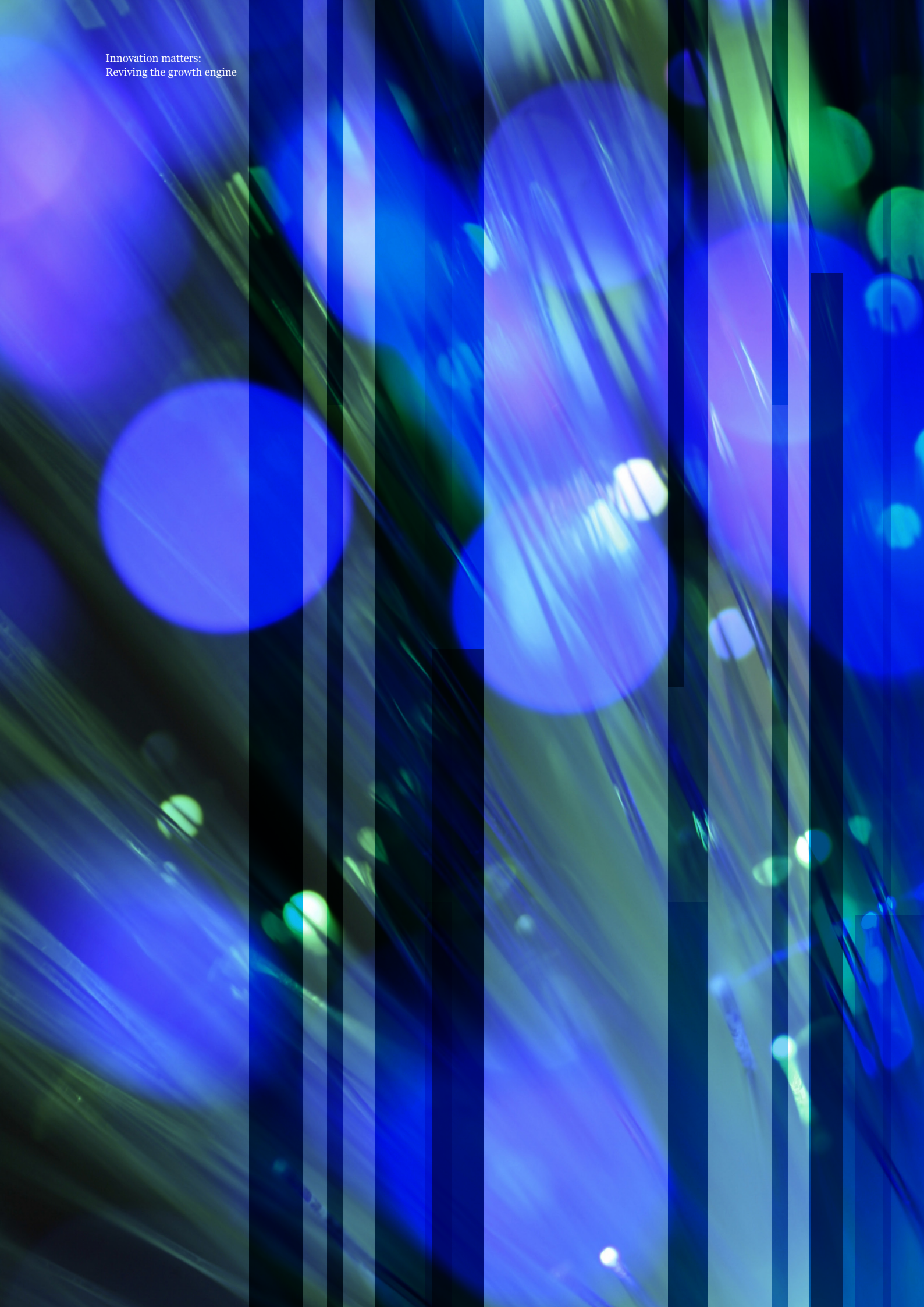
Through direct procurement of these advances, governments can facilitate proof-of-concept and accelerate market development. With government support, investments in promising but distant technologies can produce social and economic returns: this is particularly important in situations where private investors are deterred by the longer term, higher risk investment.

There are a number of rapidly advancing technology areas, highlighted by a recent McKinsey Global Institute (MGI) report[13]. Six in particular were found to require government involvement:

- Clean power and renewable energy
- Increased fuel efficiency in transport technologies
- Advanced composites
- Big Data
- Internet Of Things
- Cloud computing

In practical terms, governments can facilitate innovation-oriented procurement policies by including specific metrics on promoting innovation when awarding public sector contracts. Japan's Ministry of Economic Trade and Industry, for example, developed an integrated process designed to expand technology procurement across government in such a way that promoted innovative technologies required. An example of this is in the early 2000s when the Japanese government took an active approach to replace retired government cars with low-emission vehicles and hybrid vehicles, actively promoting these technologies.

Innovation matters:
Reviving the growth engine



2.5 Foster collaborations between different parts of the ecosystem

Unlocking the full value of innovation requires a much broader effort that goes beyond R&D or development of new products and services – there are no silver bullets.

Collaborations are crucial and can be fostered in several ways. University-industry sector cooperation, for example, correlates particularly strongly with our Innovation Capital metrics, allowing for greater diffusion from cutting-edge academic research into consumer/industrial applications. There are a number of ways in which this cooperation can be increased, including provision for more structured internships for PhD students and government and business support for a national association of university entrepreneurs[14].

An example of active development of industry-university collaboration can be seen in Spain (the fastest growing IC country). Here legislation in the early 2000s created 'Social Councils' for universities. These bodies were tasked to shape relations between universities and society and comprised largely of non-academic individuals. Spain more recently launched its 'Strategy University 2015' proposals, targeted in part at deepening these linkages to lead to future economic development. This has led to examples such as the University of Madrid, where a Centre for Entrepreneurship provides training, information, and networking opportunities for learning business skills, and the university's Institute of Knowledge Engineering, conducts research between academics and corporations including IBM-Spain, Santander, and Gas Natural Fenosa. The university is also very active in commercialisation of research projects, an activity that provided an income of 22 million euros for the institution in 2010.

History shows that this level of integration has also been made possible in several moments through the creation of innovation clusters. Venice during the Renaissance, London during the scientific revolution, and Silicon Valley today are some of the many examples from which we can learn.

For a location to 'earn the right to play', minimum infrastructure such as roads and telecommunication systems need to be in place[15]. Once a base is established, then innovation clusters can develop a specific sector focus and build scale. This focus allows locations to target a fixed pool of resources to build specific platforms. Finally, diversification is required for clusters to sustain their positions over time.

Nurturing the cluster : critical drivers of innovation vary from sector to sector. The local regulatory environment, for example, is a critical determinant for some sectors; for others, the key is the availability of venture capital or the presence of a demanding local customer base. However, the single common factor that drives—or, indeed, constrains—innovation across all sectors is the availability of a well-qualified and specialised talent pool.

Sustaining the cluster – sowing the seeds of reinvention: while focus is critical for emerging innovation hubs, as they mature they need to broaden their businesses and sectors portfolio. This diversification is vital to the long-term survival of an innovation hub—it allows the hub to survive the unavoidable downturns that affect specific sectors and provides the impetus for continuous reinvention. New innovators typically emerge in adjacent industries, or as hubs attract non-local players that want to capitalise on the local infrastructure and available talent. Research on clusters also points to the fact that those with a more diverse sector base tend to produce more sustained innovation outputs over time[19].

Stress testing these recommendations

In order to stress test our drivers of Innovation Capital further, we performed a number of correlation analyses across our sample countries between related metrics and innovation investment.

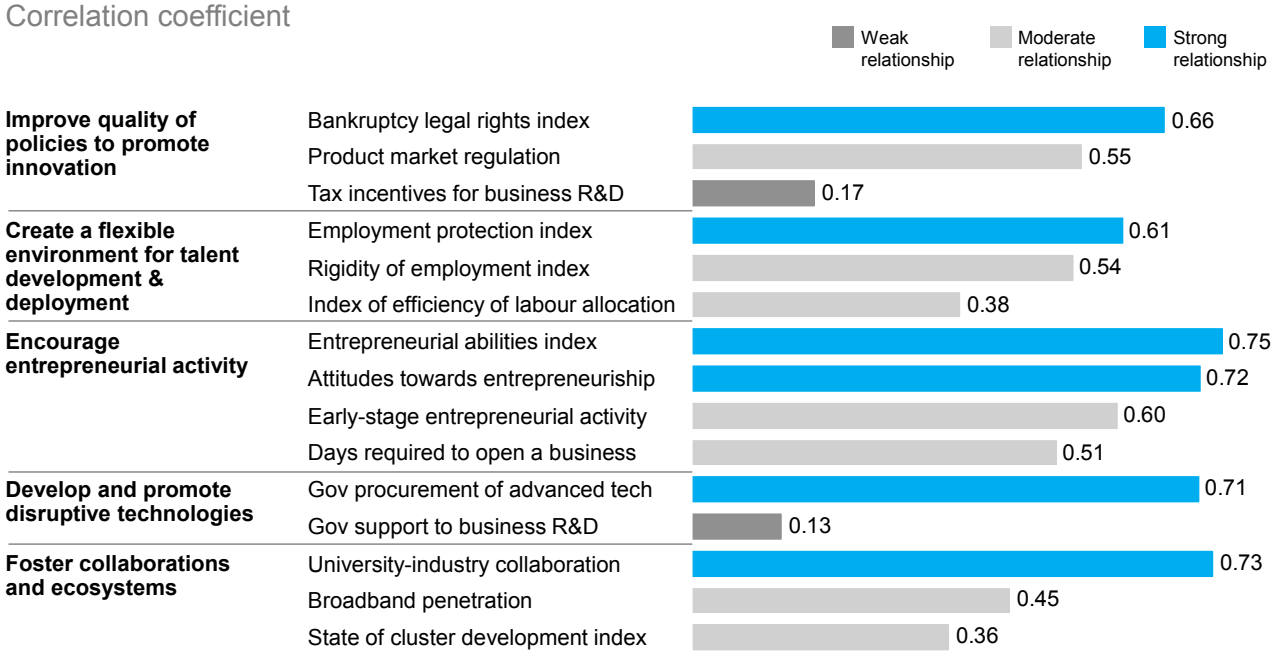
While such correlations cannot in themselves demonstrate a causal relationship between these measures, they provide a further reference point on which to base initial conclusions.

The results illustrate many of the insights from our qualitative and case study analysis, and in particular give a sense of where the strongest relationships appear to lie.

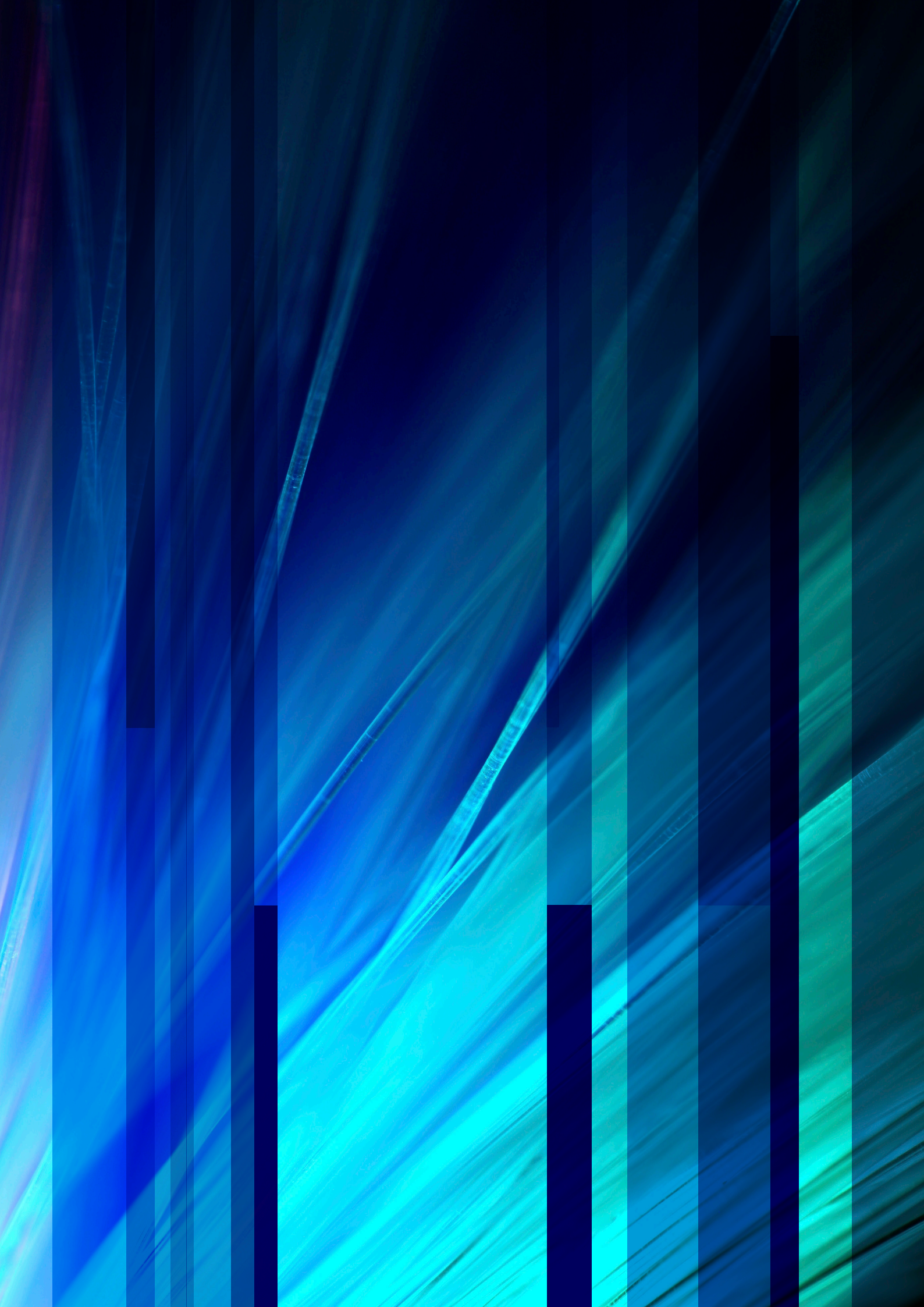
EXHIBIT 15

Supporting metrics are correlated with innovation investment

Relationship between key metrics and Innovation Capital investment
Correlation coefficient



SOURCE: OECD, World Economic Forum, INSEAD



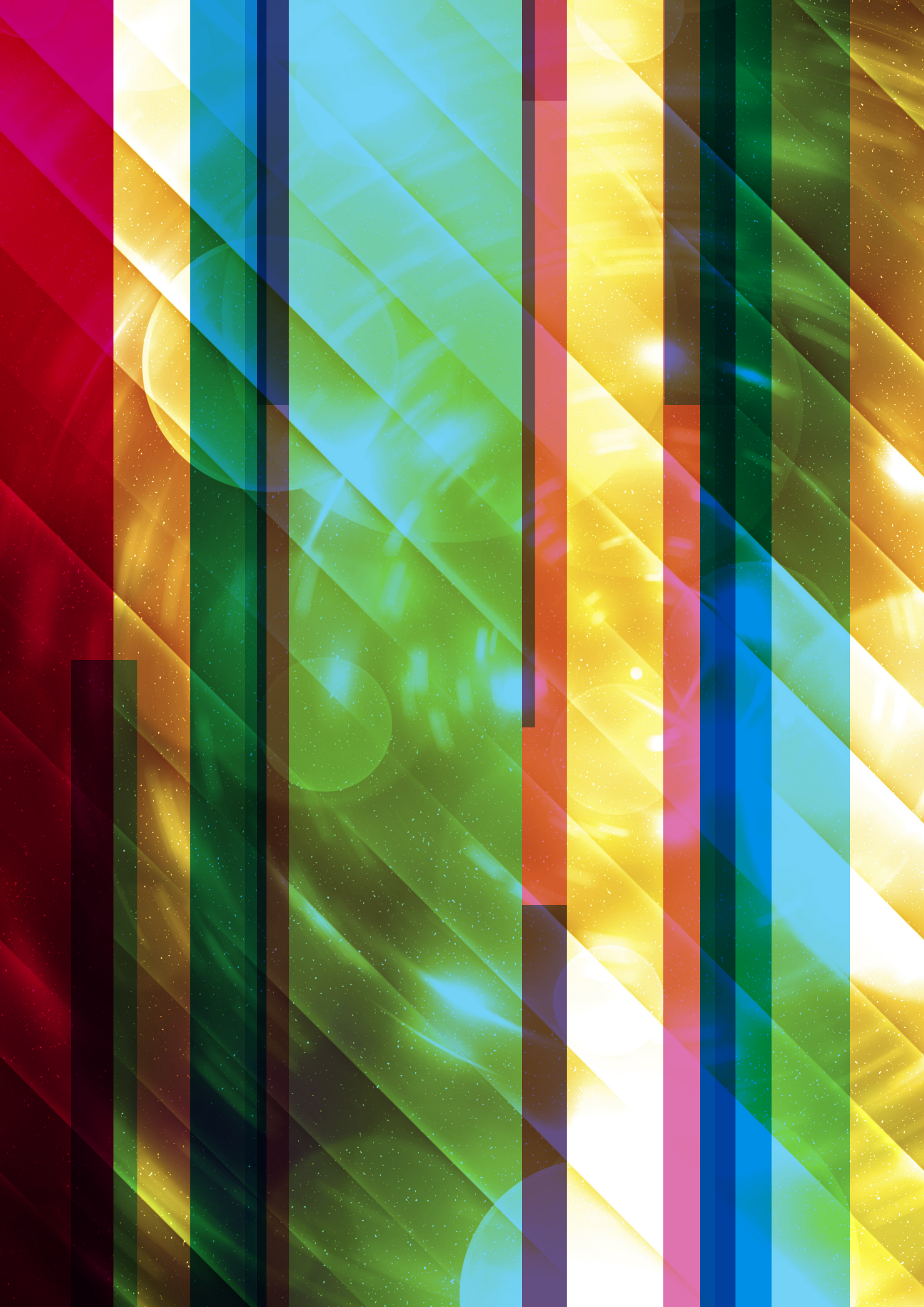
Conclusion

The prosperity in which many of us live today is built on the innovations of the past. These innovations have enabled us to automate many previously burdensome tasks, travel more freely, store and search data knowledge more quickly, and connect and collaborate with each other in new ways. Taken together, the innovations of the past two centuries have allowed us to live longer lives in a world that is vastly more comfortable, connected, and prosperous than the world that preceded it.

The continuation of this growth is however at risk – at least for developed countries. With headwinds of debt, demographics, and in many cases a challenging fiscal and macroeconomic environment, innovation is likely to be the major lever bringing about future productivity increases and therefore overall economic growth.

While traditional research and development is important, this innovation stretches far beyond that. It involves technology, process improvements and – perhaps most of all – improved Human Capital. Fostering it within economies requires the focused attention of and collaboration between policymakers and private enterprise.

Tackled appropriately, actions to promote innovation can lead us to a resumption of strong growth in developed economies. It will mean, in other words, that the generations following us are able to benefit from continued prosperity and the same degree of advancements over their lifetimes that we have ourselves enjoyed.



Appendix

Methodology for calculating Innovation Capital

Our Innovation Capital measure attempts to estimate and value the 'stock' of innovation across countries. This is defined as the level of innovative investments in an economy that lead to future economic value, in much the same way as investments in conventional Physical Capital do.

Both our categorisation of Innovation Capital and our data set draws heavily upon existing literature, including recent work on intangible capital and knowledge-based capital. In particular, we have drawn much of our data for intangible investment and stock from the work of Corrado, Haskel, Jona-Lasinio and Iommi, and the recent Intan-Invest project[2]. Our approach also draws from work by Corrado, Hulten and Sichel, as well as recent OECD work on Knowledge-Based Capital[1].

Our Innovation Capital measure comprises several asset types, grouped under three general categories:

- Innovative Physical Capital, which includes IT and Communications technology;
- Knowledge Capital, which comprises investments in software, scientific R&D, research in financial services, engineering and architectural design, venture capital, creative and artistic originals, mineral exploration, brand equity, and market research;
- Human Capital, which includes investments in education, employee development, and organisational capital.

Our definition of 'investment' here is limited to outlays on assets that last for more than one year, in order to separate out expenditures that are intended to expand future productive capacity from expenditures for continued operations. This corresponds to conventional definitions of gross fixed capital formation, under which many of our items are already categorised for several countries. On this basis, the purchase of a software programme for short-term use would not be included in these measurements, but the use of software to improve worker productivity in an organisation over time would be.

Our analysis is built on a time series from 1995 – 2008 for most measures, primarily due to data availability in more recent years being limited. For each measurement, investment flows are normalised to real 2005 values to ensure comparability across our time series. In order to do this, we used price deflators from the Intan-Invest project. For software, these contain a harmonised deflator across countries, based on a productivity-adjusted cost measure for own-account software, as well as a quality-adjusted measure for pre-packaged and custom software. For other categories, and also in line with this work, we used a broad business sector general added deflator.

While innovation flows are measured as annual investments, the stock value of Innovation Capital is determined both by the incoming investments and by depreciation of existing stock over time. This reflects the physical depreciation of some tangible Innovation Capital elements (e.g. ICT), and also the continued diffusion and advancement of the components of innovation investment over time. For example, while an R&D investment may provide economic value over a defined period of time, as it is replaced by newer technology its ability to lead to innovative products or incremental product improvements is diminished. Our depreciation rates draw mostly on the work of existing literature on intangible investment[17].

Estimates for Canada, Japan and Russia are not covered in the above Intan-Invest data set, and so were sourced from a combination of secondary literature and national statistical data. For Russia, we used information from sources including Russian national account data and the Federal Statistics Service. Our Japanese data draws upon some existing literature on the topic, the Research Institute of Economy, Trade and Industry (RIETI), as well as some market information for specific items (e.g. market research

data drew upon Esomar estimates of industry turnover)[18]. Our estimate for Canada draws upon some existing literature, as well as the Canadian Socieconomic Database from Statistics Canada[19].

Methodology for calculating innovation contribution to economic growth

Formally, the contribution of each capital type to the percentage growth in output is its percentage growth multiplied by its share of payments in output. This can be described as: $\Delta Y/Y = (PkK/PyY)*(\Delta K)/K$ where Δ is change over analysed period. This then can be written $Py(\Delta Y) = Pk(\Delta K)$, that is, the change in K multiplied by its rate of return, Pk, equals the value of the change in Y. The private rate of return Pk, is calculated so that Pk*K equals profits in the economy or, in other words, so that Pk is consistent with calculated K from the perpetual inventory model and observed economy profits.

Case studies on specific actions

1.1 Liberalise barriers to international trade of knowledge and innovation investments

Canada demonstrates excellent practice in encouraging knowledge and innovation investments. It provides a secure intellectual property rights environment and reliable legal system which encourages FDI in technology industries[20]. Canada ranks well in its ability to attract FDI[21]. This is no doubt facilitated by its light restrictions on key personnel and low non-tariff barriers to FDI[22].

A strong environment of property rights attracts trade in innovation investments by guaranteeing returns to potential investors. This draws external ideas and investment which diffuses into the domestic economy while also encouraging local firms to innovate in order to compete with external players.

1.2 Redesign bankruptcy legislation

Japan has a well-performing bankruptcy system. The cost and time to close a business is the best in the G8, as is the recovery rate for failed businesses. It is often possible to rehabilitate firms and maintain them as a going concern. Pre-insolvency work-outs are encouraged[23].

A well-functioning environment for bankruptcy has a significant impact on innovation. Effective restructuring allows companies to shed their least dynamic and efficient assets and focus on what they do best. At the same time it allows other firms to make use of underperforming assets. One indicator of how much value the assets create is recovery rate, something at which Japan performs particularly well.

1.3 Stimulate investments through tax incentives, direct subsidies or orientation of government procurement policies to directly purchase innovation

German energy policy is an excellent example of effective use of government incentives to drive innovation. Since implementing the SEG and EEG, the rate of patent application on renewable energy technology in Germany increased substantially and allowed German industry to take up a leading international position in the manufacture of green technology goods[24].

Using well-designed government subsidies to drive innovation can be an effective tool because it can create innovation in public goods which are otherwise hard to draw profit from. They can also reduce market risk, allowing companies to plan investment on a longer time horizon. Lastly, they can quickly create a market large enough to build an ecosystem of specialised firms that are collectively viable but could not start up without the guaranteed demand.

Germany runs the risk of distorting investment in renewables innovation by targeting incentives towards politically attractive industries rather than those with the strongest technical or economic merits.

2.1 Incentivise labour mobility through more flexible employment protection legislation

The US has a leading flexible and efficient labour market. It comes top among G8 economies on allowing companies flexibility in employment decisions as well as in the relationship between pay and productivity, although states differ[25]. It has achieved this status mostly through minimally-

restrictive labour laws which leave firms free to hire and fire, permit 'at-will' employment, as well as some restrictions on unions in, e.g., 'right-to-work' states. The recent move towards de-coupling health-insurance from employment should also reduce friction in the labour market.

This flexible labour market allows skills and talent to quickly reach the most productive parts of the economy, driving innovation and efficiency. It also lets companies respond quickly to changes in demand which allows the economy to serve consumers effectively and limits the inertia of 'legacy' industries.

2.2 Efficiently balance skills supply and demand

Germany is famous for the level of integration of its education system with employer requirements. More than half of German students find vocational training through apprenticeships. Germany also excels at attracting skilled talent through its targeted work permit scheme, allowing foreign students to remain to find work.

Ensuring that talent supply is tightly linked to employer needs is vital because of the importance of Human Capital in driving innovation. Skill mismatches push up labour costs in innovative industries. It also creates youth unemployment leading to a vicious circle of decreasing workforce skills, throttling future innovation.

Further integration of industry in university level education can continue to ensure a supply of the right skills to innovative firms.

3.1 Remove barriers to entrepreneurship

The UK has a strong environment for encouraging entrepreneurial activity. It has among the lowest administrative burdens on start-ups and barriers to competition[26]. The cost and difficulty of closing a business are among the best in the G8, as is the recovery rate for failed businesses[27].

Making it easy to start and run a business drives innovation by reducing the barriers to entry and allowing entrepreneurs to focus on creating new ways to add value rather than dealing with excessive red tape. Making it easy to close a business allows entrepreneurs to move on from unsuccessful ideas to new ones.

The UK could improve its environment for entrepreneurial activity by reducing the number of procedures required to start a business, as well as the time it takes[25].

3.2 Create programmes to build a positive culture around entrepreneurship

The UK has an excellent culture around entrepreneurship. Unlike the citizens of many countries which share a high regard for entrepreneurial careers, almost half of Britons believe that they have the capability to become entrepreneurs. This is responsible for the high percentage of the population engaged in entrepreneurship. Entrepreneurs maintain a celebrity status, and local bodies drive successful entrepreneurship programmes in secondary schools.

A strong culture of entrepreneurship is vital for innovation because it attracts the best talent towards innovative career paths. Top talent is motivated not just by financial returns, but by status and positive role-modelling. That talent drives the productivity of innovative industries.

3.3 Develop entrepreneurial capabilities

Sweden has seen a marked improvement in the quality and quantity of innovative start-ups. This is due in part to programmes to ensure computer literacy in all households, and in part by the success of entrepreneur incubators and skill-building programmes like the ENP at Linköping University.

Building formal networks to connect aspiring entrepreneurs and more experienced entrepreneurs builds their potential to innovate in multiple ways. It exposes entrepreneurs to new ideas. It enables them form dynamic teams. It also lets them learn from the experience of those who have succeeded and failed before.

4.1 Create independent research institutes, backed by public and private investments to research disruptive technologies

The US has a strong track record of driving disruptive technology through research institutes. This effort is particularly apparent in the DOE, DARPA, NIH and NASA. In each case, government funding of, e.g., the Human Genome Project, early digital networks, biomedical innovations and satellite technology, has developed substantial private-sector ecosystems. Those ecosystems, in turn, drive world-leading innovation and consolidate it into commercial clusters.

Using direct demand to drive innovation allows investment in promising but distant technologies. In the long term, this research produces enormous social and economic returns, but the horizon for returns and high chance of failure deter private investors. In addition, direct demand allows investment in innovations that might upset the interests of current market leaders by driving disruptive technologies.

5.1 Develop strategies to form and develop innovation clusters within the country

Japan has built world-leading cross-sector innovation clusters in, e.g., Yokhama and Tokyo. These clusters benefit from diverse local industries, strong links between indirectly dependent sectors, strong trade links and close relationships between industry and academic research. These conditions are enhanced by programmes carried out by TAMA, METI and MEXT.

Geographically concentrated hubs of clusters allow ideas to spread between sectors. It also allows directly dependent organisations to communicate quickly and efficiently, reducing the time-to-market for innovative products.

5.2 Prioritise research incentives and grants to projects with strong private interest and collaboration

The United States' Small Business Technology Transfer programme represents good practice in directing funding towards innovative projects. This programme links around $100 million annually to research carried out in partnership between non-profit research organisations and small businesses intending to commercialise research.

Effective links between fundamental research and commercialisation ensures that innovation crosses over from the lab to the market-place. Using grant policy to incentivise collaboration encourages non-profit organisations to research commercially useful topics. It also encourages for-profit firms to take advantage of opportunities to innovate.

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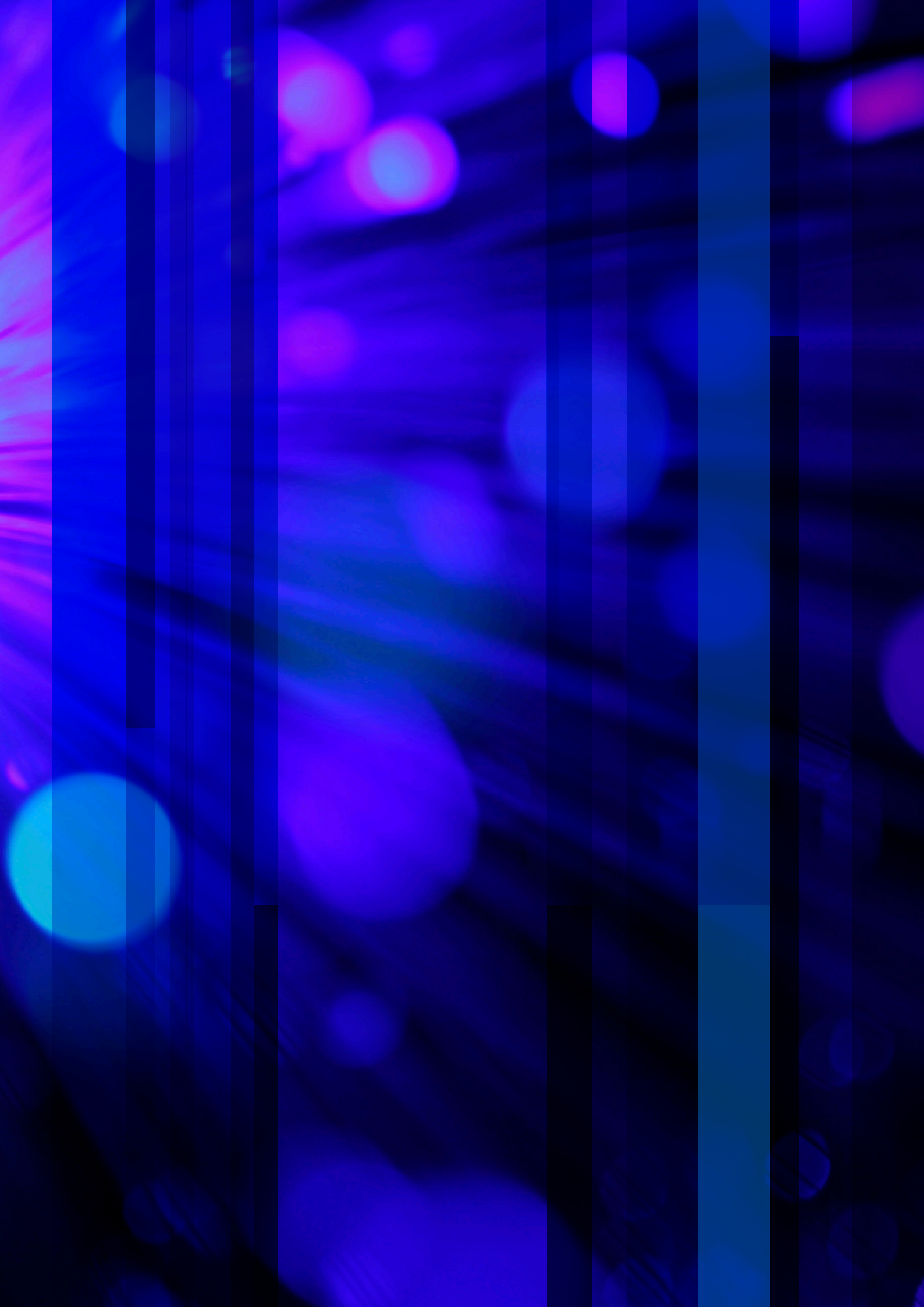

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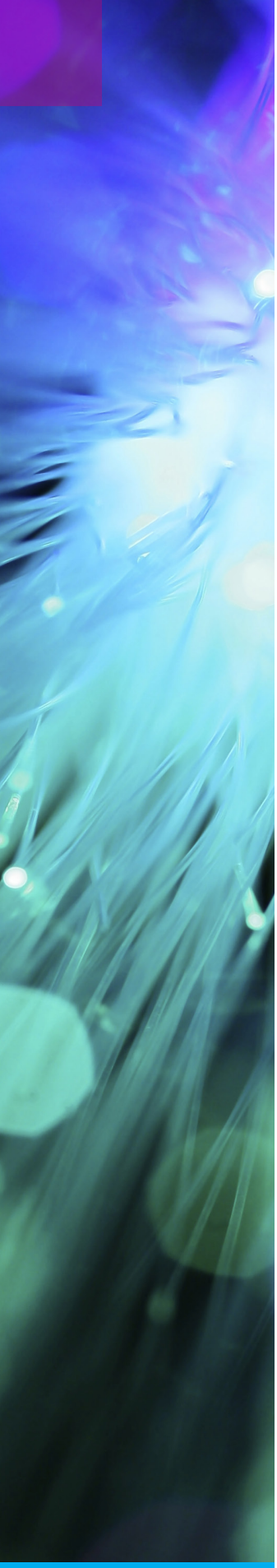

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