

# ICT INVESTMENTS IN OECD COUNTRIES AND PARTNER ECONOMIES

TRENDS, POLICIES  
AND EVALUATION

---

OECD DIGITAL ECONOMY  
PAPERS

April 2019 No. 280

## *Foreword*

This report was prepared by the Working Party on Measurement and Analysis of the Digital Economy (MADE). The report presents recent trends in ICT investment, makes an inventory of ICT investment policies in OECD countries and selected Partner economies, and reviews the evaluation of selected investment policies in some OECD countries.

The report was approved and declassified by written procedure by the Committee on Digital Economy Policy on 16 November 2018 and was prepared for publication by the OECD Secretariat.

This report was drafted by Béatrice Guérard and Vincenzo Spiezia from the OECD Secretariat.

### *Note to Delegations:*

*This document is also available on O.N.E. under the reference code:*

*DSTI/CDEP/MADE(2018)5/FINAL*

This document, as well as any data and any map included herein, are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

© OECD 2019

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgement of OECD as source and copyright owner is given. All requests for commercial use and translation rights should be submitted to [rights@oecd.org](mailto:rights@oecd.org).

## *Table of contents*

<b>Foreword</b> .....	<b>2</b>
EXECUTIVE SUMMARY .....	5
<b>1. ICT investment trends in OECD countries</b> .....	<b>6</b>
1.1. Investment trends in ICT equipment, software and databases .....	7
1.2. Investment in R&D in ICT activities .....	15
<b>2. ICT investment policies in OECD countries and selected Partner economies</b> .....	<b>20</b>
2.1. The DEO questionnaire 2017.....	20
2.2. Fostering growth of the ICT sector.....	20
2.2.1. Support to innovation in the ICT sector .....	23
2.2.2. Support to exports by ICT firms.....	28
2.2.3. Support to investment by ICT firms.....	30
2.2.4. Other measures to support growth in the ICT sector.....	33
2.3. Fostering ICT adoption and use by firms.....	34
2.3.1. Financial support .....	36
2.3.2. Other measures to foster ICT adoption and use by firms .....	41
<b>3. Evaluation approaches in selected OECD countries</b> .....	<b>43</b>
3.1. Survey-base evaluation .....	45
3.1.1. Tech City UK .....	45
3.1.2. ICT programmes in Sweden.....	50
3.1.3. ICT programmes in Finland .....	54
3.2. Econometric evaluation .....	56
3.3. Survey-based and econometric evaluation: a comparison .....	61
<b>References</b> .....	<b>63</b>

### **Tables**

Table 1. Policies to support ICT investment .....	20
Table 2. Supporting policies to ICT growth sector .....	23
Table 3. Supporting policies to increase adoption and use of ICT .....	36
Table 4. Tech City UK: summary details of programmes and activities.....	47
Table 5. Description of the programmes assessed in Sweden.....	51
Table 6. ICT programmes funded by VINNOVA in Sweden .....	52
Table 7. Description of the programmes assessed in Finland .....	55

### **Figures**

Figure 1. ICT investment across OECD countries .....	6
Figure 2. ICT investment shares in GDP.....	7
Figure 3. Measurements of ICT investment intensity: nominal versus volume .....	8
Figure 4. Price indices for investment in computer hardware and telecommunications equipment .....	9
Figure 5. Trend of investment in computer hardware, 1995-2015 .....	11

Figure 6. Trends in investments in telecommunication equipment, 1995-2015.....	12
Figure 7. Trend of investment in software and databases, 1995-2015 .....	13
Figure 8. ICT investment trends by industry, 1995-2015.....	14
Figure 9. Trends in R&D in ICT manufacturing, 2005-2017 or latest available year.....	16
Figure 10. Trends in R&D in Publishing.....	17
Figure 11. Trends in R&D in telecommunication activities.....	18
Figure 12. Trends in R&D in IT and other information services .....	19
Figure 13. Policies to support ICT growth sector.....	21
Figure 14. Policies to support ICT adoption and use by firms .....	35
Figure 15. TCUK logic model.....	49
Figure 16. Econometric methods for policy evaluation .....	57

### **Boxes**

Box 1. Measuring prices and volumes of ICT investment .....	9
Box 2. Econometric methods for policy evaluation .....	57

## EXECUTIVE SUMMARY

Investments in information and telecommunication technologies (ICTs) are the main channel through which digital transformation unfolds. Businesses adopt digital tools and new business models enabled by digitalisation by investing in computer hardware, software and databases. Faster connectivity, the deployment of the Internet of Things, increasing data flows all rely on continuous investments in communication infrastructure. Monitoring ICT investment is therefore key to measure and understand digital transformation across countries.

Policies to support ICT investment are a strategic tool to spur the digital transformation and enhance productivity and growth. However, while most countries do carry out some forms of ICT investment policy, very little is known on the effects of these policies or on the relative impact of different measures. The aim of this report is to start addressing these issues.

Section 1 presents an overview of recent trends in ICT investment in OECD countries. While many observers have pointed out the decrease in ICT investment over GDP since their peak in 2000, the report shows that the decrease in the nominal value of ICT investment over GDP did occur, for the OECD average, for computer hardware and telecommunication equipment but not for computer software and databases, which increased by 44% relative to GDP over 1999-2015.

More importantly, the ratio of ICT investment to GDP did increase in volume, i.e. when controlling for the increase in ICT prices relative to GDP prices. The increase in investment in ICT equipment relative to GDP was equal to 65% in volume over 1999-2015, i.e. the same as the increase in computer software and databases in volume. The measurement of price deflators, however, remain problematic, as countries tend to use different estimation rules.

Section 2 makes an inventory of ICT investment policies in OECD countries and selected Partner economies, based on the responses to the Digital Economy Outlook (DEO) 2017 questionnaire and a follow-up survey. All responding countries (38) have policies to support the growth of the ICT sector. Most target innovation, investment, or exports. 35 of them reported having at least one policy that specifically supports innovation, compared to 26 with measures directed at expanding firm exports, 24 with policies that promote ICT sector investment, and 12 with policies related to other ICT sector development.

Thirty-seven countries reported having at least one policy in place to encourage the use of ICTs in businesses. 25 countries out of 37 have a financial or/ and non-financial support for the adoption and use of ICT by firms, individuals or public institutions. Of the policies based on financial schemes, monetary support for the purchase of ICT equipment or towards ICT development is the most common with 16 countries out of 25 using this method. Non-financial support to ICT adoption is mainly provided through targeted training, which accounts for over half of the individual policies reported by countries.

Section 3 analyses the economic rationale for ICT investment policies and discusses the two main approaches to their evaluation: the survey-based approach and the econometric analysis. The Section also reviews the evaluation of selected investment policies in some OECD countries, building on presentations by national delegates at several meetings of the Working Party on Measurement and Analysis of the Digital Economy (MADE) over 2017-18.

## 1. ICT investment trends in OECD countries

This Section presents an overview of recent investment trends in information and telecommunication technologies (ICTs) in OECD countries and briefly discusses statistical issues related to the measurement of ICT assets.

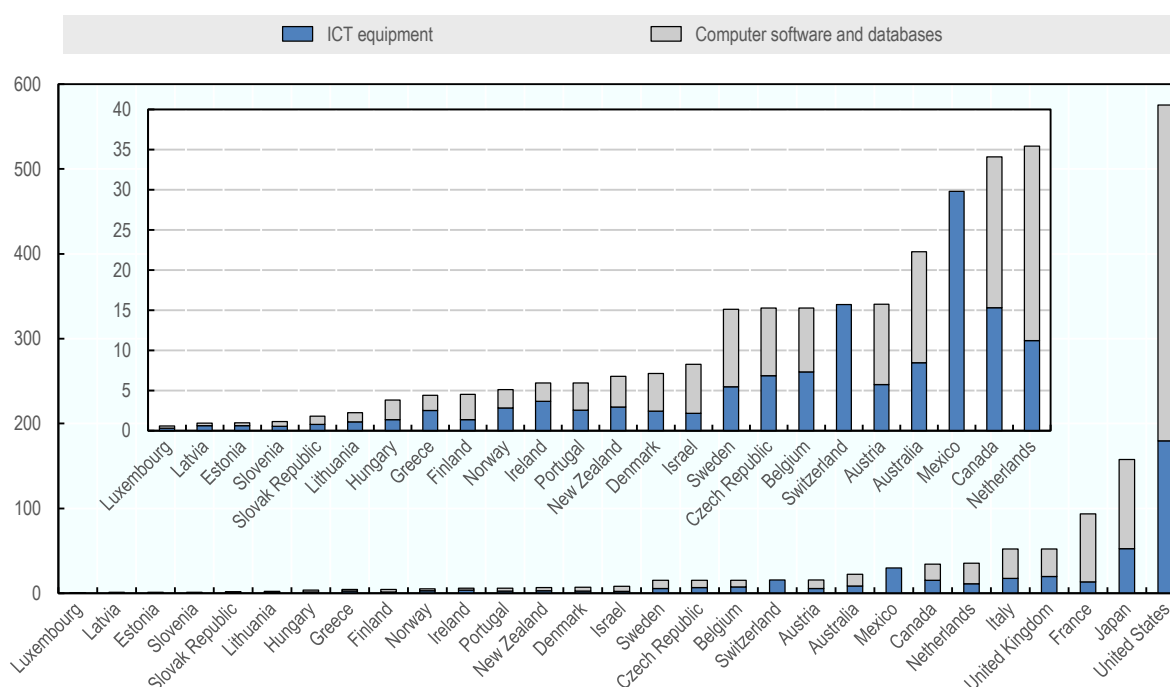
In the System of National Accounts (SNA), investment, or more precisely, gross fixed capital formation (GFCF) is defined as acquisition less disposals of produced fixed assets. The relevant assets relate to products that are intended for use in the production of other goods and services for a period of more than a year. Acquisition includes both purchases of assets (new or second-hand) and the construction of assets by producers for their own use.

According to the SNA, the following assets should be classified as ICTs: ICT equipment, which includes computer hardware and telecommunication equipment; computer software and database; as well as a subset of research and development (R&D) expenditures on ICTs.

As statistics on R&D on ICTs are not available, Section 1.1 reviews investment trends in computer hardware, telecommunication equipment and computer software and databases while Section 1.2 looks at R&D investment carried out by the ICT sector as a proxy for ICT-related R&D.

**Figure 1. ICT investment across OECD countries**

Billion USD PPP, 2017 or latest



*Note:* Investment is defined as Gross fixed capital formation, at current prices and current PPPs. In Mexico and Switzerland data for computer software and databases are not available.

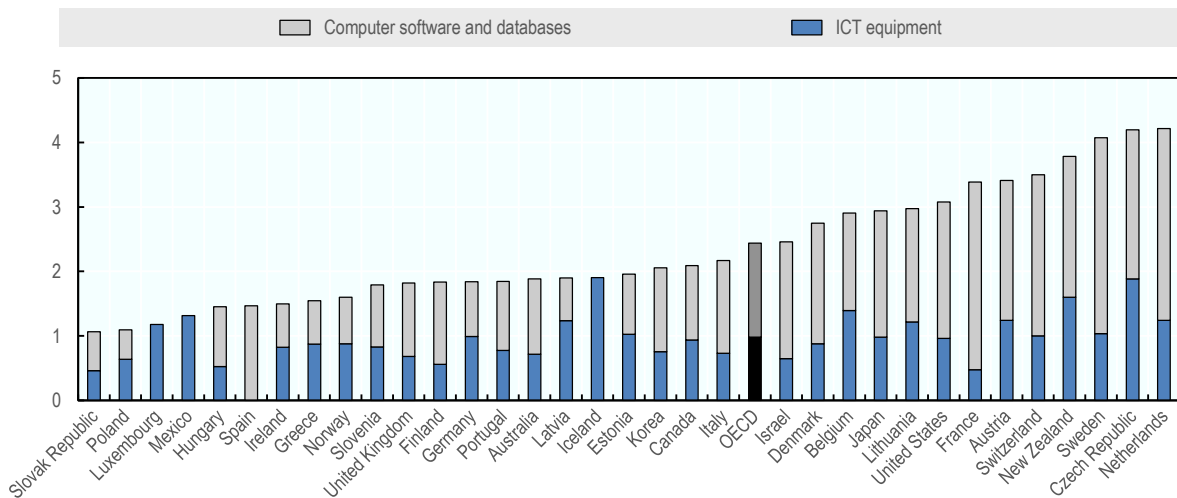
*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

### 1.1. Investment trends in ICT equipment, software and databases

Figure 1 shows the value of investments in ICT equipment, software and databases by OECD country in 2017 or the latest year available. With USD PPP 575 billion, the United States were by large the first ICT investor among OECD countries, followed by Japan (158 billion) and France (94). Computer software and database account for a large majority – between two-third and a half – of ICT investments in all OECD countries for which the breakdown is available.

**Figure 2. ICT investment shares in GDP**

In percentage of GDP, 2017 or latest available



*Note:* Data shown here are the gross fixed capital formation in percentage of GDP, in nominal terms. ICT equipment is essentially composed of computer hardware and telecommunication equipment. In Mexico data for computer software and databases are not available. OECD data is the unweighted average of available countries.

*Source:* Calculations based on OECD, National Accounts Statistics, national sources and Eurostat, November 2018.

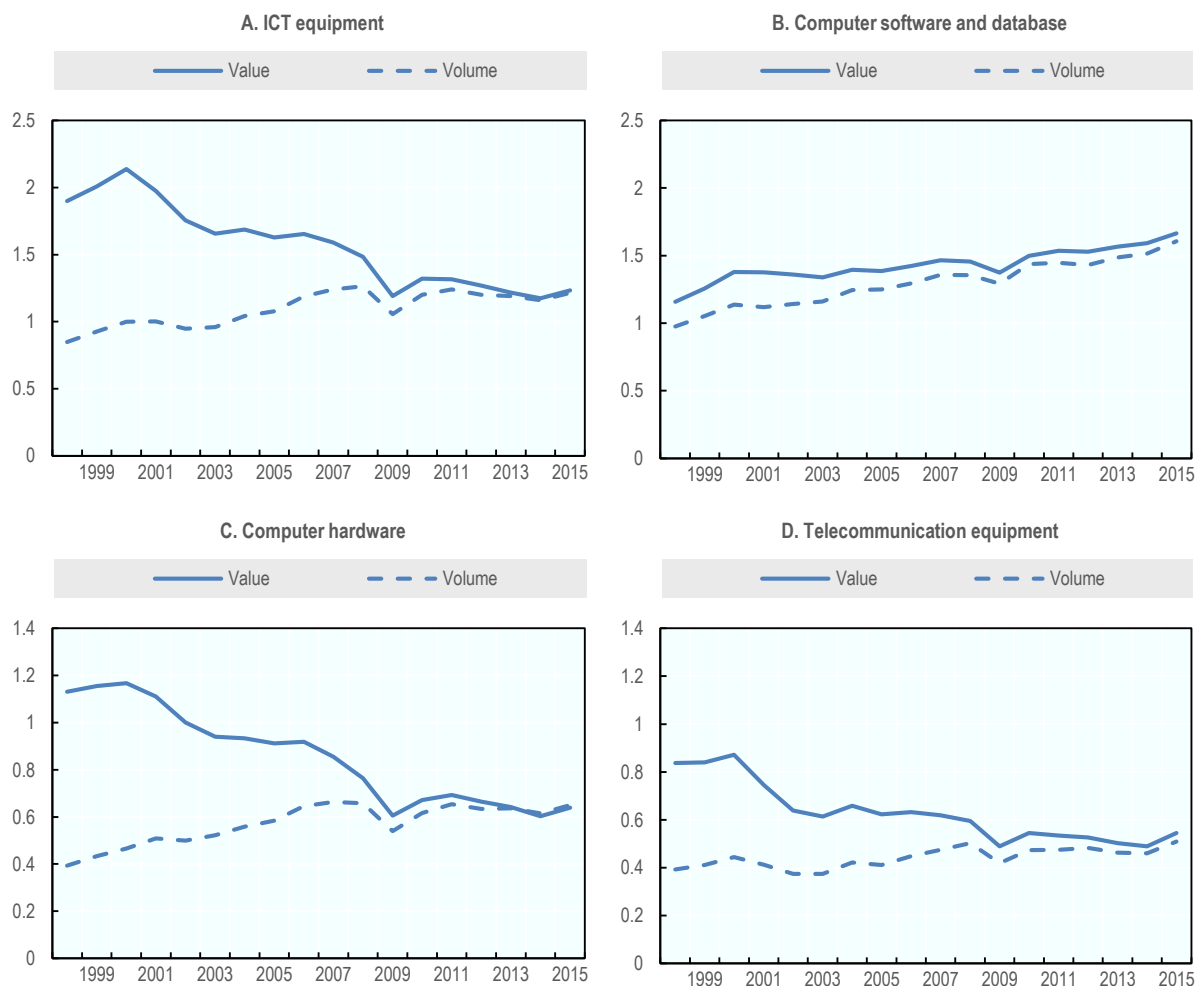
When looking at ICT investment relative to GDP, the landscape across OECD countries is very different (Figure 2). While the United States are still among the top-10 countries for ICT investment relative to GDP (3.08%), this ratio is the highest in the Netherlands (4.21), the Czech Republic (4.20), Sweden (4.07), New Zealand (3.78), and Switzerland (3.50).

Many observers have pointed out the decrease in ICT investment over GDP since their peak in 2000 as a worrying sign of a slowdown in digitalisation. Figure 3 shows that the decrease in the nominal value of ICT investment over GDP did occur, for the OECD average, for computer hardware and telecommunication equipment but not for computer software and databases, which increased by 44% relative to GDP over 1999-2015. More importantly, the ratio of ICT investment to GDP did increase in volume, i.e. when controlling for the increase in ICT prices relative to GDP prices. The increase in investment in ICT equipment relative to GDP was equal to 65% in volume over 1999-2015, i.e. the same as the increase in computer software and databases in volume.

The measurement of price deflators remain problematic in the SNA, so that the actual increase in ICT investment may have been larger, as discussed in Box 1.

**Figure 3. Measurements of ICT investment intensity: nominal versus volume**

Gross fixed capital formation as a percentage of value added - OECD unweighted average



*Note:* The OECD unweighted average shown here is the average of available OECD countries excluding Chile, Germany, Iceland, Israel, Korea, New Zealand and Turkey. For each ICT asset, measurements are presented in both at current prices and in volume. All variables in volume are based on the same country-specific year constant prices and shown for the reference year 2012.

*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

Figure 5 shows trends in the volume ratio of investment in computer hardware to GDP across countries. In 2015/17, the ratio was the highest in the Czech Republic (1.60%), Belgium (1.17%) and Denmark (0.95%) and the lowest in France (0.32%), Greece (0.30%) and Luxembourg (0.29%). Over the period 1996-2015/17, investment in computer hardware relative to GDP increased the most in Australia (34%) Latvia (33%) and the Netherlands (30%) while it decreased in the Slovak republic (-5% a year) and Greece (-1%).

**Box 1. Measuring prices and volumes of ICT investment**

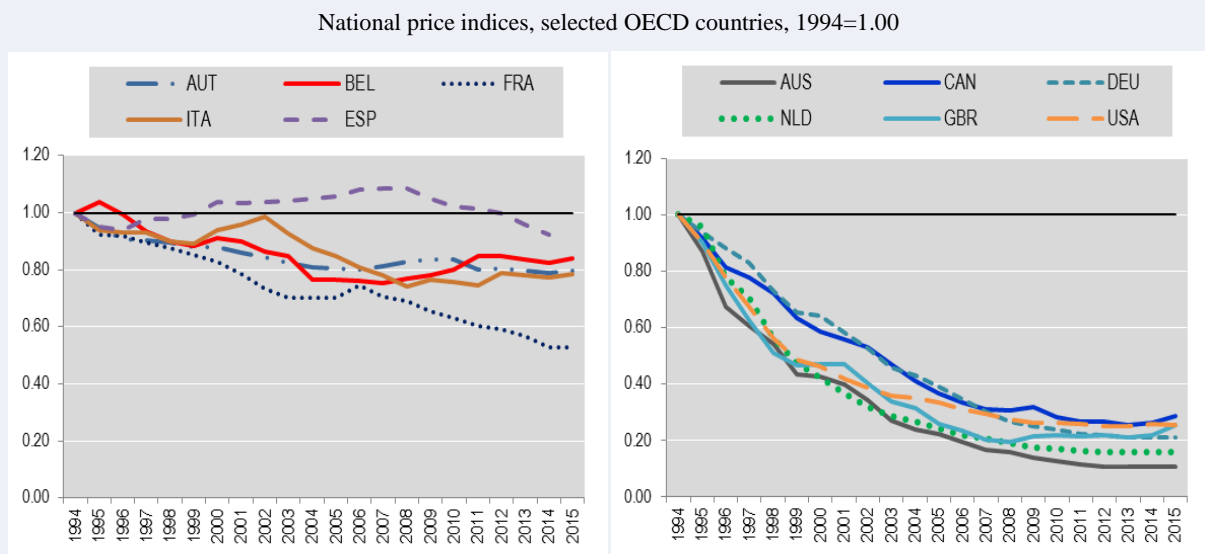
Measuring prices and volumes of ICT investment is a challenging task, due to frequent changes in quality and specifications of ICT assets. Inadequate adjustment for quality change may affect the distinction between price and volume changes, thus leading to overestimate growth of quality-adjusted prices and underestimate of growth of volumes.

Price measurement of communication services, which are used to estimate telecommunication assets in volume, is further complicated by the great variety of pricing plans and bundles, and, in some cases, funding models involving data collection and/or advertising (OECD, 2019).

Against the expectation that price movements are broadly similar across countries for globally traded goods, price indexes used in SNA for ICT equipment, software and databases, and communications services shows large differences (Ahmad et al., 2016).

As an illustration, Figure 4 compares price indices for investment in computer hardware and telecommunications equipment across selected OECD countries over 1994-2015. The decrease in the price index is 80% or above in the countries shown in the right-hand panel while it is about 20% in most countries in the left-hand panel. Cross-country differences of a similar scale are also observed for the price indices of the other ICT assets.

**Figure 4. Price indices for investment in computer hardware and telecommunications equipment**



Source: Ahmad et al, 2016.

The OECD and IMF are currently working on these issues in order to improve measurement of the digital economy and increase cross-country comparability of price deflators for ICTs (Reinsdorf et al., 2018).

Trends in investments in telecommunication equipment in volume are reported in Figure 6. In 2015-17, the ratio to GDP was the highest in Austria (1.1%) and the United States (0.8%) and the lowest in Norway (0.1%) and the United Kingdom (0.2%). Over the period

1996-2015/17, investment in telecommunication equipment relative to GDP increase the most in Mexico (16% a year), Lithuania (15%) and the United Kingdom (13%) while it decrease in Austria (-1% a year).

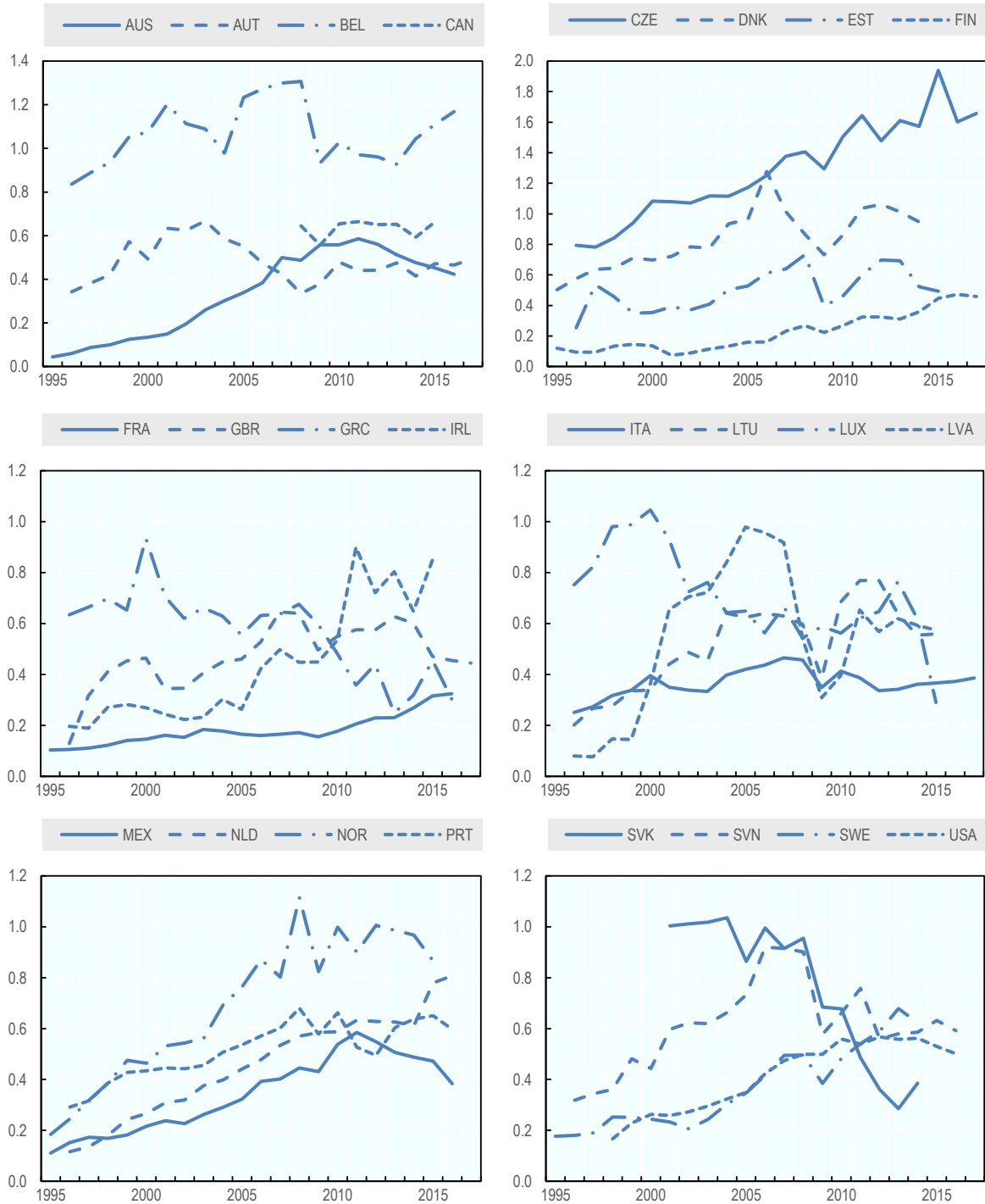
Over 1996-2015/17, investment in computer software and databases in volume increased, relative to GDP, in all countries except the United Kingdom (-1% a year). As shown in Figure 7, the increase was the largest in Lithuania (16% a year), Norway (15%) and Australia (13%). In 2015/17, the ratio in volume between investment in computer software and databases was the highest in France (3.3%), the Netherlands (3.1%), Austria and the Czech Republic (both 2.6%) and the lowest in Portugal (1.3%), Canada (1.2%) and Hungary (1.0%).

Figure 8 shows trends in ICT investment by industry for the OECD average in 1996-2015. Not surprisingly, Information and Communication Services have the highest investment ratio for all three ICT components: hardware, telecommunication equipment and software and databases. Interestingly, investment in hardware and telecommunication equipment shows a downward trend since the early 2000s even within this industry.

In 2015, investment in software and database were the highest in Financial and insurance activities (4.2% of value added) and Professional, scientific and technical services (2.9%). The upward trend in investment in software and database seem to cuts across most industries but is particular strong in: Wholesale trade; Professional, scientific and technical services; Public administration; and Electricity, gas and steam supply.

**Figure 5. Trend of investment in computer hardware, 1995-2015**

Gross fixed capital formation as a percentage of value added (volume)

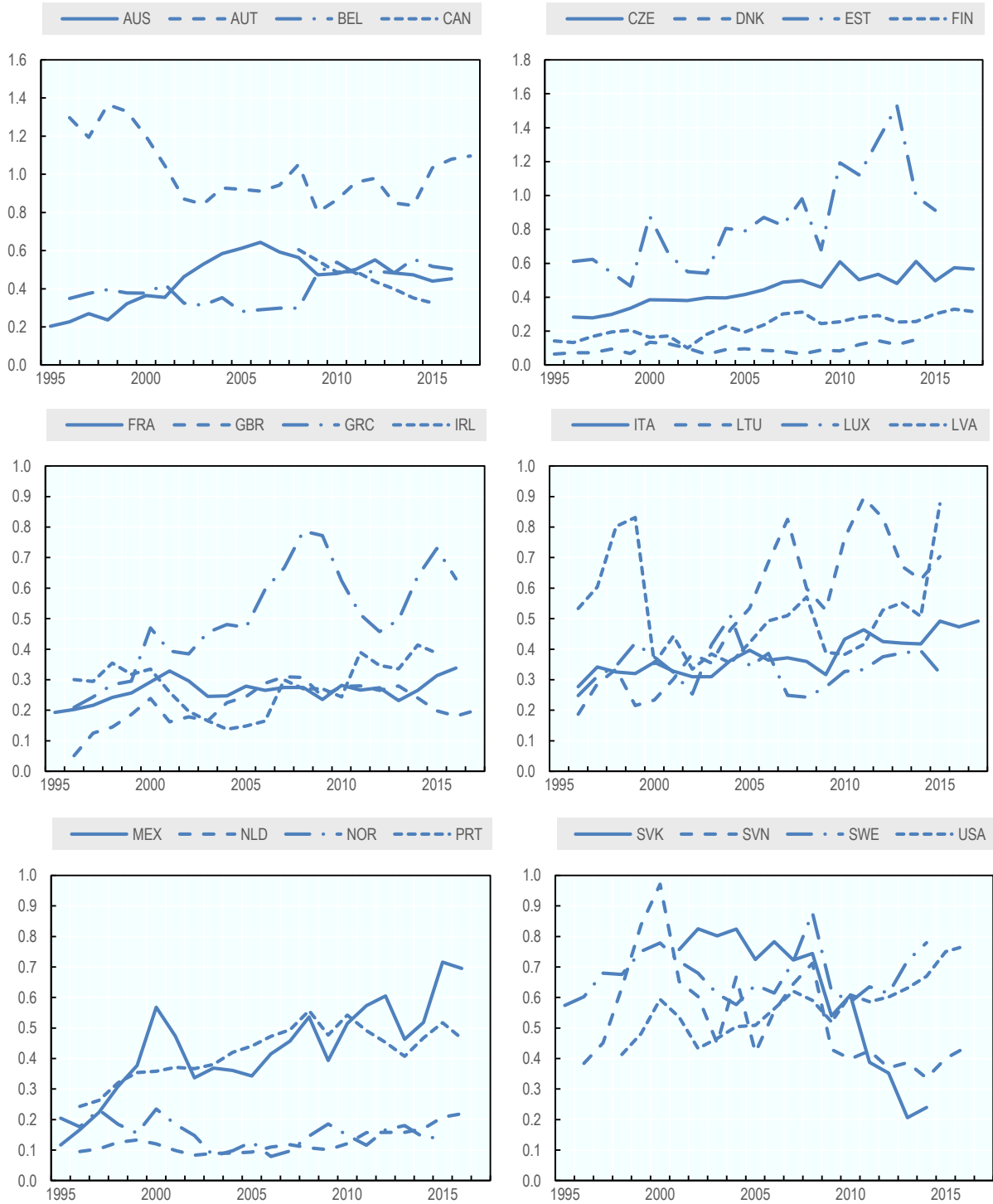


*Note:* All variables are in volume, based on the same country-specific year constant prices, and shown for the reference year 2012.

*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

**Figure 6. Trends in investments in telecommunication equipment, 1995-2015**

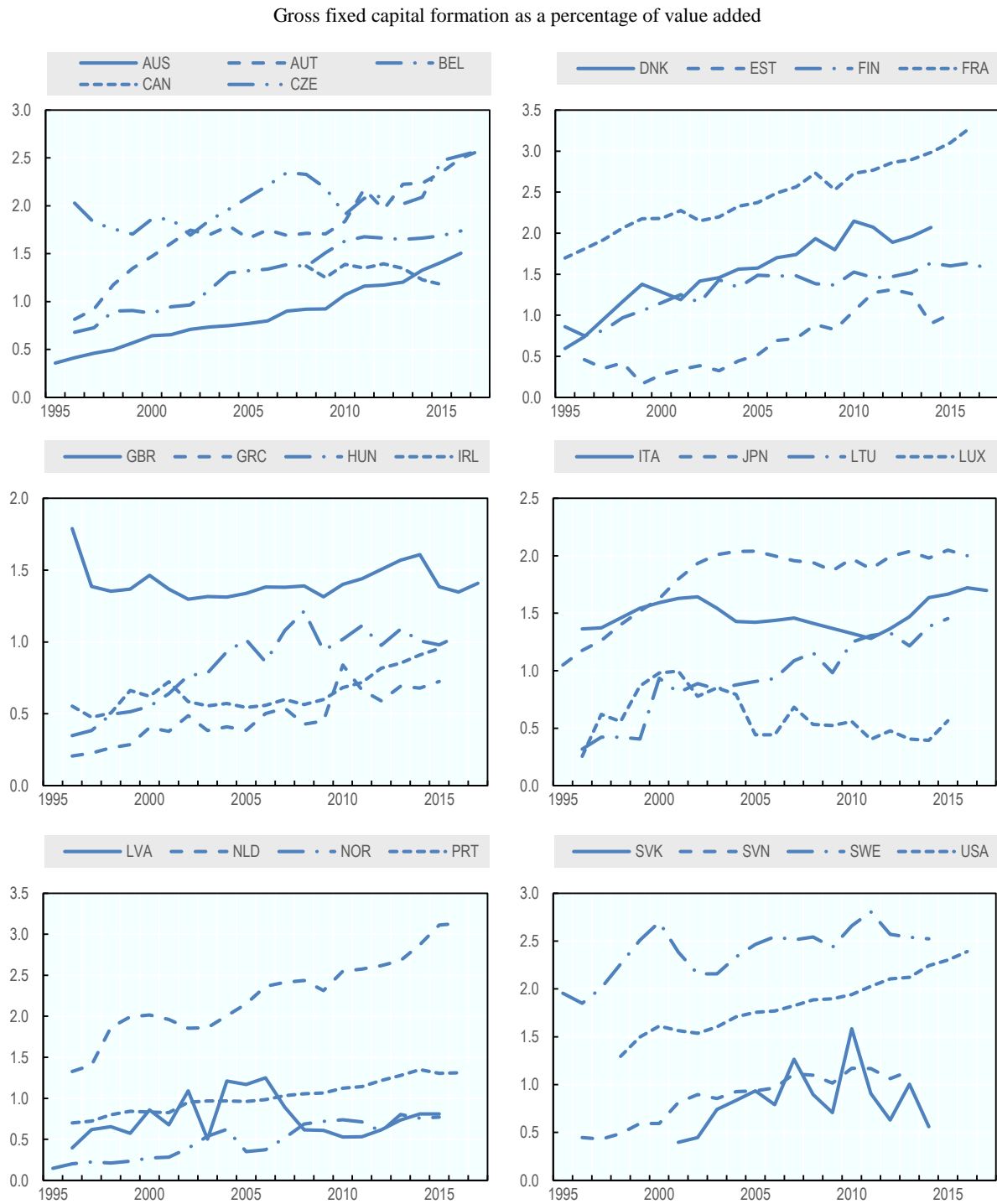
Gross fixed capital formation as a percentage of value added



*Note:* All variables are in volume, based on the same country-specific year constant prices, and shown for the reference year 2012.

*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

**Figure 7. Trend of investment in software and databases, 1995-2015**

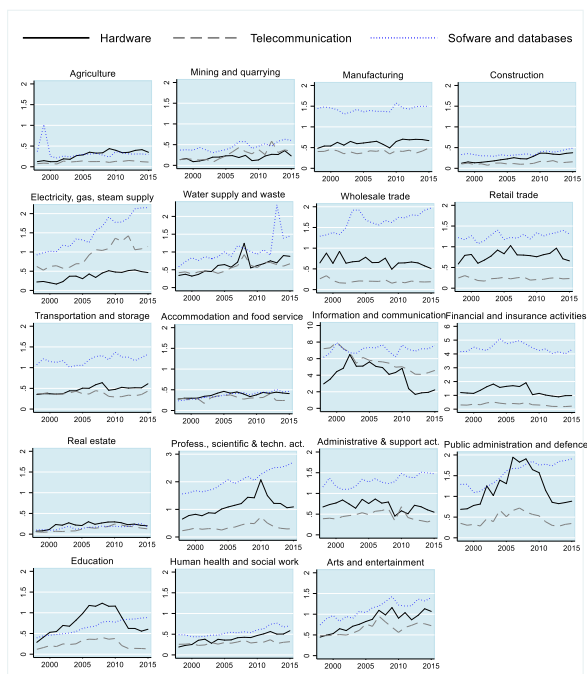


*Note:* All variables are in volume, based on the same country-specific year constant prices, and shown for the reference year 2012.

*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

Figure 8. ICT investment trends by industry, 1995-2015

Gross fixed capital formation as a percentage of value added - OECD unweighted average (volume)



*Note:* The OECD unweighted average shown here is the average of available OECD countries excluding Chile, Costa Rica, Germany, Iceland, Israel, New Zealand and Turkey. All variables are in volume, based on the same country-specific year constant prices, and shown for the reference year 2012.

*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

## 1.2. Investment in R&D in ICT activities

ICT-related research and development (R&D) expenditures are a further component of ICT investment. As such, they can be undertaken by the ICT sector as well as by other industries, e.g. software development in the automobile industry. In most countries, however, statistics on the overall ICT-related R&D, i.e. by technology field, are not available. Therefore, this Section will look at R&D investment by the ICT supplying sector as a proxy of ICT-related R&D.

While the ICT sector is likely to be the largest investor in ICT-related R&D, the proxy: *i*) leaves out ICT-related R&D by other industries; and *ii*) includes some R&D by the ICT sector that are not related to ICTs.

Following the OECD definition of ICT supplying industries (2011), based on the International Standard Industry Classification Revision 4 (ISIC Rev. 4), the following industries have been included: “Manufacturing of computer, electronic and optical products”; “Publishing activities”; “Telecommunications”; and “IT and other information services”. Some of these industries are broader than those delimited by the OECD definition but are the finest level at which R&D statistics are available<sup>1</sup>.

Among all ICT industries, R&D investment relative to value added seems to be the highest in the manufacturing of computer, electronic and optical products (Figure 9). In 2016, France (33%) Finland (28%) and the United States (24%) showed the highest intensity of R&D investment in ICT manufacturing. Over 2005-2015/17, Sweden, France, Finland and the United Kingdom, where R&D-value added ratios were the highest at the beginning of the period, showed a strong downward trend in R&D investment in ICT manufacturing. In Hungary, the ratio increased until 2011 and decreased afterwards while in Portugal it increased steadily since 2011 and until the end of the period.

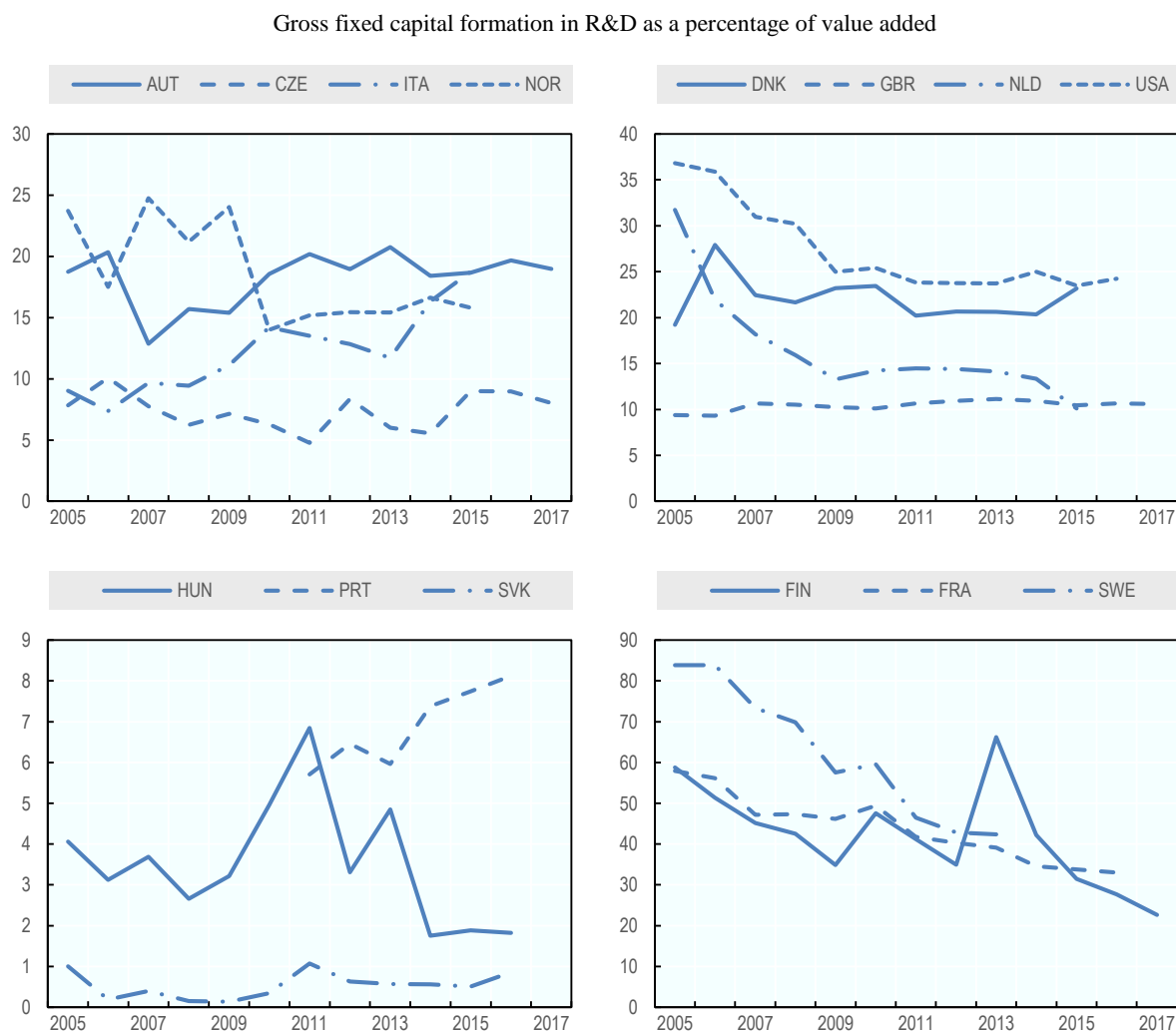
In publishing activities (Figure 10), R&D investment relative to value added in 2016 was the highest in Finland (3.7%) and the United States (3.2%). Norway showed the fastest growth over the whole period 1996-2017. In Denmark, the ratio of R&D to value added grew very fast until 2009 but decreased sharply afterward. Fast growth in Austria was also interrupted by a sharp decrease in 2007 but went back to the previous trend from 2009 on. Overall, R&D investment in publishing activities shows a strong sensitivity to the business cycle, with exception of the United States where the R&D investment -value added remained high during the whole period.

R&D investment in telecommunications show a downward trend, relative to value added, in most OECD countries over 1995-2017 (Figure 11). This trend is particularly strong in countries having high R&D investment in telecommunication at the beginning of the period, i.e. Norway, Finland, Sweden, Denmark, France and the United Kingdom. In Italy, R&D investment in telecommunications grew fast in 2000-09 but dropped afterwards. A large decrease in 2010-15 occurred in Portugal as well. Austria is the only country having increase R&D investment relative to value added in telecommunication.

R&D investment trends in IT and other information services, i.e. computer programming, data processing and hosting, and web portals related activities, vary largely among OECD countries (Figure 12). Hungary registered fast growth over 2003-14 but a sharp drop afterward. Growth was pronounced in Austria as well until 2013 but then slowed down. In the Netherlands, the United States and the United Kingdom, where R&D investment relative to value added in IT and other information services were the highest mid-1990s,

show a sharp decrease all over the period. Denmark and Finland show large cyclical fluctuations in the 2000s and a downward trend afterwards.

**Figure 9. Trends in R&D in ICT manufacturing, 2005-2017 or latest available year**



*Note:* All variables are in volume, based on the same country-specific year constant prices, and shown for the reference year 2012.

*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

**Figure 10. Trends in R&D in Publishing**

Gross fixed capital formation in R&D as a percentage of value added

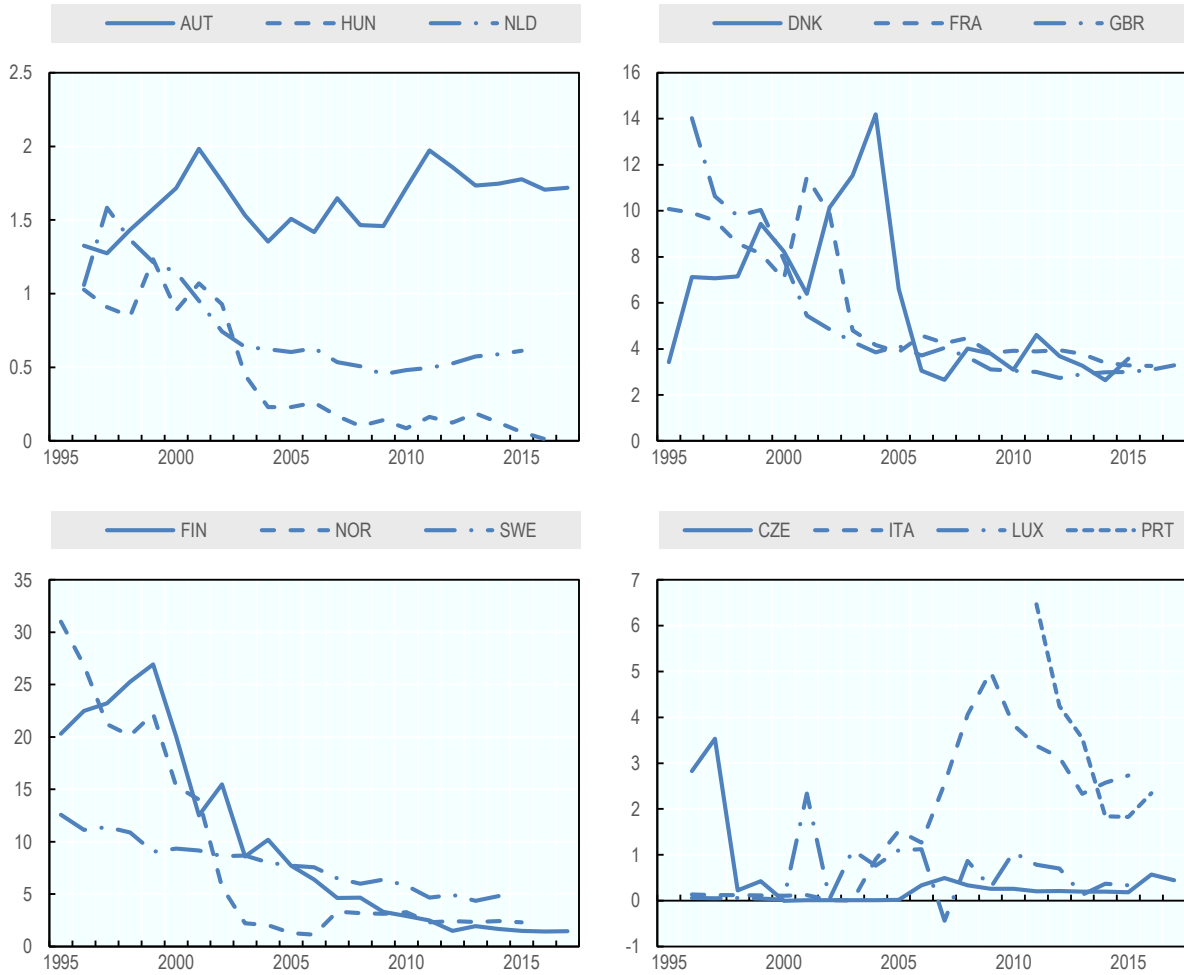


*Note:* All variables are in volume, based on the same country-specific year constant prices, and shown for the reference year 2012.

*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

**Figure 11. Trends in R&D in telecommunication activities**

Gross fixed capital formation in R&D as a percentage of value added

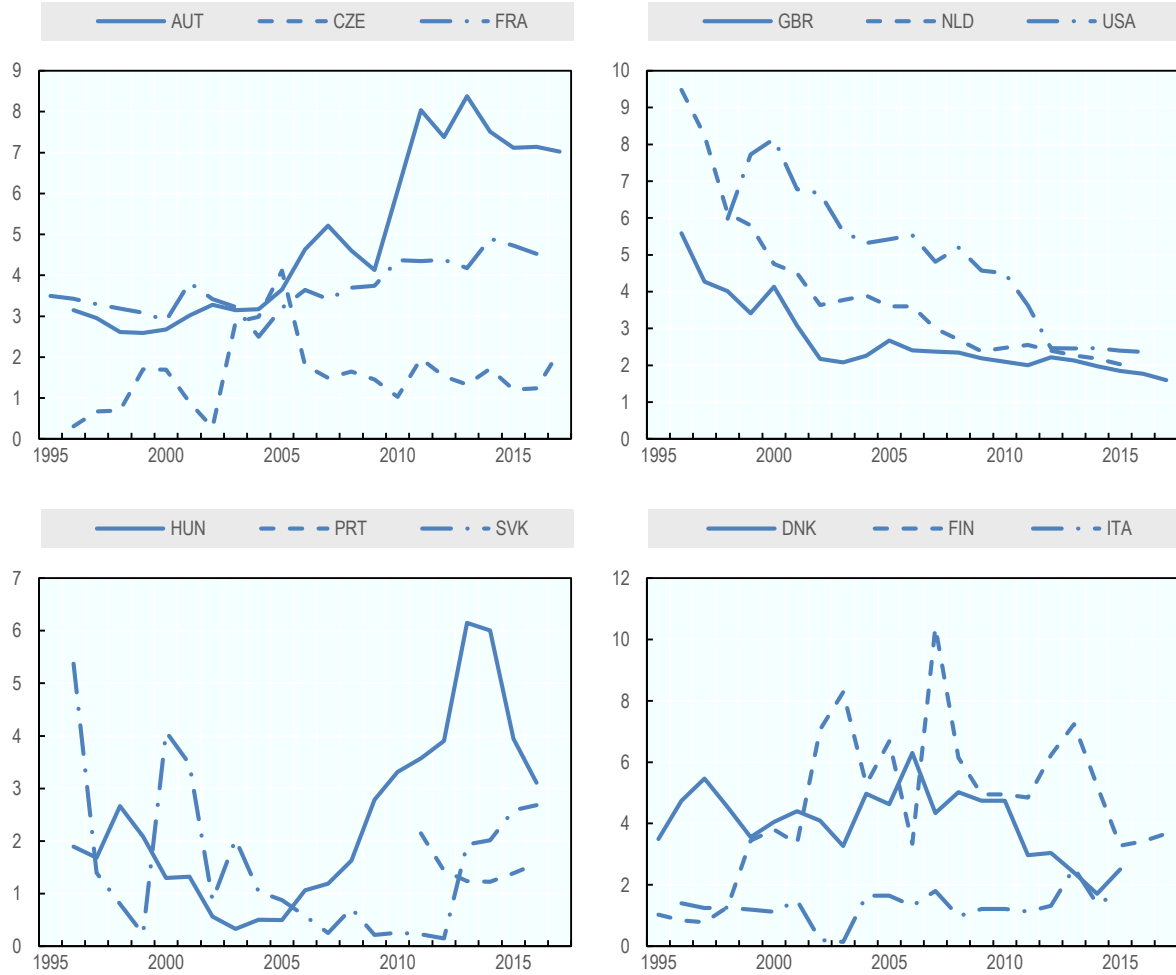


*Note:* All variables are in volume, based on the same country-specific year constant prices, and shown for the reference year 2012.

*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

**Figure 12. Trends in R&D in IT and other information services**

Gross fixed capital formation in R&D as a percentage of value added



*Note:* All variables are in volume, based on the same country-specific year constant prices, and shown for the reference year 2012.

*Source:* Calculations based on OECD National Accounts (database), [https://stats.oecd.org/Index.aspx?DataSetCode=SNA\\_TABLE8A](https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A) (last accessed in October 2018).

## 2. ICT investment policies in OECD countries and selected Partner economies

This section presents an inventory of ICT investment policies in OECD countries and selected partner economies based on the responses to the Digital Economy Outlook (DEO) questionnaire 2017 and a follow-up survey carried out in the same year. Further information has also been collected from the governments' websites.

Its aim is twofold. The first is to provide a sense of the breadth and scope of instruments used by countries to support ICT supply and use. The second aim of this inventory is to provide a background for the discussion on policy evaluation developed in Section 3.

### 2.1. The DEO questionnaire 2017

The DEO questionnaire 2017 includes the following two sets of questions related to ICT investment policies:

- Does your country have policies in place to support the growth of the ICT-supplying sectors, including through innovation policies?
- Does your country have in place policies to increase the adoption and use of ICTs by firms?

Such policies have been clustered according to their objectives and instruments, as shown in Table 1.

**Table 1. Policies to support ICT investment**

<b>Policies to support the growth of the ICT-supplying sectors</b>	<b>Policies to increase the adoption and use of ICTs by firms</b>
<b>Support to investment (excluding R&amp;D)</b> e.g. tax incentives, loans, etc.	<b>Financial support to ICT investment and expenditures</b> e.g. tax incentives, cash subsidies, loans, etc.
<b>Support to innovation</b> e.g. R&D subsidies, incubators, standard settings, etc.	<b>Non-financial services</b> e.g. business information, trade shows, feasibility studies, standard settings, etc.
<b>Support to exports</b> e.g. service subsidies, cash subsidies, etc.	<b>Others</b>
<b>Other support to firms</b> e.g. block grants, training, etc.	

*Source:* OECD Digital Economy Outlook Questionnaire 2017, follow-up survey and national governments websites.

### 2.2. Fostering growth of the ICT sector

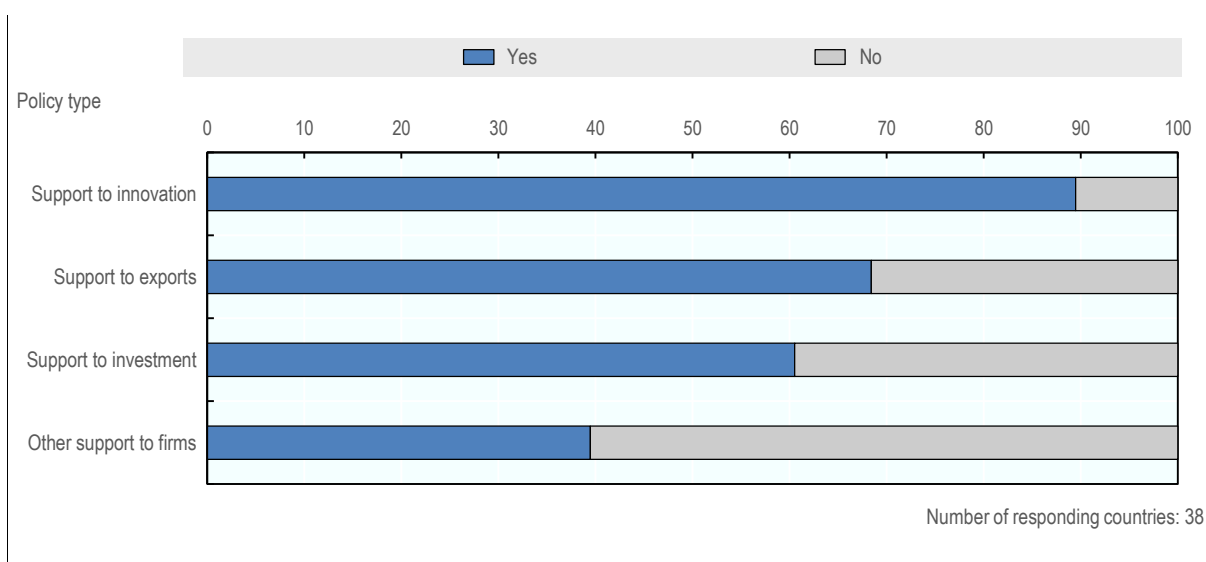
All responding countries<sup>2</sup> (38) have policies to support the growth of the ICT sector. Most target innovation, investment, or exports. Thirty five of them reported having at least one policy that specifically supports innovation, compared to 26 with measures directed at

expanding firm exports, 24 with policies that promote ICT sector investment, and 12 with policies related to other ICT sector development (Figure 13). Innovation policies seem to have a wider breath as countries have 76 distinct policies to promote innovation in the ICT sector, as opposed to investment and exports, which have 51 and 41 policies, respectively (OECD, 2017).

Although not directly targeted to investment, both innovation and export policies for the ICT sectors aim to promote the growth of firms in the sector, thus their investments, which largely consist of ICTs.

Support to the ICT sector is delivered through a variety of means, including tax incentives, loans, R&D subsidies, export subsidies, block grants, and educational training programmes. Of all the policies reported by countries in the survey, 39% targeted SMEs and start-ups, while 25% were focused on companies in the ICT sector, 17% were open to all companies and the remaining 19% had other firm requirements.

**Figure 13. Policies to support ICT growth sector**



*Source:* OECD Digital Economy Outlook Questionnaire 2017, follow-up survey and national governments websites.

The most frequent policy measure to strengthen the ICT sector is funding, which may include subsidies for companies to undertake further investment in infrastructure or research and development (R&D), or to encourage exports.

Governmental funding programmes are used frequently to encourage innovation and investment, and are employed by all surveyed countries with the exception of Colombia, Latvia and the Russian Federation. Government sponsored training programmes are also commonly seen as a way to develop expertise in ICT and thereby to promote innovation. These projects may be aimed at developing knowledge, sharing experiences and creating best practices, or providing expertise on a subject so that local firms can better compete in the market. Tax incentives and faster depreciation of capital goods are common tools used in many countries.

In addition, 16 countries offer a mixed policy approach which often includes a training component in conjunction with other types mentioned above, like grants, subsidies, loans

or tax exemptions. Finally, many governments establish high-level strategies as a way to support ICT development at a broader scale, for instance in digital or innovation strategies.

Several governments, in an effort to promote innovation, have launched programmes aimed at helping start-ups or young SMEs through accelerators or incubators. Fourteen of the 34 respondent countries have such programmes, making it the third most common ICT policy. While both accelerators and incubators share the same aim – to help starting businesses grow – their methods differ. Both types of institutions rely on a network of entrepreneurs to promote synergies and learning from other members, as well as some sort of mentorship, but accelerators also provide intensive education along with seed funding for the selected businesses in exchange for taking ownership of a share of the business.

Other countries have programmes where the government acts as a guarantor for start-up companies or SMEs to facilitate their access to finance in the early development stages. Another way to ease the firm creation is to accompany it by “regulatory sandboxes”, which allows the temporary provision of licenses in sectors using new technology (World Bank Group, 2017). This approach is being used in a number of countries, e.g. Denmark, Sweden and the United Kingdom.

**Table 2. Supporting policies to ICT growth sector**

Policies to support ICT sector growth by area: overall, investment excluding R&amp;D, innovation and exports

Country	Overall	Innovation	Exports	Investment	Other support
Australia	✓	✓			✓
Austria	✓	✓			✓
Belgium	✓	✓	✓		✓
Brazil	✓	✓	✓	✓	✓
Canada	✓	✓	✓		✓
Chile	✓	✓			
China	✓	✓	✓	✓	✓
Colombia	✓		✓		✓
Costa Rica	✓	✓		✓	✓
Czech Republic	✓	✓		✓	
Denmark	✓	✓		✓	
Estonia	✓	✓	✓	✓	
Finland	✓	✓	✓		✓
France	✓	✓	✓	✓	
Germany	✓	✓	✓		✓
Hungary	✓	✓	✓	✓	✓
Ireland	✓	✓	✓	✓	✓
Israel	✓	✓	✓		✓
Italy	✓	✓	✓	✓	
Japan	✓	✓			
Korea	✓	✓	✓	✓	✓
Latvia	✓	✓	✓		✓
Lithuania	✓	✓	✓	✓	✓
Luxembourg	✓	✓		✓	
Mexico	✓	✓		✓	
Netherlands	✓	✓	✓		
New Zealand	✓	✓	✓		✓
Norway	✓	✓	✓		
Poland	✓	✓	✓	✓	
Portugal	✓	✓	✓		✓
Russian Federation	✓		✓	✓	
Singapore	✓	✓		✓	✓
Slovenia	✓	✓			
Spain	✓	✓	✓	✓	
Sweden	✓	✓			✓
Switzerland	✓	✓	✓		
Turkey	✓	✓	✓		
United Kingdom	✓	✓	✓	✓	

Source: OECD Digital Economy Outlook Questionnaire 2017, follow-up survey and national governments websites.

### 2.2.1. Support to innovation in the ICT sector

Countries use a variety of measures to support innovation in the ICT sector. For instance, in *Australia*, the National Innovation and Science Agenda (NISA) undertakes a wide range of measures, including financial support for innovative business, research-business collaboration, skills, government procurement and data policy. The 2018-19 Budget announced an AUD 2.4 billion investment in research, science and technology capabilities.

The "Smart and Digital Services Initiative (SDS-I)" in *Austria* serves to promote R&D projects for innovative service. The initiative has two main focuses. The first "Industry 4.0", which offers services such as monitoring systems new business models based on sensor data and networked systems. The second is "Blockchain", which makes it possible to manage data and exchange values in all application areas securely and transparently, in a decentralised manner and without "middlemen". Funding is usually provided as a grants. Also, the Austrian programme "Benefit" promotes R&D for ICT products and services aimed at improving the quality of life of elderly people and helping them to live more independently as long as possible. Finally, "ICT of the Future" (FFG) is the funding programme of the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT) for the promotion of challenging technology development and innovation in ICTs, interlinked with application fields and societal challenges. The programme supports ICT innovation in different ways, for instance through a "one-stop shop" offering a diversified and targeted programme portfolio. Overall, FFG gives Austrian businesses and research facilities quick and easy access to research funding.

*Belgium's* government runs WeLL (Wallonia e-health Living Lab). The programme provides a platform to health-related firms where participants can discuss creative ideas and find technological solutions.

In *Brazil*, the "Information Technology Law" is an important instrument of the Brazilian innovation promotion policy. Issued in the early 1990s, the law aims to boost competitiveness and increase technical training of Brazilian companies producing computer, automation and telecommunications goods. As a counterpart to the tax incentives, beneficiary companies should promote investments in R&D, based on yearly plans established by the companies, and whose results are evaluated annually. In 2014, 510 companies benefited from the tax incentive initiative "*Informática 37*".

The National Research Council of *Canada* (NRC) conducts the Industrial Research Assistance Program (IRAP), which provides support to SMEs for the development and commercialisation of technologies, including ICTs. In 2016-17, CAD 172 million of the Federal Budget was dedicated to on-going IRAP funding.

In *China*, the Department of Science offers enterprises supports for ICT innovation, especially in key infrastructure and core technology sectors since 2015. The 12th 5-year plan (2010 – 15) set an R&D spending target of 2.2 percent of GDP by 2015, the support for R&D has been renewed through the 13th 5-year Plan (2015 – 20). Chinese businesses financed 76.1 percent of the country's gross expenditure on R&D in 2016. As part of the "Made in China 2025" programme, 901 government guidance funds were launched for helping financing R&D of Chinese firms. Tax breaks are also being provided to firms to further incentivise investment in R&D. The Department of Science also encourages patent applications in the ICT sector.

The Ministry of Science and Technology (MICIT) of *Costa Rica* supports technological innovation and patents in targets ICT SMEs through the innovation fund PROPYME, which provide non-reimbursable financial support, up to 80% of the total cost of innovation and technological development projects.

In 2016, the Ministry of Higher Education and Science of *Denmark* spent DKK 207 million (EUR 28 million) for the "Innovation Incubator Scheme". Four incubators provide professional counselling, pre-seed and seed capital for entrepreneurs and new innovative start-ups, out of which 40% were ICT firms in 2016. The innovation incubators operate at the earliest stage of the investment chain, where venture capitalists and other private

investors are reluctant to engage. Through the “Innobooster programme”, the Danish Innovation Fund provides grants for knowledge-based innovative projects from SMEs, start-ups and scientists, which are mostly ICT projects. The grants for these projects, which are mostly focused on ICTs, range between DKK 500 000 and DKK 5 million (EUR 67 000 and EUR 670 000).

Since 2004, Enterprise *Estonia* (EAS) has supported the creation of “Technological Competence Centres” to improve availability of R&D, technological development and innovation for companies in ICT-related sectors. The centres are co-financed by the European Union Regional Development Fund (ERDF).

*Business Finland* (formerly Tekes) has a growth accelerator programme supporting Finnish companies to go global, as well as providing funding for innovation. Over EUR 330 million have been engaged between 2014 and 2018 to support all types of companies in R&D projects on 5G, wireless technologies, IoT, cloud services, software, big data and cyber security.

In 2013 *France* launched a programme called “French Tech”. French Tech allocates EUR 200 million to the development of start-up accelerators, targeting technology firms engaged in key sectors such as health, clean energy, biotechnologies, and finance. “Investissements D’Avenir” (“Investments of the Future”) is another programme run by France, targeting research, education and the digital economy. By the end of 2015, the programme had financed about 2 500 projects in these areas for an amounts of EUR 37 billion, out of a total budget of EUR 47 billion. The Ministry of higher education, research and innovation leads several initiatives to develop business innovation, among which “I-Lab” support system for the creation of innovative companies, business incubators, research tax credit (“crédit d’impôt recherche (CIR)”), competitiveness clusters, public-private research centers (Carnot institutes), student entrepreneurship centres, business accelerators. Over EUR 3 billion have been allocated to “ICT 2020”, a support programme to consolidate and expand Germany’s ICT sector, which includes improved access to technological know-how for SMEs and support activities. “Micro-electronics” is a EUR 4 billion programme aimed at boosting innovation related to micro-electronic components, which are central to Germany’s competitive position. Cyber security is the subject of “Safe, secure and empowered in the digital world”, a programme with a budget of almost EUR 2 billion. Two other programmes, for a total budget of EUR 4 billion, focus on robotics, AI and the interaction between human workers and machines.

*Ireland* helps ICT sector innovation via “Enterprise Ireland” (EI) through direct funding and grants, technology centres and “Campus incubation centres” for start-ups. EI also provide assistance to ICT companies to access EU and ESA research supports for instance in the areas of embedded systems (ARTEMIS) and nanoelectronics (ENIAC).

In *Israel*, the Innovation Authority runs Tnufa, a program supporting over one thousand technological start-ups with USD 3 million budget. An additional Incubator program provides a specific fund of USD 41 million.

In *Italy*, “Venture Capital Fund” supports venture capital investment in firms with high growth potential. It is financed by a combination of national and international private investors, with the goal of supporting innovative start-ups. A similar programme, “Smart and Start”, supports the establishment and growth of new businesses in the digital economy. Interest-free loans to cover capital investment and operating costs related to starting a business. The loan amount can cover up to 80% of expenses (maximum EUR 1.2 million),

if the start-up consists entirely of people under the age of 36 or women, or includes at least one Italian PhD who has been permanently engaged abroad. Furthermore, the research tax credit, set up in 2015 has been extended until 2020 and strengthened from a rate of 25% to 50% on incremental Research and Development costs up to an annual ceiling of EUR 20 million a year per beneficiary, calculated on the basis of the average expenditure on Research and Development in the years 2012-2014. Finally a “Patent Box” initiative has been introduced. The aim of the “Patent Box” is to attract more long-term domestic and international investors by offering a special rate of taxation for incomes deriving from the use of intellectual property rights.

In *Japan*, the programme "Strategic Information and Communications R&D Promotion" provides incentives to R&D in ICT firms, by creating partnerships between universities, independent administrative institutions, companies and local governments. Designated experts identify key areas of development to which targeting funds of around JPY 1.5 billion. Another programme of JPY 5 billion targets a specific technology. It promotes innovation hubs with a focus on IOT in order to accelerate the adoption and diffusion of the technology, especially in SMEs and start-ups.

The new Ministry of SMEs and Start-ups (MSS) of *Korea* is encouraging closer collaboration between 25 public research institutes to provide enterprise-oriented “One-stop service” for businesses for counselling SMEs, provide research assistance and grant patents for free. The “Smart Challenge Project” targets more specifically ICT-related sectors.

In *Latvia*, there are no ICT sector specific incentives for innovation though ICT firms may use the broader supports, corporate tax incentives on specific business R&D depreciations, and support to collaboration between scientists and businesses and Innovation Voucher Scheme.

In *Lithuania*, the Research and development programme 2014-20 has a budget of EUR 326 million for increasing the intensiveness of RDI activities in the private sector. Smartinvest LT+, funded on EU Structural Innovation Fund, aims at attracting foreign direct investment (FDI) to R&D activities related to research and development, research infrastructures and process or organisational innovations. Also direct grants are provided with the “Intellect” joint science-business project programme along with R&D tax incentive. In August 2017, the Open Circle Capital (risk capital fund) was launched to support new technology venture creation and scaling up.

In 2014, *Luxembourg* launched the "Digital Luxembourg" to increase collaboration between public and private sector research through better coordination and researcher mobility by concentrating research activities in the City of Sciences, Research and Innovation in Belval. Support to young start-up companies with the Technoport and House of Biohealth incubators SMEs are supported through Fit4Digital and Fit4Start programmes providing funding, coaching and training. Finally, the LHoFT Foundation (Luxembourg House of Financial Technology) is a public-private joint venture that drives technology innovation for Luxembourg's financial services industry.

Since 2004, the Ministry of Economy of *Mexico* has introduced a specific program PROSOFT for the innovation and development of Software Industry. In 2016, around 400 companies were supported.

In the *Netherlands*, the Ministry of Economic Affairs and several institutes have allocated EUR 40 million to accelerate ICT-innovation among businesses. Dutch Digital Delta is the platform that connects scientists and corporate businesses with each other and

governments. Moreover, the programme provides knowledge-sharing initiatives and financing options, stimulating public and private co-operations. At the same time, the National Cybersecurity Strategy cooperates in enhancing the resilience of the Netherlands in the digital domain, by building a safe, open and stable information society by sharing knowledge, providing insight and proper perspectives for action.

The Norwegian government's main instrument for innovation and development of enterprises and industry, Innovation *Norway*, provides competence, advisory, promotional and network services. Though there is no scheme specifically targeted on ICTs, in 2016 Innovation Norway approved 849 applications for funding of projects in the ICT sector, representing 15% of the total number of applications approved in that year.

*Poland* has adopted a “Strategy for Responsible Development”, a programme supporting ICT-related R&D targeted to academia and private business. In 2016-17, two specific grant programmes have been launched in sectors of cybersecurity and gaming industry.

In *Portugal*, the Innovation National Agency (ANI) promotes R&D investment in businesses through tax incentive with the Sifide programme and through several financial incentives. For the period 2014-16, 360 firms have benefited from the R&D co-promotion programme and 83 firms from the Demonstrators programme. The first of these two programmes aims at establishing mid- and long-term partnerships among different R&D actors, by co-planning development of new technology activities. The latter programme consists of projects demonstrators of advanced technologies and pilot lines. The Ministry of Science, Technology and Higher Education also supports the International Partnerships that enable, foster and strengthen scientific collaboration among Portuguese universities and their integration into internationally acknowledged networks. Currently the International Partnership programmes are "MIT-Portugal", "Carnegie Mellon-Portugal", "UT-Austin Portugal" and "Fraunhofer Portugal Research". In addition, “Business Innovation and Entrepreneurship” is a programme promoting innovation in business, through the production of new goods/products, services and processes that support its progression in the value chain.

In *Singapore*, the government has launched the “Incubator Development Programme” to support start-up creation. The programme provides for grant support of up to 70% of costs for the creation of start-up incubators. The Infocomm Media Development Authority (IMDA) has also launched various ICT-specific research and innovation programmes such as AISG on artificial intelligence or Singapore Data Science Consortium (SDSC) on data science projects.

*Slovenia* has issued a call for proposals to support research and development programmes, aiming at developing research projects, and linking partners from industry and public research sector.

Within the framework of its *Strategic Action in Economy and Digital Society*, *Spain* has allocated EUR 36.3 million to R&D projects in low-maturity technologies by for-profit firms, being active by no less than 3 years. Projects are focus on electronical devices, IoT, cloud computing, big data, high performance computing, robots and autonomous systems, cross sectorial solutions, 3D printing, cybersecurity and cross-sectorial applications.

In *Sweden*, the Research and Innovation Bill 2017 sets the orientations for R&D policy with a ten-year perspective with an allocation of SEK 3 billion (USD 355 million) until 2020. The Swedish Research Council and Swedish Innovation Agency (Vinnova) allocate nearly SEK 900 million annually for research and research infrastructure related to ICT, out of which SEK 150 million (USD 18 million) are dedicated to research on the 5G mobile

technologies conducted by the centre at the Royal Institute of Technology. Additional funds have also been allocated for research on machine learning to the Knowledge Cluster in Stockholm, one of the three most prominent centres in the world, and to the Linköping University. The 2017 bill provides for an increase in grants to the Research Council in order to support data-driven research. Furthermore, the Innovation Council has participated in the governments establishing of five innovation partnership programmes (IPPs), which provide an umbrella for existing innovation programmes. The five IPPs are: i) next-generation travel and transport; ii) smart cities; iii) circular and bio-based economy; iv) life science; and v) connected industry and new materials. Digitalisation cuts across all five programmes. With about SEK 2.11 billion (USD 250 million), “Connected industry and new materials” was the IPP with the largest amount of grants financed by Vinnova in 2017.

*Switzerland* has a specific National research programme on big data with a budget of CHF 25 million (EUR 22 million) for 2015-23.

In *Turkey*, profits resulting from software development and R&D activities are exempt from income and corporate taxes. Software and services produced in these zones are exempt from value added taxes. Salaries of researchers, software and R&D personnel employed in these zones are exempt from all taxes.

The *United Kingdom* runs several programmes to support innovation in ICTs. “HutZero”, for instance, is an early stage cyber security accelerator, offering a business mentoring programme. Other programmes aim at encouraging the commercialisation of academic research, or helping the most promising technological SMEs to scale up. The United Kingdom runs programmes dedicated to local development, such as “DCMS”, which provides GBP 11 million to Leeds, Sheffield and Manchester local authorities to host three incubator spaces for start-ups and SMEs. Innovative financial services firms are supported through “Fin Tech Innovation Hub”. Finally, a regulatory sandbox has the objective of to provide businesses with an environment where they can test their services with real consumers, without immediately incurring the normal regulatory consequences of engaging in the activity in question.

### 2.2.2. Support to exports by ICT firms

In *Belgium*, all firms engaged in digital business can benefit from the services of “digital wallonia.be”, a platform promoting Belgian firms in the international market. The platform is meant to emphasise all aspects of digital technology such as e-business, e-commerce, e-tourism, e-learning and eHealth. “Boost-Up/TIC” consists in a call for creative projects, where the winner – which is specialised in ICT related services - has access to a loan aimed at increasing its presence on the international markets.

Through the *e-Xport* initiative, *Brazil* promotes a complete program for companies to increase exports via e-commerce.

In *Canada*, the Canadian Trade Commissioner Service (TCS) spend about USD 195 million in 2014-15 to support the commercialisation of technologies developed by Canadian researchers and businesses through partnerships in foreign markets, counselling and marketing strategies.

In *Colombia*, 700 IT companies have benefited from USD 6 million financial aid over 2014-16 within the “Colombia Bring It On” programme for strengthening their international commercial capacity. Part of the collaboration between the Ministry of Information Technologies and Communications and ProColombia, this program develops workshops, business conferences and seminars, among other events, in which Colombian

businesses connect with potential customers and international investors. "Here We Make it Possible" is an initiative to showcase the Colombian IT and Digital Content Industry to the world, which is also used to strengthen IT and Digital content industries through knowledge transfer.

In *Estonia*, the Ministry of Economic Affairs, in cooperation with Enterprise Estonia, support exporting ability of ICT firms by raising awareness and improving knowledge about export-oriented activities.

In 2015, the Ministry of Economic Affairs and Employment of *Finland* launched the "eCommerce Growth Programme". The programme is based on a study that addressed the trade potential for e-commerce and identified areas of improvements – including developing commercial know-how and finding new potential customers abroad. The main objective of the programme is to increase turnover and export, thus boosting value added and job creation. eCommerce Growth aims to achieve such goals through business coaching and information sharing. Finland also runs the policy package "Digital Health Export Programmes", aimed at boosting export of firms working with technologies that improve the quality of health-care services.

Within his action plan for business growth and transformation "PACTE", *France* support exports by SMEs aiming through a one-stop shop and a digital platform providing support solutions. Ten French start-ups coming from the French Tech and the French Lab and some innovative start-ups oriented to the Chinese market have been the beneficiaries of the acceleration program "Impact China 2019" run by BPI France.

In *Hungary*, the government support mentoring to help ICT start-ups enter international markets.

The "Market Research and Internationalisation Supports" programme, run by Enterprise *Ireland*, aims to increase the export capability of companies through customised sales training and free access to international trade experts. The Department of Foreign Affairs and Trade and the Department of Jobs, Enterprise and Innovation led trade missions and events to give innovative companies the opportunity to connect with existing and new customers, access key decision makers, increase sales in international markets, and exchange ideas.

The *Israel* the Investment Centre from the Ministry of Economy provides grants and tax exemptions for businesses where exports account for over 40% of their revenues.

*Italy* has put in place policies to support firms' penetration in non-EU foreign markets through the launch and distribution of new products and services, with a target to high-tech firms. Specific measures include financing at subsidised interest rates, covering up to 85% of the amount of the budgeted expenses, but not exceeding 25% of average turnover in the last 3 years.

Since 2008, *Korea* has been carrying out several programmes to support exports and globalisation of the software industry. In 2016, the total envelop for these programmes amounted to KRW 2.82 billion (EUR 2.15 million).

Over the period 2016-23, the Investment Development Agency of *Latvia* provided ICT SMEs with EUR 6.2 million support through "International Competitiveness of Clusters" program to and EUR 32 million through the start-ups incubator program.

In *Lithuania*, the Ministry of Economy provides consulting on export matters to SMEs. The service is provided through the delivery of a voucher. The Ministry also provides direct loans to exporting firms, or services aimed at increasing visibility on international markets.

In 2014 the Exporter Development Agency of *New Zealand* (NZTE) received USD 69 million additional funding from the government to increase the number of ICT firms in its portfolio. These companies have access to NZTE's International Growth Fund, which is a grant to assist with market validation, and similar ventures.

*Norway* engages in a series of measures aimed at boosting export of the ICT sector. These include direct loans to buyers of exports from Norway, offered by Export Credit Norway or commercial banks or investors. The loans have a repayment term of two years or more. All loans require full guarantee coverage by GIEK (The Norwegian Export Credit Guarantee Agency) or other suitable financial institutions.

In 2012 the *Russian Federation* introduced the "Supporting access to markets of foreign countries and support for exports" action plan that promotes Russian firms and of those ICT-related firms to increase their export activities.

*Spain* is engaged in "Internationalisation Plan for ICT Companies", with a budget of over EUR 1 billion, aimed at promoting ICT adoption to improve productivity and competitiveness in SMEs to meet the European e-commerce targets and to increase the visibility and international presence of Spanish technology based companies. To achieve the goal, measures involve public procurement and promoting synergies between R&D and international trade.

*Turkey* offers subsidies to specific industries to encourage growth and exports, including the ICT sector. For example, the "Technology Development Zones" provide location-dependent incentives to the cooperation between domestic and international firms.

In the *United Kingdom*, "Great.gov.uk" is an online service to help domestic businesses breaking into overseas markets and take advantage of the global appetite for UK goods and services. The service adds to other programmes such as "E-exporting", which assists over 3 000 companies to become exporters and it has delivered export deals totalling GBP 388 million since 2014. The new digital trade hub is part of an effort to help a further 100 000 more UK businesses export by 2020. Through E-exporting alone, government intends to deliver an additional 20 000 online exporters and GBP 2 billion worth of value to the UK economy by 2020.

### 2.2.3. Support to investment by ICT firms

Since 2016 *Australia* provides new tax breaks for early stage investors in innovative start-ups and introduced new arrangements for venture capital investments. Through the CSIRO Innovation Fund and the Biomedical Translation Fund, the government support greater private sector investment by co-investment in innovative ideas.

Broadband *Austria* 2020 provides state-aid for physical broadband infrastructures. With the "JumpStart" program, the Federal Ministry of Digital and Economic Affairs (BMDW) and Austria Wirtschaftsservice GmbH (AWS) are strengthening the support program for young, innovative start-ups with a focus on supporting and developing the service and competence portfolio of selectively selected incubators and accelerators. The so-called "Once-Only Prinzip" (only once principle) was set up to reduce administrative burdens on innovative start-ups in their early-stages. According to this principle, firms cannot be asked

by the public administration to resubmit information that they have already provided in the past.

The W.IN.G (Wallonia Innovation and Growth) is an innovation funds in **Belgium** targeting digital start-ups at an early-stage or after an accelerator/incubator stage. It also provides a KIKK Belfius prize that awards more innovative start-ups in their domain.

“Usinas Digitais” is a programme run by the Ministry of Science, Technology, Innovations and Communications of **Brazil**. It provides financial support to projects of innovation and technological development with high potential. Another project offers tax reductions for investors that purchase debt issued by telecommunications operators to finance broadband infrastructure projects. The Ministry has also a national start-up acceleration programme “Start-up Brasil”.

In **Canada**, the Business Development Bank of Canada’s “IT Venture fund” invests in emerging Canadian IT companies with a focus on the internet and mobile sectors. It also finances from USD 250 thousand to USD 35 million business loans. The Federal Economic Development Agency for Southern Ontario has another programme that helps SMEs more specifically with the aim to promote economic growth and job creation. Canada’s Accelerator and Incubator Program (CAIP) also provides funding over a five year period to early-stage start-ups and entrepreneurs to develop sustainable and high-growth business through 16 outstanding accelerators and incubators.

In **Colombia** “Apps.co” is an initiative that aims at empowering the new generation of digital business with boot camps and services for start-ups and incubators.

In **China**, “Thirteen Five” information technology strategy is meant to increase financial investment in key areas of information technology and network security. The government intends to increase government purchase to expand the scale of innovative enterprises and their access to funds for science and technology investment. In addition, the government supports enterprises with the objective to increase ICT innovation in key infrastructure and core technology, with a focus on encouraging patent applications.

The government of **Costa Rica** has established a Free Zone Regime (FZR), aimed at creating a competitive investment environment to attract ICT and ICT related sectors. The FZR is system of incentives that the Ministry of Foreign Trade acting - jointly with the President of the Republic - grants to companies that meet certain requirements and obligations.

The Ministry of Industry and Trade of the **Czech Republic** runs a programme aimed at the development of high-speed internet access networks and information and communications technologies. Eligible firms are SMEs, large enterprises, and start-ups. The programme has a budget of EUR 250 million and runs from 2015 to 2020. ICT investment by Czech businesses also benefited from the expansion of the European Structural Investment fund dedicated to competitive and innovative SMEs.

The Ministry of Justice of **Denmark** has improved access to real estate financing of ICT infrastructure for commercial providers of electronic communications networks or services.

In **Estonia**, “Start-up Estonia” programme aims boost to start-ups with global potential by deepening partnership and cooperation with the best start-ups, incubators, accelerators, and public sector and private enterprises in Estonia. Start-up Estonia’s program is powered by KredEx and financed from the European Regional Development Fund with EUR 7 million.

**France** provides fiscal incentives for software development and data hosting. The first consists of expanding the special rate of taxation for incomes deriving from the use of intellectual property rights to software licences (a rate of 15%). A fiscal reduction on electricity charges are also applied for companies in data hosting sectors. Similarly, incentives to adoption of industrial robots are provided, in the form of loans of an amount ranging from EUR 100 000 to EUR 5 million.

In **Hungary**, the Ministry of National Development runs a venture capital programme to help ICT start-ups to enter new markets. It provides also grants and tax exemptions to boost growth.

In **Ireland**, Enterprise Ireland provides direct funding and support to “High Potential Start-up” while SMEs and larger companies may benefit from “Tailored company expansion package” typically by way of grant and/or redeemable preference shares.

In **Italy**, “digital bonuses” consist in fiscal incentives for the purchase of certain categories of assets that are believed to promote technological adoption and digital transformation, investment in intangible assets.

To develop new software and internet-based industry, the government of **Korea** has created a common infrastructure for the Internet of Things, cloud, big data and mobile convergence. In November 2017, the government launched a “Plan to Create an Ecosystem to Nurture Innovative Start-ups”. It includes tax incentives for business angels, public-private venture capital funds, measures to promote M&As (Mergers & Acquisitions) and strengthening KOSDAQ (Korean Securities Dealers Automated Quotations) market (a second-tier market for smaller firms) to support innovative SMEs. As part of this plan, the government set up an “innovation adventure fund” worth KRW 10 trillion (USD 9.3 billion): *i*) the public sector will contribute KRW 3 trillion through fiscal expenditure and policy-based loans and the private sector will provide KRW 7 trillion; and *ii*) it will provide a comprehensive funding package for venture business throughout different stages, from commercialisation of ideas to market launch, and from M&A to business reorganisation. In addition, the Tech Incubator Programme for Start-ups (TIPS) was launched in 2014 to better combine technological development and business expertise. The programme, which is modelled on Israel's Technology Incubator (TI), is designed to induce angel investors to provide incubation and mentoring, which is combined with government R&D (Randall S. Jones, Jae Wan Lee, 2018). The government has put in place different measures to promote growth of software companies. These include consulting on international markets and marketing. The government is also engaged in nurturing ICT creative firms and the development of digital content.

In **Lithuania**, an open credit fund aims at supporting financial intermediaries who grant credit to SMEs, including those operating in the ICT sector, with the objective of favouring business expansion. For instance, the Ministry of Economy of the Republic of Lithuania guarantees the repayment to banks of the first loan instalment of up to 80% of the amount of principal in case of all SMEs loans, and also provides guarantees for SMEs leasing transactions (guarantee up to 60% of the leased asset price). Similarly, the programme Portfolio Guarantees support loans to eligible SMEs by providing credit risk protection (in the form of a first loss portfolio capped financial guarantee up to 80% of the loan amount) in order to reduce SMEs' barriers to finance, e.g. lack of sufficient collaterals. The focus of the programme is on young and risk-taking firms with high growth potential.

In **Luxembourg**, “Future Fund” is a EUR 150 million fund, which aims to stimulate the diversification and sustainable development of the Luxembourgish economy. The Fund

invests directly or indirectly in Venture Capital funds and SMEs to foster strategic sectors such as ICT. Similarly, “Digital Tech Fund” was launched jointly with a group of private investors to support the development of start-ups which are operating within the national digital economy field. “ICT spring” and “IT days” are examples of fairs dedicated to ICT firms that are supposed to strengthen public-private partnerships. “Technoport” is another initiative which aims to provide incubator services to digital start-ups and co-working spaces in order to help and support individuals and small teams to validate and bridge their ideas to success.

In *Mexico*, the National Entrepreneur Institute runs several initiatives to boost investment in the ICT sector. These include “Financing Scheme for software companies and Related Services”, a targeted support for “high-impact” entrepreneurs and subsidies.

In the *Netherlands*, the aim of the “StartupDelta” program is to merge the Dutch start-up ecosystem into one single connected hub to enable breaking down barriers and improve access to talent, capital, networks, knowledge and markets. StartupDelta aims to improve and simplify existing public-private investment, lending and subsidy programs.

*Russian Federation* government reduced tariffs for insurance payments for IT companies (14% of the salary fund, the standard rate is 30%). The rationale for this support mechanism is the high cost of qualified specialists relative to fixed assets’ costs.

*Singapore* has launched an accelerator “ICT Industry Development Programmes” for entrepreneurs and SMEs.

In *Spain*, the government has allocated EUR 7 million in grants and 45 million in loans for “Next Generation Broadband Extension Program”, aimed at extending the coverage of the broadband in key areas. Another programme is “Enisa-Agenda Digital” that has the objective of supporting entrepreneurs in the ICT sector. The programme had a budget of EUR 15 million in 2016.

In the *United Kingdom*, the “British Business Bank” is a government-owned business development bank dedicated to making finance markets work better for smaller businesses, including technology firms. With the “Enterprise Investment Scheme” and the “Seed Enterprise Investment Scheme”, the UK government promotes investment in digital business through tax incentives and other forms of supports for small and high growth potential firms.

#### **2.2.4. Other measures to support growth in the ICT sector**

Skills shortages in high-growth sectors like the ICT sector is a big obstacle to investment and further growth. To reduce such a shortage, some countries have introduced policy programmes to improve coordination between prospective employers and providers of education and training, and encourage of workplace learning. Migration channels for highly qualified foreigners continue to be refined in many countries, adjusting the selection criteria of permanent programmes and reviewing conditions for temporary programmes (OECD, 2018).

*China* established a “green card” in 2004 to facilitate the immigration of high-skill workers, in particular ICT specialists.

In *Germany*, a yearly national IT-Summit with focus on the ICT Sector is regularly held in order to promote and develop ICT firms.

The Ministry of National Development of *Hungary* is establishing expert and mentor networks to help ICT start-up companies entering international markets by providing free public support, e.g. consultancy, training, and events.

Similarly, *Enterprise Ireland* has several programmes to enhance leadership and management skills, provide strategic advices to increase performance and competitiveness. To help recruitment, the “Job expansion Fund” provides firms with a grant of up to USD 150 thousand.

*Israel* has established the innovation visa program in order to enable foreign entrepreneurs to develop their innovative technology project as an Israeli company, and receive a work permit visa. As part of the Innovation Visas program, entrepreneurs will be able to stay in Israel for a period of up to 24 months. During their stay they can receive support by the Tnufa Program to help develop their innovative idea.

The Ministry of Economics in *Latvia* runs a programme to provide ICT and non-technological training as well as training to facilitate the attraction of investors. Micro and small firms are eligible for the programme, which has a budget of approximately seven million over six years. A similar programme “Support for employee training” is offered to all ICT firms, with no restrictions on size.

The government of *New Zealand* is supporting NZTech to launch a nation-wide “Techweek” event. This event will bring together the technology sector, the wider business community, and New Zealanders from across the country to promote their high-tech industry and bring investors and ICT talent to New Zealand, inspire youth to get into tech, and encourage business uptake of ICT through events in various regions.

In *Portugal*, the programme “SME’s Qualification” aims at improving knowledge of foreign markets, international marketing, web presence and other aspects of the digital economy.

The *Singapore Economic Development Board* provides co-funding to support manpower development in the application of new technologies and professional know-how.

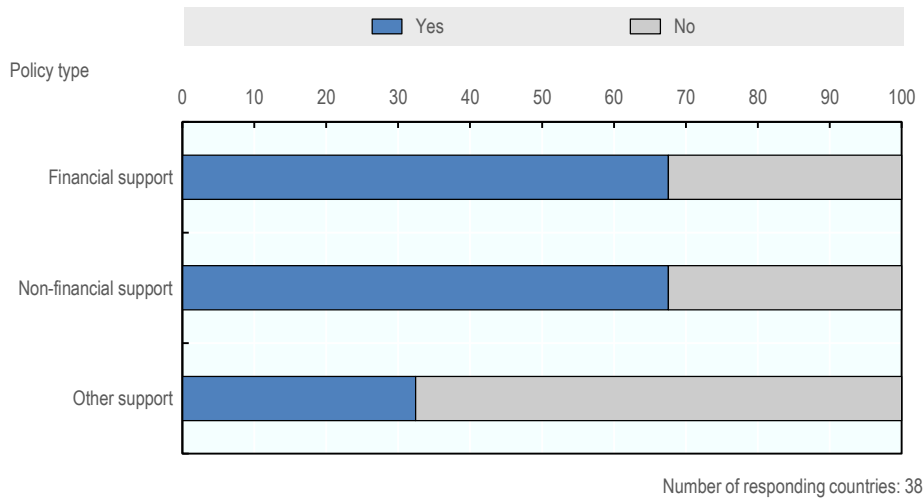
### 2.3. Fostering ICT adoption and use by firms

Thirty-seven countries<sup>3</sup> reported having at least one policy in place to encourage the use of ICTs in businesses (Figure 14). Yet, many of the policies reported under this heading are actually targeted on innovative ICT firms, as discussed in Section 1 above, rather than aimed at fostering ICT adoption by all firms.

Supporting ICT use in firms can be done through both financial and non-financial means. Financially-based schemes are as common as non-financially based ones. 25 countries out of 37 have a financial or/ and non-final support for the adoption and use of ICT by firms, individuals or public institutions. Of the policies based on financial schemes, monetary support for the purchase of ICT equipment or towards ICT development is the most common with 16 countries out of 25 using this method.

Non-financial support to ICT adoption is mainly provided through targeted training. Training accounts for over half of the individual policies reported by countries. The training is mostly focused on the digitalisation of business services, e-commerce, or on the effective use of digital media.

**Figure 14. Policies to support ICT adoption and use by firms**



Source: OECD Digital Economy Outlook Questionnaire 2017, follow-up survey and national governments websites.

To support the creation of a Digital Single Market, the *European Commission* has planned to invest EUR 21.4 billion through the European Structural and Investments Funds’ (ESI Funds) for ICT investments during the 2014-20 funding period. The countries which are the main beneficiaries of the funds are Poland (EUR billion 4), Italy (3.5) and Spain (2.5). The main objectives of the ESI Fund are:

- to ensure a better access of consumers and businesses to online goods and services across Europe by improving e-government services and applications and improving public sector information access
- to create the right conditions for digital networks and services by deploying broadband mostly for high- and very high-speed networks, and through other types of ICT infrastructure and large-scale computer systems, EUR 850 million from the fund is dedicated to this objective.
- To enhance the growth potential of the European Digital Economy by supporting ICT Services and applications for SMEs, opening up business opportunities for digital companies regarding intelligent transport systems, and introducing Intelligent Energy Distribution Systems and ICT solutions to address the challenge of healthy active ageing.

**Table 3. Supporting policies to increase adoption and use of ICT**

Policies to increase adoption and use of ICT by type of incentives

Country	Overall	Financial support	Non-financial support	Other support
Australia	✓		✓	✓
Austria	✓	✓	✓	
Belgium	✓	✓	✓	
Brazil	✓	✓	✓	
Canada	✓	✓	✓	
Chile	✓	✓		
China	✓	✓	✓	✓
Colombia	✓		✓	✓
Costa Rica	✓	✓		✓
Czech Republic				
Denmark	✓	✓		
Estonia	✓	✓	✓	
Finland	✓	✓	✓	✓
France	✓	✓	✓	
Germany	✓	✓	✓	✓
Hungary	✓	✓	✓	✓
Ireland	✓	✓	✓	✓
Israel	✓	✓	✓	✓
Italy	✓	✓	✓	
Japan	✓	✓		
Korea	✓	✓	✓	✓
Latvia	✓	✓	✓	✓
Lithuania	✓	✓	✓	✓
Luxembourg	✓	✓		
Mexico	✓	✓		
Netherlands	✓	✓	✓	
New Zealand	✓	✓	✓	✓
Norway	✓	✓	✓	
Poland	✓	✓	✓	
Portugal	✓	✓	✓	✓
Russian Federation	✓		✓	
Singapore	✓	✓		✓
Slovenia	✓	✓		
Spain	✓	✓	✓	
Sweden	✓	✓		✓
Switzerland	✓	✓	✓	
Turkey	✓	✓	✓	
United Kingdom	✓	✓	✓	

Source: OECD Digital Economy Outlook Questionnaire 2017, follow-up survey and national governments websites.

### 2.3.1. Financial support

In *Austria*, the Ministry of Digital and Economic Affairs (BMDW) jointly with the Austrian Federal Economic Chamber (WKO) launched in 2018 the “KMU-Digital-Paket” (SME Digital Package) to increase the digitization of small businesses and make better use of the opportunities offered by digitization. As a first step, SMEs can check their progresses with digitalisation on-line and receive some general guidance. In the second step, they

received free, customised advices on the opportunities created by digital technologies for their own business. In the third step, SMEs, with the help of a consultant, develop a digitalisation strategy with a special focus on e-commerce, business models and processes, or IT security and privacy. Finally, SMEs can benefit from funding support to further training, with a grant up to 50% of the costs and a ceiling of EUR 4 000.

In **Belgium**, the Wallonia's Agency for the Enterprise and the Innovation and (AEI) provides SMEs established in Wallonia with the "chéques technologiques" (technology checks) to pay for technological services provided by an approved research centre. The allocation budget for 2014-20 is EUR 2.3 million. An additional financial support is given to SMEs to create an e-business website to develop their activities.

Since 2015, the National Economic and Social Development Bank (BNDES) in **Brazil** provides loans for investments in technology and innovation by SMEs with annual revenues below USD 25 million. In addition, "Amazonia Connectada" provides state incentives for the installation of 3G networks to expand coverage in regions lacking telecommunication infrastructure.

Since 1985, **Canada** provides SMEs with incentives to invest in R&D through the Scientific Research and Experimental Development (SR&ED) tax incentive program. In 2014-2015, the program, administered by the Canada Revenue Agency (CRA), processed 24 302 claims, provided over USD 3.1 billion in tax assistance in support of industrial R&D. Another complementary program, the Industrial Research Assistance Program (IRAP), provides support to SMEs for the development and commercialisation of technologies.

In **China**, the Ministry of Finance provides tax incentives for R&D in order to encourage innovation and use of ICT. These measures target SMEs and might consist in corporate tax reductions or exemptions from VAT. Alternative measures include a fund for national emerging industries with the objective of support innovation within firms.

Through the INNpulsA programme for SMEs and micro enterprises (MSMEs), **Colombia** raised the proportion of MSMEs connected to the internet from 7% in 2010 to 60.6% in 2013. Another programme, the "Mintic-INNpulsA Mipyme", promotes the digitalisation of smaller firms along a production chain by providing support to the large company in the chain, so-called 'anchor'. Through this programme, the incentives to the large firm are spread to smaller firms throughout the production chain. Finally, the "Vive Digital Plan" for people, run by the Ministry for ICTs (MINTIC), promotes training of workers who manage IT processes in public and private companies.

The Government of **Denmark** provide financial support to households and enterprises for the deployment of the broadband connections in areas where the speed is below 10 Mbps download or 2 Mbps upload. This initiative has a budget of DKK 200 million over 2016-19.

The Ministry of Economic Affairs and Communications of **Estonia** provides direct financial support for firms investing in industrial automation and digitisation, e.g. software development, cyber security solutions, internal networks, audits, industrial robots, and production systems development.

Business **Finland** (formerly Tekes) is offering different scale funding for companies planning to either digitalise their businesses or create new technologies, platforms or business models. Grants range from EUR 50k to EUR 100k and "soft loans" can be provided up to several millions of Euro.

In **France**, the newly established "Conseil National de l'Industrie" (CNI, National council of Industry) provides fiscal incentives for investment in software, computers and other

digital technologies, up to 40% of the capital good price. As part of the project “Investissements d’Avenir”, Bpifrance grant loans for the adoption of robots in SMEs. To be eligible, firms have to submit a plan to introduce automating equipment in their production or distribution process, with the objective of improving competitiveness and productivity. The loan can be used to cover material and immaterial costs such as equipment, feasibility studies, expenditures related to personnel, and purchase of services linked to the project and training. The loans range from EUR 100 000 to 5 million. Eligible firms should have less than 5 000 employees and annual revenues below 1 500 million; they can operate in manufacturing but also mining and utilities.

In *Hungary*, the Ministry of National Development and the Hungarian Chamber of Commerce and Industry run programmes to support the integration of ICT and e-business tools for the optimisation of business operation and management.

*Ireland* assists SMEs to adopt e-commerce through the Trading Online Voucher Scheme, which offers training and advice, along with financial assistance. It is a matched funding opportunity, where the maximum amount payable is EUR 2 500 or 50% of the eligible cost, exclusive of VAT. The scheme can be used for the development or upgrade of an e-commerce website, such as implementing online payments or booking systems.

In *Italy*, the 2017 Budget Law has introduced a “digital bonus” consisting in fiscal incentives (super and hyper depreciation) for certain categories of assets linked to a company’s production management system or supply network. For depreciation purposes, the cost is increased by: a) 250% for investments in the new operating assets to promote technological and digital process transformation; b) 140% for investments in intangible operating assets. The “Nuova Sabatini” law aims at supporting businesses requesting bank loans to invest in new capital goods, machinery, plant, factory equipment for use in production and digital technologies (hardware and software). The aid is on a form of a contribution partially covering interest paid by business on bank loans of between EUR 20 thousand and EUR 2 million, granted by banks and approved by the Ministry of Economic Development. Another measure is a Guarantee Fund, which is directly aimed at SMEs in order to increase access to financing, through state guarantee or bank loans. SMEs will obtain financing without additional guarantees on the amount of the Guarantee Fund. The Fund does not intervene directly in the relationship between the bank and the enterprise. The parties contractually determine the rates of interests, the conditions of reimbursement etc. Eligible actors are SMEs, including craft businesses; SMEs and mixed consortia; registered trade professionals or members of professional associations registered with the Ministry of Economic Development. The maximum coverage guaranteed is equal to 80% of the financing. The maximum amount guaranteed by the Fund is EUR 2.5 million per company, a ceiling that can be used with one or more financing operations. All operations are admissible, medium-long and short term, for liquidity or investment operations. In order to gain access to the Guarantee Fund, eligible enterprises must be assessed economically and financially viable start-ups are evaluated on the basis of their business prospectuses.

In *Japan*, the Ministry of Economy, Trade and Industry grants SMEs tax incentives to promote productivity-enhancing investment. SMEs also receive direct financial support for the adopting of information technologies and other investment in digitalisation.

The Ministry of Economy of *Latvia* runs a EUR 60 million programme in 2016-23 to support the adoption of new technologies in industry.

In 2016 *Lithuania* launched several programmes to support innovative production and services in SMEs and to ease their access to financing. The budget for these programmes included an allocation of EUR 87 million over 2014-20 from the EU-funded European Regio Invest LT+ programme as well as EUR 130 million from private funds.

Similarly, the *Luxembourg Future Fund* is a EUR 150 million fund which aims to stimulate the diversification and sustainable development of the Luxembourgish economy. It was set up by the European Investment Fund (EIF) and the “Société Nationale de Crédit et d’Investissement” (SNCI) and combines a EUR 120 million contribution from SNCI with EUR 30 million from the EIF, to be spent over a five year period. The Fund will invest and co-invest in early-stage and fast-growing innovative SMEs as well as in venture capital funds.

In *Mexico*, the PROSOFT programme of the Ministry of Economy promotes IT adoption and innovation across strategic sectors, including i) “mature sectors”: mechanical metal, textile-clothing and leather-footwear, wood and furniture, steel, and food and beverages; ii) “dynamics sectors”: automotive and auto parts, aerospace, electric, electronic and chemical; and iii) “emerging sectors”: biotechnology, pharmacist, information technology, creative industries, and medical equipment and devices.

In the *Netherlands*, the “Smart Industry Implementation Agenda 2018-21” helps Dutch SMEs to commercialise new ICT and manufacturing technologies. The Agenda has identified eight key issues, including efficient and secure data exchange among businesses; established nine acceleration projects and launched 32 Fieldlabs. The latter provide an environment where Smart Industry solutions are developed, tested and implemented, and where participants can learn how to apply them.

In *Poland*, the Ministry of Development’s “Intelligent Development” programme finance two sets of projects: i) the development of companies which, by investing, developing and implementing innovative products or services, or cooperating with R&D units, gain new markets and improve their products; ii) projects by business institutions providing free or partially co-financed advisory services or financial instruments in the form of loans, sureties or capital entries. The programme targets primarily micro, SMEs as well as start-ups, and an allocation of EUR 584 million has been allocated for the period 2014-22.

In *Portugal*, the Portuguese Agency for Competitiveness and Innovation (IAPMEI) provides financial support for projects in all economic activities. Among those projects, the Business Innovation and Entrepreneurship project promotes innovation in businesses, strengthen international market’s orientation and foster skilled entrepreneurship in new areas with growth potential.

In *Spain*, the Ministry of Energy, Tourism and Digital Agenda provides financial support to promote a boost in electronic commerce of small and medium-sized firms in the retail sector. Another programme, launched in 2016, promotes cloud computing solution for SMEs, with a budget of EUR 40 million. These programmes are part of the “Agenda Digital”, a strategy to increase ICT uptake of Spanish firms.

In *Singapore*, the “iSPRINT Programme” assists ICT adoption by SMEs with the objective to increase the use of smart technology and boost productivity and growth. In addition, the “Productivity and Innovation Credit Scheme” grants tax deductions on expenditure incurred on pre-defined activities that promote innovation and productivity. In 2017, the Info Comm Media Development Authority of Singapore allocated USD 80 million to a four-year program “SMEs Go Digital (SGD)” to help SMEs use digital technologies by providing sector-specific solutions such as e-commerce, online ordering and payment, fleet

management system, cleaning resource management system etc. SGD also looks at incorporating IOT, robotics, data analytics, immersive media, and cybersecurity into the solutions for SMEs.

#### Non-financial services

In **Austria**, the Austrian Federal Economic Chamber (WKO) launched the “digital.now E-Business Roadshow” in September 2018 to help small companies find out the potential benefits from digital technologies for their business.

In **Belgium**, the Wallonia’s Agency for Enterprise and Innovation (AEI) runs a communication programme since 2016 to encourage women entrepreneurs to use digital tools and women workers to take up digital jobs. The programme informs young women about the opportunities of the sector, offers them training and promotes the experience of distinguished women in the technological and scientific fields.

In **Colombia**, Colombia 4.0 is a free online platform where national and international experts give conferences, hold workshops and exchange experiences.

The Government of **Costa Rica**, in collaboration with the private sectors and the academia, has designed policies to support the use and adoption of ICTs. In particular, the Innovation and Human Talent Council carries out programmes to improve skills in ICT-related areas such as engineering, cyber security, big data analytics and business intelligence, among others.

**Denmark** participates in the European Multi-stakeholder Platform for ICT standards. In particular, Denmark encourages partnership for firms in specific sectors such as retail and wholesale trade as well as transportation, to promote the use of digital technologies by SMEs. Workshops, conferences and web-based communication, together with a reduction in regulatory are used to encourage digitalization in administration, ERP-systems, online sales and marketing.

In **Finland**, Business Finland (formerly Tekes) – the Finnish Funding Agency for Innovation - provides networking services in order to promote collaboration among firms, researchers and foreign investors. Non-financial measures, e.g, international exhibition, trade shows and training programmes, are also implemented to increase ICT adoption by firms.

In **Germany**, the government participates in “Industrie 4.0”, a multi-stakeholder platform aimed to identify challenges and provide solutions for the successful implementation of digital policies. “Trusted Cloud” is a programme that is directly addressed to SMEs. In particular, the German government supports the establishment of a “Trusted Cloud Platform”, easing the application of cloud technologies in SMEs. This platform provides a comprehensive package of orientation knowledge with regard to cloud computing. Another public programme, called “Go-Digital”, provides assistance to SME’s through external consultancy in IT-security, online marketing and digital business process in general. Target actors are SMEs with fewer than 100 employees. The overall budget is EUR 1.5 million and it has been in place over 2015 and 2016. A related policy to support ICT-related information sharing is “Mittelstand-Digital / Mittelstand 4.0 Competence Centres”, which consists in support for SMEs and craft businesses through information, qualification and demonstration (test areas, labs etc). Each Competence Centre gets a yearly financial support of about EUR 2 million for at least three years. The Competence Centres are established with the aim of helping SMEs and craft business with digitalisation and networking and the application of Industrie 4.0 technologies.

In **Hungary**, non-financial initiatives to increase ICT adoption include “Modern Businesses Programme”, which aims to rise ICT-awareness among managers of SMEs.

The **Israel Investment Centre** in the Economy Ministry provides ICT training and support for SMEs, focusing on e-commerce capabilities.

**Lithuania** runs “Business consultant LT”, which provides high quality informational and advisory support for different kind of business planning issues, e.g. starting up a business, finding sources of financing, adopting of new technologies, etc. Targets are SMEs less than five years old.

Several policies to support ICT adoption are implemented by **Switzerland**. For instance, “Regional Policy” (NRP) provides coaching on regional innovation systems to manufacturing SMEs in rural and mountainous regions. A web-based “SME-Portal” provides business information and tools for small and medium size enterprises. The service includes information about IT-infrastructure, IT-security or e-commerce. A similar initiative is “digital.swiss”, an information platform for gathering information on digitalisation and showing the potential benefits for other businesses. Digital.swiss is a private initiative which is not financially supported by the State Secretariat for Economic Affairs (SECO), which takes part in the steering committee. Finally, “E-Economy Report” monitors the progress of the E-Economy in Switzerland relative to other countries. The objective is to inform about economically relevant advances in efficiency through networked protagonists and processes, and to suggest proposals and measures, if deemed necessary.

**Turkey** has in place programmes to encourage SMEs to adopt cloud computing solutions and more in general to purchase computers and other information technology. The government supports usage of ICT by providing education and training in the field of computer and information technology.

### **2.3.2. Other measures to foster ICT adoption and use by firms**

In **Australia**, the Entrepreneurs’ Programme provides firms with advice and support to increase productivity and to seek growth opportunities. Practical support for businesses, researchers and entrepreneurs includes: advice from people with relevant private sector experience, co-funded grants to commercialise novel intellectual property in the form of new products, processes and services, funding to take advantage of growth opportunities, and connection and collaboration opportunities. As part of its policy to spur ICTs use, the Australian Government has allocated over AUD 30 million through to 2019-20 to the Australian Cyber Security Growth Network (ACSGN), an industry-led and not-for-profit programme to encourage business to use ICTs and create opportunities in the rapidly growing cyber security sector.

The Ministry of Information Technologies and Communications of **Colombia** finances programmes to increase Internet connectivity in business, harnessing technological tools in small business and promote e-commerce. In addition, the government provides ICT training to entrepreneurs.

In **Belgium**, «Parcs d’Activité 4.0» aims to help firms participating in the programme to gain access to fast broadband connectivity. A pilot project on 3D Printing aims at developing a European platform to facilitate the uptake of additive-manufacturing technologies. Eligible firms are SMEs and research centres from member regions of the Vanguard initiative (regions cooperating on the basis of their domains of smart specialisation).

In 2017, the Federal Ministry for Economic Affairs and Energy in *Germany* has implemented the Third Amendment Act of the German Telemedia Act (TMG) on liability of WiFi operators, which is expected to increase the number of free WiFi hotspots and facilitate Internet access for SMEs.

*Lithuania* has put in place a series of measures to support ICT uptake by firms. Both direct grants and partial financing of loan interests are available to firms for investment related to the implementation of innovative business processes based on ICTs.

In *Sweden*, the “Government’s strategy for new industrialisation”, launched in 2015, is a policy package aimed at strengthening companies’ capacity for change and competitiveness. The package includes specific focus areas such as the implementation of Industry 4.0, sustainable production and skills development.

### 3. Evaluation approaches in selected OECD countries

Section 2 has shown that there are many policy initiatives in OECD member countries to support the ICT-producing sector and to promote ICT investments in non-ICT industries. These measures absorb a non-negligible amount of resources. The European Structural and Investment Fund (ESIF), for instance, has allocated EUR 21.4 billion to ICT investment over the 2014-20 funding period.

The rationale for policy support to ICT investments is based on, at least, four arguments.

The first argument is that private returns on ICT investment are lower than social returns due to positive externalities (Arrow, 1972; Nelson, 1959). For instance, the adoption of an enterprise resource planning (ERP) system by a firm is likely to increase not only its own productivity (private return) but also the productivity of its suppliers and customers (social return), who would benefit from more timely and efficient information flows with the adopting firm (positive externality). As each firm takes investment decisions based on its own return, ICT investments tend to be lower than the socially optimal level. Public support to ICT investment, therefore, may compensate for this gap.

The second argument lies with capital market imperfections, which may lead to financial constraints on firms with risky projects or insufficient collaterals, thus reducing their capability to invest (Arrow, 1972; Hall, 2002). A growing body of empirical research suggests that financial markets fail to invest sufficiently in small firms (Lerner 2009) as well as in new, technology-intensive one (Hubbard 1997), thus leading these firms to under-invest in ICTs.

Another rationale for ICT investment policies is that firms may lack the skills to identify the benefits from adopting digital technologies and/or to use them effectively (Cohen and Levinthal, 1990). Therefore, policies to improve skills, share business best practices and help firms pooling together around ICT-related projects aim to compensate for underinvestment in ICTs.

A final, often implicit, argument for policy support to ICT investment is that first-movers may acquire market predominance to a degree that can be difficult to revert in future (Arthur, 1989). Large market shares of few Internet-based firms are, to some extent, the result of their having invested on the Internet ahead of their potential competitors. As time matters, public policies to speed up the pace of ICT investment are therefore justified.

While there are theoretical arguments and some indirect evidence, mostly based on R&D and innovation literature, that ICT investment may be too small or too slow, it is a matter of debate whether and to what extent policies may be effective to address this issue.

Externalities, market failures and competition are not, in themselves, sufficient to justify government intervention. Selective intervention such as firms' subsidies targeted on specific activities may result into inefficient outcomes and market distortions that might be even more severe than the problems they are meant to solve. There are two main reasons that may lead to such negative outcomes: information asymmetries and biased incentives (Coyne and Moberg, 2014).

For selective policy interventions to be justified, policymakers must have better information than, or complementary to, market agents do. In particular, they must collect sufficient evidence that the lack of private funding is hampering ICT investment, an

assessment that is fairly hard to make. In addition, they must have better information than private investors on the business potential and financial risks of the firms applying for support. While this may be true in specific circumstances, it is far from being the general case. If policymakers do not have better or complementary information than market agents, policy support would not lead to better results than those that would have been obtained by the market alone (Rodrik, 2014).

To be effective, the agencies implementing the policy in question also need to have stronger incentives to increase economic welfare than market agents do. However, free-riding, principal-agent, and moral hazard problems can also occur in governmental agencies, potentially leading to sub-optimal choices (Niskanen, 1975). Furthermore, special interest lobbying may direct support to groups that would not deserve it based on an economic assessment (Baldwin and Robert-Nicoud, 2007). Political willingness to support the ICT sector and ICT uptake by firms might also be motivated by electoral reasons, as support to innovation is perceived as something positive by many voters (Gustafsson et al., 2018).

When affected by information asymmetries and biased incentives, investment policies may lead to a range of undesired outcomes. They may end up subsidizing rent-seeking firms that are more effective in capturing public support; distorting competition in favour of less productive firms; providing incentives to invest in the “wrong” assets or technologies; and reducing welfare by increasing administration costs and taxation in order to manage and finance the policy programme (Deiaco and Tingvall, 2017).

At a more operational level, the choice of specific instruments add further uncertainty about the effects of these policies. A first distinction is between grant support and tax incentives. Grants can be directed to specific projects that governments considered likely to offer high social returns, but they depend on discretionary decisions by government agencies. They are, therefore, more prone to issues of information asymmetries and biased incentives. In addition, their administration can entail significant costs, particularly in relation to targeting.

Tax incentives, on the contrary, do not condition the provision of support and leave firms the choice about the level of ICT investment to undertake. The narrower scope for discretionary selective measures by the government makes tax incentives more easily compliant with competition and international trade rules (OECD, 2014). However, tax incentives have a limited capability to support projects with higher expected social returns, i.e. the very rationale for policy support. The cost to finance tax incentives is also more difficult to forecast, with a potentially negative impact on public finances.

The literature on the evaluation of R&D support provides several insights that are useful for ICT investment policies as well. In this literature, there seems to be broad consensus that tax incentives are more suited to encourage R&D activities oriented towards the development of applications that can be brought to the market within a reasonable timeframe. In contrast, direct grant support is more suitable for supporting longer-term, high-risk research and for targeting specific areas that generate public goods, e.g. health or defence, or that have high potential for spillovers (Appelt et al., 2016).

Transposed to ICT investments, these findings suggest that tax incentives may be more effective to increase ICT uptakes by firms in all sectors of the economy, where the application of ICTs on production activities tend to be less uncertain and lengthy. Direct grant support, on the contrary, seems more suitable for the development of innovative products and services by the ICT sector, which require longer-term, high-risk activities but have high potential for spillovers.

Other features that may affect the impact of policy support to ICT investment include:

- the scope of the activities supported, e.g. all sectors or specific activities;
- the type of firms covered, e.g. all firms or SMEs;
- conditionality, e.g. the extent to which the public grant must be matched by firm's resources;
- whether tax incentives apply to all ICT investments (*volume-based credits*) or only investment above a certain level (*incremental credits*);
- the ceiling and thresholds for eligibility; as well as
- the duration and the predictability of the programmes;
- the availability of cloud services, which may provide a less costly and more effective alternative to ICT investment, particularly for small and medium firms.

Appelt et al. (2016) provide a survey on the effect of these features on R&D tax incentives.

While there is, in principle, a sound rationale for ICT investment policies, the above discussion points out the need to evaluate the effects of specific programmes over time and across countries.

The evaluation of investment policies, however, is far from being systematic. When undertaken, it generally takes one of two forms: beneficiaries/managers' surveys and econometric analysis.

Through beneficiaries/managers' surveys, senior personnel at a sample of beneficiary firms or managers of the policy programme are asked to give their subjective assessment of what the situation of the beneficiary would have been had they not received the grant.

Econometric analysis, on the contrary, uses data on the programme, the beneficiaries and a set of control firms to test for a statistical link between the amount of an investment grant to a firm and the observed change in investment in the same firm.

Both types of evaluations have advantages but also significant shortcomings. The remainder of this section provides a few examples of both types of evaluations in selected OECD countries in order to illustrate their approaches and discuss their results.

### 3.1. Survey-base evaluation

This section illustrates the survey-based approach to policy evaluation with reference to policies to support growth of the ICT industry or ICT-related R&D in three countries: the United Kingdom, Sweden and Finland. The analysis is based on presentations by national delegates at several MADE meetings over 2017-18.

#### 3.1.1. Tech City UK

Tech City UK (TCUK) was established as an independent, private sector organisation in 2010 to accelerate the development of digital businesses and entrepreneurs across the UK. It has been supported with core funding of around GBP 2 million (EUR 2.268 million) a year by the UK government, first through the Department for Business, Energy and Industrial Strategy (BEIS) and currently from the Department for Digital, Culture, Media and Sport (DCMS).

TCUK seeks to address the barriers to starting and growing digital tech businesses and the digital tech sector in the UK, and as well as issues that affect the sector and its ecosystem

more widely. The initial focus was on London, reflecting the cluster of activity around Shoreditch in East London, though it had a remit for the UK as a whole. In 2015 Tech North was established, as part of TCUK, to extend its mission to the North of England, with supplementary funding of just below GBP 2 million (EUR 2.268 million) a year.

The main activities and features of TCUK are reported in Table 4.

In December 2016, DCMS commissioned an evaluation of TCUK (SQW, 2018) with the following main objectives:

- assess the impact of TCUK (and Tech North) activities on beneficiary firms and, to the extent possible, on the wider ecosystem;
- estimate the extent to which the funding of TCUK (and Tech North) were justified by the benefits achieved;
- review how interim recommendations had been taken forward, and draw lessons on:
  - how TCUK complements other organisations in the digital economy space;
  - how the effectiveness of the TCUK initiative could be improved.
- outline monitoring and evaluation data limitations and propose areas to strengthen or amend data being collected to improve impact assessment possibilities.

The scope of the evaluation focused on the three key sets of activities delivered by TCUK: business lifecycle programmes, to support businesses at various stages of their development; digital skills programmes, to address labour market issues and potential skills shortages; and its leadership and advocacy role on behalf of the digital tech sector.

The evaluation has involved a number of stages, including:

- desk-based review of programme documentation, monitoring information and wider data/evidence;
- development and evaluation model (“logic model”), as illustrated in Figure 15;
- consultations with 29 stakeholders representing a wide range of perspectives;
- In-depth telephone interviews or online surveys with the beneficiaries of the programmes;
- a series of case studies for the different programmes.

The evaluation of outcomes and impacts of the business lifecycle programmes focussed on the following three schemes, targeting companies at different stages of development: the most pioneering late-stage tech companies in the UK that have global growth ambitions (*Future First*); earlier stage companies with growth potential (*Upscale*); and leading tech start-ups in the North of England (*Northern Stars*). Further information on these schemes are reported in Table 4 below.

The evaluation identified some common effects across all three schemes, particularly on the capabilities, practices and behaviours of companies:

**Table 4. Tech City UK: summary details of programmes and activities**

Programme/activity	Brief summary
<b>Business lifecycle programmes</b>	
Future Fifty (TCUK)	<p>Started in 2014.</p> <p>Supports the UK's top growth-stage digital companies – cohorts of up to 50.</p> <p>Provides access to government and the private sector (experts etc.).</p> <p>Builds links to the UK and overseas investors.</p> <p>Establish the foundation for IPO readiness, M&amp;A and global expansion.</p> <p>Delivers through networking, events, and some tailored support to help companies grow.</p>
Upscale (TCUK)	<p>Started in 2015.</p> <p>Aimed at early stage companies who have received Series A* funding and ready for that next step in their growth cycle – cohorts of up to 30.</p> <p>Connects companies with founders and leaders to help tackle challenges of scaling</p> <p>Provides support on specific topics (e.g. strategy, marketing, recruitment).</p>
Northern Stars (Tech North)	<p>Started in 2015.</p> <p>A pitching competition that identifies and showcases the best tech start-ups in the North of England.</p> <p>Online application process, supported by a series of Regional Pitch events, culminating in a Grand Final.</p> <p>Ten winning companies are chosen by a high-profile panel of judges.</p>
Founders Network (Tech North)	<p>Started in 2016.</p> <p>Connects start-up founders from across the North of England and brings together individuals within their local communities to share networks and opportunities.</p>
<b>Digital skills programmes</b>	
Digital Business Academy (TCUK)	<p>Started in 2014.</p> <p>Massive Open Online Course (MOOC) that brings together resources from industry experts and educational institutions such as University of Cambridge, University College London, Founder Centric and Valuable Content.</p> <p>11 online courses free to users to develop skills to start, grow or join a digital business.</p> <p>Upon completion, access to rewards including free co-working, internships and bespoke mentoring support.</p> <p>Over 17 600 users.</p>
Tech Nation Visa Scheme (TCUK)	<p>Started in 2015.</p> <p>TCUK acts as endorsement body for scheme (Tier 1 exceptional talent), offering a dedicated route for businesses to attract world class talent outside the EU.</p> <p>An endorsement from Tech City UK allows an individual to submit their Visa application to the UK Home Office.</p> <p>This visa can be granted for up to five years after which an individual is eligible to apply for settlement in the UK.</p>
Tech Immersion (TCUK)	<p>Started in 2016.</p> <p>Half-day workshop for organisations to understand and engage with start-up culture in UK, making the start-up world more accessible and providing industry insights to senior leaders from corporate backgrounds.</p>
<b>Thought leadership and advocacy</b>	
Tech Nation report (TCUK)	<p>Presents the current state of UK digital economy. Raises awareness and improves public understanding of the strengths and values of digital sector.</p>
Marketing and partnerships (TCUK)	<p>Activities to promote and raise the profile of the UK digital tech sector, and to develop partnerships and highlight issues facing the sector to relevant organisations and policy-makers.</p>
Hackney Report - Challenge of growth series (TCUK)	<p>New initiative (in development stage) that gives insights into challenges facing entrepreneurs at different stages in lifecycle.</p>
Regional access to investment (Tech North)	<p>Proposed new co-investment fund that will improve access to investment in North of England by bringing together private investors, increase funding available.</p>

*Note:* \* First significant round of a firm's venture capital financing - refers to the class of preferred stock sold to investors in exchange for their investment.

*Source:* SQW, 2018, <https://www.gov.uk/government/publications/impact-evaluation-of-tech-city-uk> (accessed on 15 October 2018).

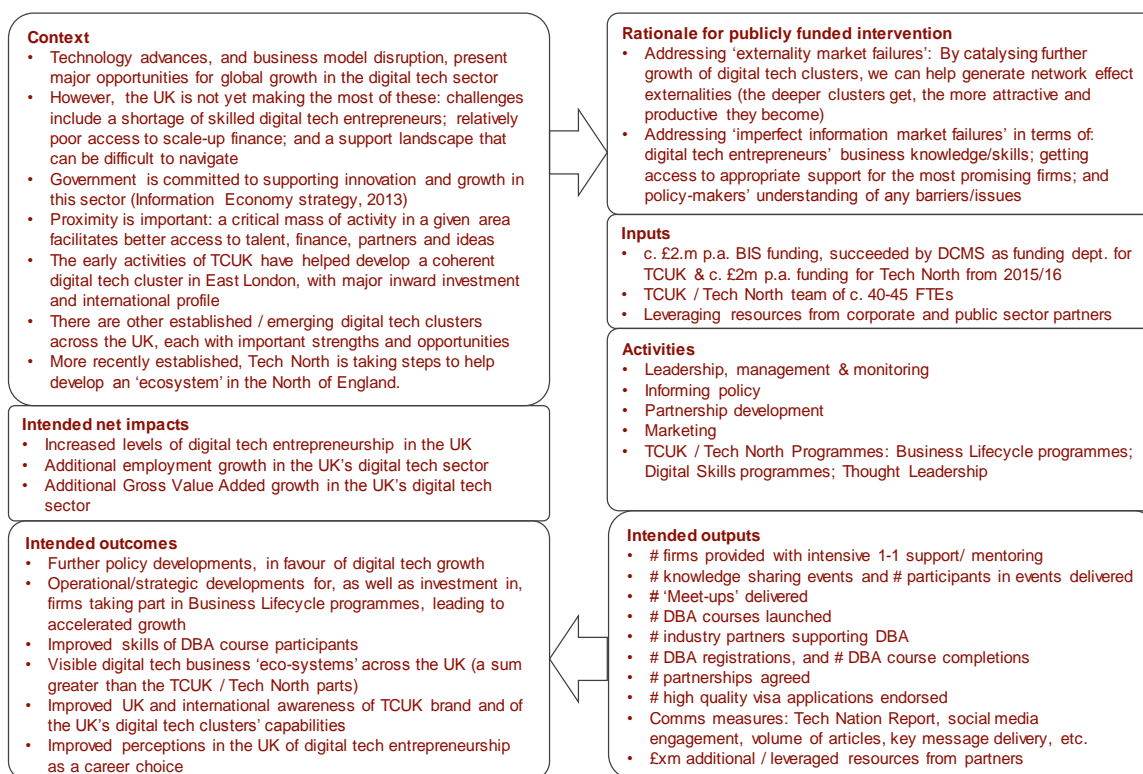
- Beneficiary companies in all three programmes commonly reported networking and new connections, the increased promotion and recognition of their business, improved peer-to-peer learning, and gaining access to government to communicate the issues facing the digital tech sector.
- In addition, beneficiaries of Upscale reported the access to expertise and improved management capabilities, and those beneficiaries of Northern Stars commonly reported the improvement in credibility of their business and improved ability to pitch the business.

On average, companies engaged in the three programmes have grown significantly during and since their participation. However, the effect on quantifiable performance measures, e.g. employment and sales turnover, that could be attributed to the programmes was limited, particularly for Future Fifty. Companies in this programme reported that this was not their expectation as the focus was on the networking and profile-raising. Beneficiaries of Northern Stars were most likely (four out of eight) to report benefits to their turnover and employment, which may reflect their earlier development stage.

Through both the Digital Business Academy (DBA) and the Tech Nation Visa Scheme, there is evidence that the digital skills programmes are helping address key challenges:

- Over three-fifths of DBA survey respondents reported having have progressed with a business or business idea, progressed in their digital career or started their digital career – with some of these respondents attributing their progress partly to what they have learnt.
- Case-study evidence on the Tech Nation Visa Scheme highlights the ways in which this has helped to bring new talent and connections to the UK, thereby addressing shortages or bringing in new ideas.

Figure 15. TCUK logic model



Source: SQW, 2018, <https://www.gov.uk/government/publications/impact-evaluation-of-tech-city-uk> (accessed on 15 October 2018).

There have been a number of outcomes relating to the thought leadership and advocacy role of TCUK and Tech North, in particular: the raised profile and promotion of the UK internationally as one of the top places for digital tech companies; the increased awareness and understanding of regional clusters, particularly within the UK but also to an extent internationally; and the voice provided to the digital tech sector, especially in policy circles.

According to several respondents, there have been some important links between activities, suggest that TCUK has drawn across the package of support to deliver synergies. In particular, the business lifecycle programmes have been used to support promotional activities. Future Fifty, for instance, has attracted high potential companies that reflect the strongest on the UK digital tech scene. The potential of these companies have helped to raise the international profile of the UK digital tech sector.

The evaluation also provides some "estimates" of the economic effects of the programmes. However, as acknowledged by the evaluation report, these "are based on a small number of companies who were able to attribute changes in their performance, and do not take account of the wider non-quantifiable benefits that the programmes have brought about, such as enhanced networks and knowledge" (SQW, 2018).

A further conclusion from the evaluation is that, while TCUK's systems and processes for collecting (and reporting) monitoring data appear to be extensive, there is a need to ensure consistency and accuracy of data over time and between different sources. In addition, the

current monitoring indicators are mainly focussed on activities rather than TCUK's intended outcomes, and a shift in focus towards the latter would be useful.

The evaluation also led to a number of recommendations:

- There is currently a plethora of brands, e.g. TCUK, Tech North, Tech Nation and others, and some simplification and/or clarity is required. The unclear distinction between TCUK and Tech North should also be addressed.
- Longer-term certainty over funding is required, in order to assist with strategic development and planning.
- Finally, coordination between TCUK and other existing initiatives, such as those relating to export advice or access to finance, should be strengthened.

### *3.1.2. ICT programmes in Sweden*

In 2015 VINNOVA, Sweden's innovation agency, commissioned an evaluation of four programmes to support the development of the Swedish ICT sector in 2000–12. The main features of the four programmes are shown in Table 5.

A total of 41 projects were randomly selected and evaluated, i.e. 7% of all projects. The total number of projects, their breakdown by programme and by firm size as well as those selected for evaluation are shown in Table 6.

The evaluation process included desk research (reading the applications, intermediate reports and final reports of the projects), interviews with persons that worked in the projects and a survey.

The number of interviews depended on the size of the project and the amount of information available. In total, 58 project managers, 2 programme managers and 6 high-ranking civil servants were interviewed.

The interviews were semi-structured. This method helped to make sure that the same questions were asked to all participants while, at the same time, allowing the interviewer to ask follow-up questions and collect further information that were not part of the questionnaire.

An online survey was also carried out among the project managers to complement the results of the interviews. The survey was sent to all 340 managers – some responsible for more than one project - and was opened for responses for a period of two weeks. 83 of them completed the survey, i.e. a response rate of 34%. The survey contained questions on the results achieved by the project and perceived benefits from the participation in the programmes. A so-called “subjective counterfactual” approach was used: the interviewees were asked to assess what results would have been achieved (if any) without the support of VINNOVA.

#### *ICT as enabling technology (2001–12)*

Enabling ICT is an umbrella programme, i.e. a programme that includes several programmes, and was launched by VINNOVA in 2009. The overall objective of the programme was to contribute to ICT-based commercial solutions from system industry established in Sweden. This objective was to be accomplished through breakthroughs in technology but also through increased know-how in embedded systems, software and hardware in systems. 354 projects were financed over 2001-10, for a total funding of SEK 941 million (EUR 91 million).

The respondents reported that one main impact of the programme was the increased know-how and knowledge developed through the research carried out in the projects. Out of the 20 projects that were evaluated through interviews, eleven were carried out together with an industrial partner and had some influence on the solutions implemented later by the industry.

Five projects resulted in the creation of new companies. Four of these companies could be funded through the project. One of them was acquired by a larger company, and the other had a joint turnover of SEK 39 (EUR 3.8) million in 2013.

**Table 5. Description of the programmes assessed in Sweden**

VINNOVA ICT programmes and projects

<i>Programme/project</i>	<i>ICT – As enabling technology</i>	<i>Communication of the future</i>	<i>Programme for ICT sector</i>	<i>Vehicle ICT</i>
Key objectives	Contribute to ICT-based commercial solutions from system industry established in Sweden	Keep or reach Sweden's top global position in the area of IT and Telecom. Additional goal: establish technical solutions to increase growth of services in networks and terminals	Promote commercialisation of ICT innovation, increased participation in EU's framework programmes and higher competitiveness through IT open solutions	Strengthen the international competitiveness of Swedish vehicle industries through a strategic collaboration in Vehicle-ICT and Telematics
Time period	2001–12	2001–12	2005–11	2005–08
Total budget	EUR 150 million	EUR 100 million 430 million kronor was funded by VINNOVA	EUR 25 million	EUR 29 million
Funding by VINNOVA	EUR 91 million	EUR 42 million	EUR 12.5 million	EUR 9.6 million
Number of projects	368	149	53	33

*Source:* Based on Tekes, 2015.

The survey with project managers also suggests that the programme had an impact on the development of new innovations. According to the survey, 74% of the projects in the Enabling ICT program led to new innovations. The survey also suggest that 56% of the projects resulted in a significant breakthrough for the leading partner organization.

Based on the project reports and interviews with partners in 20 projects, the Enabling ICT programme seem to has had a high impact on technology development, enabling research institutions to further develop their research in a certain field, and in doing so, progressing from basic research to industry application.

For one of the smaller projects in this evaluation - VINNOVA funding was SEK 200 thousand (19 million) - the project manager reported that project would have reached the same results even without the financial support by VINNOVA. In all other cases, VINNOVA's funding made the project possible, at least to some extent.

In six of the projects evaluated, project partners believe that only some of the project activities would have been carried out without the funding from VINNOVA. One project partner states that the funding from VINNOVA gave the research a clearer focus towards commercialisation. In another project, its output would have been lower quality without the funding from VINNOVA.

In twelve cases, the projects managers stated that the projects would not have been carried out without the support by VINNOVA.

**Table 6. ICT programmes funded by VINNOVA in Sweden**

Programme	Small	Medium	Large	Projects selected for evaluation
<i>ICT – as enabling technology</i>	123	114	117	20 (2 S - 5 M - 13 L)
<i>Communication of the future</i>	37	30	80	13 (1 S - 3 M - 9 L)
<i>Programme for the ICT Sector</i>	9	31	8	4 (1 M - 3 L)
<i>Vehicle ICT</i>	3	16	17	4 (1 M - 3 L)

Note: Small: less than SEK 500 000 (EUR 48 518); Medium: SEK 500 000 – 2 499 999 (EUR 48 518 – 242 493); and Large: SEK 2 500 000 (EUR 242 494) and above.

Source: Tekes, 2015.

### *Communication of the Future*

As in the case of Enabling ICT, the Communication of the Future programme is an umbrella programme launched in 2009. The programmes grouped programmes aiming to support the development of commercial solutions through ICTs.

The programme had a number of effects both on new and existing companies. Services and technology developed within the project has been adapted by industry partners as well as in start-up businesses derived from the projects.<sup>4</sup> Several projects were also able to provide industry partners and other companies with new ideas.

In some cases, projects were able to develop a product or service ready for the market, which, however, were not commercialised. This suggests that some of the expected effects of the projects have not been realised.

The results from the survey as well as the interviews with project partners suggest that the programme had an impact on knowledge sharing between project partners, where participating companies have benefited from the transfer of knowledge. There were also examples of projects enabling an exchange of knowledge between business and academia.

The programme has helped to develop technical solutions that increase growth of services in networks and terminals, through the creation of start-up companies and the development of technical services, which have later been adapted by industry partners. There are also examples of projects addressing regulatory aspects and market conditions for different kinds of network services, for instance through transfer of knowledge to policy makers and through active participation in standardisation development.

Out of the 21 people interviewed for the 13 projects, 11 believe that the programme had a decisive role for results and impacts of the project. Another five interviewees reported that the results would have been achieved in part without the assistance of VINNOVA. One respondent said that the results would have been achieved in any case, but that it would have taken longer. Four respondents stated that the same results would have been achieved without the financial assistance of VINNOVA.

Compared with the associated partners, the project managers are more positive about the role of VINNOVA. According to the managers, none of the projects would have been fully executed in the same size or form without the funding from VINNOVA.

In eight of the 13 projects, the funding from VINNOVA was a prerequisite for enabling the project. Five of the projects evaluated would have been carried out at least in part but the funding from VINNOVA enabled a more efficient scale. One project manager reported that the funding were essential to keep up with the pace of development in the research field in question. According to another project manager, the funding enabled Sweden to remain at the forefront in its research field. Another research group reported that it would have been able to receive funding from other sources but that the project financed by VINNOVA ensured stronger collaboration between industry and academia.

### *Programme for the ICT Sector*

The programme was carried out in 2006-12, with the overall objective of strengthening Sweden's position as a leading ITC nation through the development of the competence and competitiveness of Swedish companies and thus promoting the scientific development at Swedish universities and research actors. The programme was also meant to contribute to the increase of SMEs involvement in R&D projects and to develop Sweden's participation in international research projects, especially in the EU framework programme.

In the evaluation of the programme, a total of eight people from four different projects were interviewed while the managers of five additional projects participated in a survey.

Eight project managers reported the projects led to innovations that are now used in industry. In three of these projects, the innovations were regarded as significant breakthroughs. In general, the results of the programme contributed to making the participating companies more competitive.

The implementation of new solutions is perhaps most evident in the case of System design on silicon, where the project is said to now be part of "millions of mobile telephones". In the case of INSICT, a programme aimed to promote the use of ICT among SMEs, the projects did not result in new innovations but enabled companies to implement innovative solutions in their products and increase their competitiveness.

In those SMEs where the ICT solutions have been part of the production process, this led to lower production costs and/or higher productivity. Return on Investment (ROI) could be achieved within 36 months for the vast majority of companies that had received funding through INSICT. The projects enabled growth of revenue for those companies that received support, and according to one of the key persons in INSICT, the tax revenue was greater than the total pay-out in the project already after three years.

The different projects in the ICT Sector programme have been in different stages of the product development. Many of the projects with both industrial and academic partners suggest that the projects have strengthened the linkages between them.

Both the survey and the interviews suggest that the results achieved would have been not feasible (one of four) or only partially feasible (3/4) without the programme. The respondents to the survey were also very positive about the role of VINNOVA.

Given that 80% of the projects in this evaluation have led to new solutions, the programme is considered as efficient and effective. The fact that all but one of the goals formulated in the project applications have been reached supports this impression. All project managers and project partners in this evaluation believe that their projects were successful.

### *Vehicle ICT*

The overall aim of the Vehicle ICT programme was to enhance the competitiveness of the Swedish automotive industry through ICTs and telematics, by promoting the cooperation between the automotive industry and the ICT industry as well as with research.

The programme had two components. The electronics component addressed computers and ICT in vehicles in order to meet consumers' demands about security, the environment, comfort etc. The telematics component aimed to develop wireless solutions, e.g. mobile networks and location services. The programme was expected to deliver market solutions in five to ten years after its completion, i.e. 2013–18.

The programme was co-financed by public funding - SEK 125 million, out of which 90 million by VINNOVA – and private funding by Saab Automobile AB, Volvo Personvagnar AB, Scania CV AB and Volvo AB, which accounted for 58.4% of the total budget.

The programme evaluation was based on interviews with the leaders of four projects as well as on survey filled out by seven programme managers. According to the evaluation, vehicle ICT created practical and commercially useful results, mainly through the demand- and user driven focus of the programme. Cooperation with Volvo within the programme generated new business opportunities for partnering firms and led to the development of new software, which is now the standard equipment for Volvo vehicles.

Interviews also indicate that the projects helped reducing costs and improve quality through the development of more efficient methods and tools for the development of cars and components. Two technology-driven start-ups were created as a spin-off of the Vehicle ICT programme.

In general, participants believe that the programme has contributed to strengthening the competitiveness and the growth perspectives of the Swedish automotive industry. Four of the project managers interviewed suggest that the projects not would have been feasible without the financial support of VINNOVA. One project manager indicated that the project would have been delayed up to eight years without VINNOVA support.

The programme also seems to have had impact on innovation. Cooperation and networking among different types of actors were strengthened through different between automotive companies, ICT consultants and academic institutions, with the establishment of new open innovation platforms.

#### ***3.1.3. ICT programmes in Finland***

Tekes – the Finnish Funding Agency for Innovation – was the main public funding organisation for research, development and innovation in Finland until 2017. As of 2018, it merged with Finpro – the Finnish trade promotion organization – into Business Finland. Tekes used to fund wide-ranging innovation activities in research communities, industry and service sectors and especially promotes cooperative and risk-intensive projects. In 2015, Tekes commissioned an evaluation of two programmes for the ICT sector: the Digital Product Process (DPP) and the Embedded ICT (Ubicom) programme. The main features of these two programmes are shown in Table 7.

**Table 7. Description of the programmes assessed in Finland**

Tekes ICT programmes		
<i>Programme</i>	<i>Digital Product Process</i>	<i>Embedded ICT</i>
Key objectives	To intensify cooperation across organisational boundaries, strengthen research concerning product processes, promote the readiness of industry to exploit research information from leading experts around the world	To strengthen the research in ubiquitous computing, enhance the international cooperation environment, spur on cooperation between different branches of industry
Time period	2008–12	2007–13
Total volume (€)	EUR 82.6 million, of which EUR 34.6 million was funded by Tekes	EUR 330 million, of which EUR 147.5 million was funded by Tekes
Other information	105 projects	465 projects, mapping of innovation landscapes

Source: Tekes, 2015.

The evaluation of DPP and Ubicom included of a desk study, interviews of the key stakeholders and well as electronic survey of the beneficiaries. The focus of the evaluation was on the results, the relevance and the efficiency of these programmes.

#### *Digital Product Process (2008–12)*

The Digital Product Process (DPP) programme was implemented in Finland between 2008 and 2012. The programme aimed at developing new business processes and ICT solutions for the manufacturing industry and to increase customer orientation and productivity in company networks that design and deliver products, systems and services to global markets. Overall DPP was meant to be more market than research-oriented. The programme had a total budget of over EUR 82 million, out of which EUR 34.6 million were granted by Tekes, and financed 105 projects.

A large majority of the beneficiaries taking part in the evaluation (71%) reported that the projects funded under DPP succeeded according to or beyond expectations. The projects have resulted in new services, products, methods, technological development as well as academic outputs, e.g. publications and journal articles. The respondents also referred to innovations (e.g. software tools, service products, new technology, improved processes, and cloud services) that occurred in over half of the DPP projects. More importantly, in almost 80% of the projects, business activities were developed, though new entrepreneurial activities, improved level of skills, improvements in planning processes, and the introduction of new business models that increased efficiency and flexibility.

The participants also agreed, although to lesser extent, that networking was improved among companies seeking international growth (55% agreed or fully agreed), with the public administration (40% agreed or fully agreed) and with international research organisations (35% agreed or fully agreed).

The respondents reported that applying for funding and preparing for a project was easy, cooperation with Tekes was smooth, and practices related to reporting were functional

(75% agreed or fully agreed to these three statements). The management of the project was also regarded as efficiently organised (at least quite well or reasonably).

Participants reported that some projects would have been carried out even without the Tekes funding, although on a smaller scale. Funding has also had either a significant or relatively significant impact on the content, quality and implementation of the project. Taking part in the DPP programme has additionally affected the speed of concept development and piloting, networking as well as the ability to apply acquired skills and models in other projects.

### *Embedded ICT (2007–13)*

The Embedded ICT programme (Ubicom) aimed to developing and piloting embedded IT solutions, as a key component for the Internet of Things (IoT). The programme was meant to address growing demand for processor power, memory capacity and portability in an increasingly decentralised system.

Ubicom was implemented between 2007 and 2013 with a total budget of over EUR 330 million, out of which EUR 147 million were granted by Tekes. The programme financed more than 460 company and research projects.

According to the respondents' self-assessment, a majority of the projects funded under Ubicom have been either successful or have exceeded expectations. Over 70% of the respondents reported that the projects resulted in innovations whereas the figure was even higher (78%) concerning developments in business activities. The results largely relate to product development and pre-commercial phases, such as pilots and prototypes of products and software. In several projects the participants were also able to create new products, services and solutions such as sensors/probes, platforms and software that increased the company's turn over. Additional results included development of competences, new networks, patents, new knowledge and new technologies.

Ubicom participants were most satisfied with the development of key technologies and components as well as piloting (almost 80%) while satisfaction with planning methods and tools (52%) and business models (27%) was lower.

Respondents reported that most programme activities under Ubicom (e.g. activation of business and research projects, funding and networking) were conducted very well or at least quite well. Respondents, however, were less satisfied with networking with the representatives of the public administration as well as foreign research institutes.

In order to assess the impact of the programme, the beneficiaries were asked how their programmes would have been different in the absence of Ubicom. Most respondents reported that their projects would have been smaller and their results would have been used less extensively. The absence of support would also have had a negative impact on the quality and the content of the projects.

## **3.2. Econometric evaluation**

The econometric approach aims to overcome the shortcomings of the survey-based evaluation, i.e. the subjective assessment of the outcomes, by testing for a statistical link between a policy measure, e.g. a grant for ICT investment, and its desired objective, e.g. an increase in ICT investment. In particular, the econometric approach addresses three issues in relation to the evaluation of investment policies:

1. government programmes may finance investment that firms would have undertaken in absence of the policy (*additionality*);
2. they may target firms that would not increase investment despite receiving policy support (*deadweight*); and
3. higher investment by beneficiary firms may come at the cost of lower investment by firms excluded by the policy (*displacement*).

Box 2 provides an overview of econometric methods for policy evaluation.

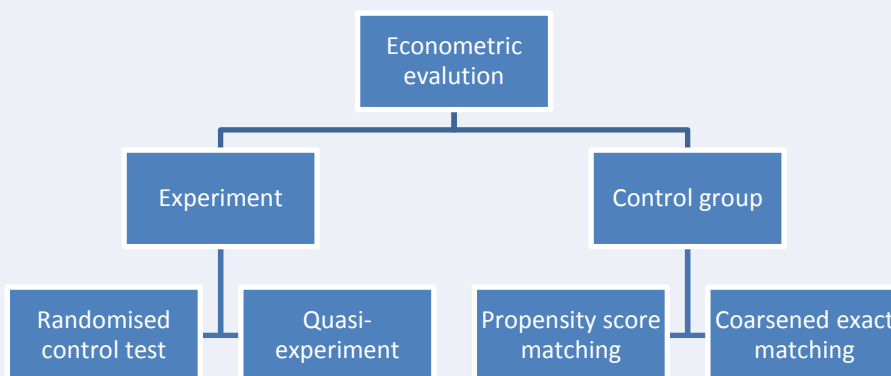
**Box 2. Econometric methods for policy evaluation**

When evaluating a policy measure, the question to address is “what would have been the outcome for the firms receiving policy support if they had not received it?” Another way to frame this question is to look for a counterfactual outcome.

A comparison between firms participating in a policy programme and firms not participating does not provide a valid counterfactual. In general, some firms have a higher probability to apply for a programme and/or their application tends to be more successful than others. In addition, participants are selected through a selection process and according to some eligibility criteria set by the programme. As a result, firms selected into the programme tend to be systematically different from other firms and a comparison between the performances of two groups is not informative of the effects of the policy.

A number of econometric techniques have been developed to address these issue (Figure 16).

**Figure 16. Econometric methods for policy evaluation**



Source: OECD

The ideal setting to define a counterfactual would be an experiment, where firms are randomly assigned to a policy programme, an approach known as randomised control trial (RCT). Because of the random assignment, there is no systematic difference between firms

in the programme and the other firms. Therefore, differences in the outcomes of the two groups could be safely ascribed to the effects of the programme.

Unlike in other sciences, the opportunities for RCTs, however, are not frequent in economics. RCTs have been used mostly by researchers in the field of labour market policy, although there are a few examples where they have been carried out to evaluate some types of business support (Bakhshi et al., 2013).

Evaluations take more often the form of quasi or natural experiments. These typically occur when the introduction of a new policy or a change in the feature of some existing measure, potentially affecting all firms, create a natural counterfactual, i.e. the same firms before the change in policy.

As an alternative to an experiment, the evaluation can be based on the comparison with a control group. This approach starts with the set of firms receiving policy support (*treated*) and a larger set containing all other firms (*untreated*). Next, it matches each treated firm to one or more of the untreated firms, based on similarities in their characteristics. It then creates two groups: the original treatment group, except for those firms with no match; and all the matches for the treatment group. Finally, the two groups are compared to estimate the effects of the policy (*treatment effect*).

Two methods are widely used to create control groups: propensity score matching (PSM) and coarsened exact matching (CEM). The two methods differ in the way treated and untreated firms are matched.

PSM estimates the probability for each firm, in either group, to be treated, based on their matching variables. This probability, i.e. the propensity score, is the only basis for matching (Rubin 2001; Rosenbaum & Rubin 1983).

CEM matches firms on every available variable, but there is flexibility in what counts as a match. The matching rules are tight in the beginning and, if necessary, are systematically coarsened to allow for more matches, up to a pre-determined coarsening limit (Iacus et al., 2011 and 2012; Blackwell et al., 2009).

One disadvantage of PSM is that it cannot guarantee that treated and control groups are similar to each other with respect to every matching variable. Indeed, the focus is on the total score rather than on the individual scores. Unlike PSM, CEM guarantees that the control and treatment groups are similar with respect to each matching variable. In addition, CEM matching is based not only the average but also the higher moments of the distribution (Deiaco and Tingvall, 2017).

In recent years, a number of studies have evaluated the effects of investment policies in several countries, in some cases with a specific focus on ICT investment or ICT-related innovation.

In *Sweden*, the effects of innovation subsidies have been analysed against the objective to overcome markets failure that may hamper the development of innovative firms (Gustafsson et al., 2018 and 2016). One such so-called market failure is that banks and other private actors, such as venture capital funds, are too risk averse, given the great uncertainty of innovative projects, to invest in these firms. Innovation subsidies have been found out to go mainly to firms with low productivity and profitability, but with a high capital intensity, high wages and high skilled labour force. These firms are perhaps more likely to be skilled at seeking subsidies than being innovative firms suffering from market failures in the capital markets. The authors regard this finding as evidence that subsidy

programs could lead to firms specialising in seeking subsidies rather than producing on the market (Gustafsson et al., 2018).

Furthermore, the evaluation shows a lack of robust long-run effects, although there are some positive short-run effects. Investments, in particular, are significantly higher the year the firm receives a subsidy (22% above the control group), but drop afterward and even become negative. The finding that the increase occurs the same year as the firm receives the subsidy suggest that the firms have correctly anticipated the subsidy and made plans in advance. The negative effects the following year might be due to the subsidy triggering early investing (Gustafsson et al., 2016). Although innovation subsidies may not have long-lasting effects, they may still be desirable to the extent their objective is to speed-up investment in new technologies, including ICTs, and avoid that competitors may acquire first-mover advantages that may be difficult to reverse.

In **Belgium** the effects of a subsidy program for small and medium sized enterprises in Flanders (De groeipremie) were evaluated over 2004-09 (Decramer, 2014). The subsidies were awarded according to a ranking system that favoured young, growing and productive firms with a strong cash flow, granting subsidies to the highest scoring firms until the depletion of funds. This allocation system - only firms above the cut-off score were granted a subsidy - creates a quasi-experimental setting for an econometric evaluation. The evaluation shows a sizable positive effect on investment for the firms that were granted the subsidy, but mainly for the very small firms, e.g. firms with less than ten employees. For the larger firms, a positive effect was found on profits, suggesting that they use the subsidy to finance investments that they would have undertaken anyway.

In **Norway**, government support to firms from Innovation Norway (IN) – a government agency that aims to promote firm growth through innovation programs, regional support and other industrial policies – were analysed over the period 2001-12 (Cappelan et al., 2015). Financial support was granted to projects within a broad scope, such as investments in buildings, machinery and ICTs, restructuring and readjustment to changing market conditions, innovation and internationalisation, renewal and modernisation, business establishment, generational change, etc. The evaluation compares firms that received support from IN (the “treated” firms) with a comparison group of non-treated firms that was matched according to a set of individual firm characteristics.

For the innovation and regional assignment, the estimates of the average treatment effects are highly significant and robust as regards number of employees, sales revenues and value added, but much weaker for labour productivity (value added per worker) and returns to total assets, the latter variables being a proxy for more productive investments. The lending program did not appear to be particularly successful. Only few of the estimated effects are significant, and neither of these are robust. Finally, the evaluation found no evidence that the programs targeting start-up firms improve survival probabilities compared to the control group.

In **Hungary**, an evaluation of the development subsidies for micro, small and medium-sized enterprises, in the context of the EU Cohesion Policy programmes, was undertaken for the period 2007–13 (Banai et al., 2017). Based on a micro database, the evaluation assessed the effects of the beneficiaries’ first subsidies on various performance indicators, using a combination of propensity score matching and fixed effects panel regression.

According to the results of the evaluation, development funds had a significant positive impact on the number of employees, sales revenue, gross value added and in some cases, operating profit. These effects were exceptionally high in the case of ICT subsidies, with

respect to practically every analysed variable. Furthermore, the evaluation found no difference in the effects of non-refundable subsidies (grants) and refundable assistance (financial instruments) extended under the Structural Funds and the Cohesion Fund.

In *Germany*, the effects of the investment subsidies, under the joint Federal Government/Laender scheme “Improving regional economic structures” (GRW) were analysed in Saxony Anhalt in the last funding period 2007-13 (Dettmann et al., 2017).

The effects of the investment subsidies were measured as the growth in full-time equivalent (FTE) employment in firms. In the short run, i.e. one year after the beginning of the project, the investment subsidies (EUR 316 million) increased employment by 3 160 FTE, i.e. each EUR 100 000 subsidy led to an increase of 0.5 FTE. In the mid-run, i.e. one year after the end of the project, the employment effect was twice as bigger, i.e. 7 320 FTE.

The effects of investment subsidies were way above-average in the sectors production and maintenance of electrical equipment, machinery and computers (1.5 FTE per EUR 100 000) as well as trade, repair, transport and ICTs (1.4 FTE). The effects were also larger in very small plants (less than 10 FTE), i.e. 0.98 FTE per EUR 100 000 subsidy.

In the *United Kingdom*, the change in the eligibility criteria for on depreciation allowances in 2004 provided a quasi-experimental setting to evaluate how tax incentives affect firms' investment (Maffini et al., 2015). The results suggest that the investment rate increased between 2.1 and 2.6 percentage points when firms became qualified for first-year depreciation allowances (FYAs) relative to firms that never qualified. This implies an increase in investment rate of 11 per cent at the mean. This large effect does not seem due to an increase in available cash but it is primarily driven by a decrease in the cost of capital. Firms respond rather quickly to FYAs, within 12 to 18 months. Firms also bunch just below notches in the cost of capital created by the qualifying thresholds, although such behaviour does not drive the main results of the evaluation.

The effects of the Regional Selective Assistance (RSA) have been analysed by Criscuolo and al. (2012) over 1986-2004. RSA was the main business support scheme in the UK in the period considered and provided discretionary grants to firms upon the condition that the supported project was undertaken in an Assisted Area – as defined by the EU - and involved capital expenditure on property, plant or machinery. The evaluation finds out a strong and positive effect of the RSA grant on investment but only for plants with less than 150 employees.

In *Italy*, investment policies have been the object of repeated evaluations over time. Arzeni and Carboni (2006) have analysed the effects of investment grants on ICT investments in a stratified sample of 2290 Italian manufacturing firms with 11 to 500 employees. A matching estimator for the average treatment effect is applied to explore the effectiveness of subsidies. Regardless of sector, the effect of public grants in small firms is substantial, both for total and ICT investment, while for large firms the effects are less clear. Subsidies boost ICT investment in small firms by 32% compared to firms not receiving subsidies; for medium-large firms, however, the benefits are statistically insignificant. This finding suggests that the incentive policy should be directed to small firms since they make much

Bronzini et al. (2007) evaluate the impact of investment tax credit (ITC) on business investment using a unique policy experiment provided by the ITC program carried out by the Italian Government through Law 388/2000. The aim of the program is to spur capital accumulation in Italy's lagging areas, as identified by the European Commission. The programme provides that firms investing in the South of Italy and few selected areas in the Centre and the North are granted a tax exception as a percentage of their annual net capital

expenditures. Both manufacturing and service firms are eligible under the program. All tangible and intangible capital goods are included, with the only exception of advertising, goodwill and R&D expenditures, office furniture, and vehicles for third-part transportation.

As other ITC schemes, this measure reduces the cost of acquiring capital for firms without affecting the returns from capital. Unlike other ITC schemes, however, the tax credit is not restricted to profitable enterprises with tax liability. Indeed, the credit can be deducted from any outstanding payment due to the central administration, including social security contributions.

The evaluation is based on firms having received the tax credit during the period 2001-04. As the ITC is granted following an application by the firms, i.e. there is self-selection into the programme, the evaluation uses different strategy to define a valid control group. All these empirical strategies point to the same conclusion: the ITC program has been highly effective in stimulating investment. This findings is robust to the way the comparison groups are selected and investment is measured. In addition, the investment boost attributable to the ITC is not driven by time substitution or counterbalanced by negative side-effects on factor efficiency and profitability, at least within the time window of data availability.

Finally, Colombo et al., (2013) analyse the effect of public subsidies on firms' investments and investment-cash flow sensitivity in a longitudinal sample of 288 Italian unlisted, non-venture capital backed, owner-managed new-technology-based firms (NTBFs), over a 15-year period from 1994 to 2008. Seventy-five of these firms received one or more public subsidies in the observation period.

During the observation period, there was no large-scale national public support scheme in Italy expressly targeted to NTBFs. As a result, NTBFs in the sample received direct financial support from 28 different policy schemes and a variety of financial instruments, including tax credits, non-repayable grants and low interest loans.

The findings suggest that investments of small NTBFs are sensitive to internal cash flows, while those of large NTBFs are not. In the short run, public subsidies to small NTBFs lead to higher investment rates and lower elasticity of investment to cash flow, i.e. less binding financial constraints. While the increase in the investment rate disappears in the long run, the elasticity of investments to cash flow remains negligible. These results support the view that public subsidies can help small NTBFs persistently removing the financial constraints on their investment.

### 3.3. Survey-based and econometric evaluation: a comparison

There are both strengths and weaknesses with the survey-based approach. Direct interactions with programme managers and participants help to understand the process through which the policy programmes delivered – or not – the expected outcomes. By their very nature, surveys and interviews make it possible to collect “tacit” information that would hard to quantify. When it comes to measure the effect of a policy, however, the perception by programme managers and participants is less satisfactory. People with an interest in a project, whether they have received policy support or have been responsible for its provision, have an incentive to speak favourably of its effects regardless of the actual outcome. Due to this bias, survey techniques are likely to over-estimate the effects of programmes (Bamberger 2009; List & Gallet 2001; Deiano and Tingvall, 2017).

Econometric analysis, on the contrary, help to test a statistical link between policy and outcomes and address issues of additionality, deadweight and displacement, which are key to the evaluation but remain beyond the scope of the survey-based approach. Yet, the econometric analysis has its own shortcomings. First, it cannot account for differences in the way a given programme was undertaken and has limited information on how to improve it. In addition, despite the fairly sophisticated methods to control for the effects of unobservable factors discussed above (Box 2), no econometric analysis is able to fully separate the impact of policies form other confounding factors. As Rodrik (2007) points out, investment policies are targeted on firms and industries that would be in difficulties in the absence of the program, so the estimated effects of these policies are likely to be downwards biased.

The above discussion shows that both qualitative and quantitative information are useful to the evaluation of ICT investment policy. Countries should use these tools more systematically to build the evidence base to inform their policies.

## References

- Ahmad, N., J. Ribarsky and M. Reinsdorf (2017), "Can potential mismeasurement of the digital economy explain the post-crisis slowdown in GDP and productivity growth?", *OECD Statistics Working Papers*, No. 2017/09, OECD Publishing, Paris, <https://doi.org/10.1787/a8e751b7-en>.
- Appelt, S., et al. (2016), "R&D Tax Incentives: Evidence on design, incidence and impacts", *OECD Science, Technology and Industry Policy Papers*, No. 32, OECD Publishing, Paris, <https://doi.org/10.1787/5jlr8fldqk7j-en>.
- Arrow K.J. (1972), "Economic Welfare and the Allocation of Resources for Invention", in: Rowley C.K. (eds) *Readings in Industrial Economics*, Palgrave, London, [https://doi.org/10.1007/978-1-349-15486-9\\_13](https://doi.org/10.1007/978-1-349-15486-9_13).
- Arthur, W. (1989) "Competing Technologies, Increasing Returns, and Lock-In by Historical Events", *The Economic Journal*, Volume 99, Issue 394, pp. 116-131, <https://doi.org/10.2307/2234208>.
- Atzeni, G.E and O. A. Carboni (2006), "The effects of Subsidies on Investment: An Empirical Evaluation on ICT in Italy", *Revue OFCE*, June 2006.
- Bakhshi, H. et al. (2013), *Creative Credits – A Randomized Controlled Industrial Policy Experiment*, London, Nesta.
- Baldwin, Richard E. and Frédéric Robert-Nicoud (2007), "Entry and Asymmetric Lobbying: Why Governments Pick Losers", *Journal of the European Economic Association*, MIT Press, Vol. 5(5), pp. 1064-1093, September.
- Banai A. et al. (2017), "Impact evaluation of EU subsidies for economic development on the Hungarian SME sector", *MNB Working Papers* 2017/8, Magyar Nemzeti Bank (Central Bank of Hungary).
- Blackwell, M. et al. (2009), "Coarsened exact matching in Stata", *Stata Journal*, Volume 9, Issue 4, pp. 524-546, Stata Press
- Bronzini, R. et al. (2008), "The Effect of Investment Tax Credit: Evidence from an Atypical Program in Italy", *Rivista di politica economica*, Volume 98, Issue 4, pp. 79-112.
- Cappelen, Å et al. (2015), "Effect on firm performance of support from Innovation Norway", *Reports 2015/35*, Statistics Norway.
- Cohen, W. M. and D. A. Levinthal, (1990), "Absorptive capacity: A new perspective on learning and innovation", *Administrative Science Quarterly*, Volume 35, pp. 128-52.
- Colombo, M. G., A. Croce and M. Guerini (2013), "The effect of public subsidies on firms' investment-cash flow sensitivity: Transient or persistent?", *Research Policy*, Volume 42, Issue 9, pp. 1605-1623, <https://doi.org/10.1016/j.respol.2013.07.003>.
- Coyne CJ, and L. Moberg (2014), "The political economy of state-provided targeted benefits", *Review of Austrian Economics*, Volume 28, pp. 337-356, <https://doi.org/10.1007/s11138-014-0274-8>.
- Criscuolo, C. et al. (2012), The Causal Effects of an Industrial Policy, *NBER Working Paper Series*, Volume 17842, <http://www.nber.org/papers/w17842>.
- Decramer S. (2014), "How effective are investment subsidies in Flanders? An RDD approach", *VIVES Discussion Paper*, Volume 45.

- Deiaco, E. and P. Tingvall (2017), *Swedish Innovation Policies - Design, Selection and Evaluation*, 130th Meeting of the Committee on Industry, Innovation and Entrepreneurship, OECD, [https://www.researchgate.net/publication/316738521\\_Swedish\\_Innovation\\_Policies\\_-\\_Design\\_Selection\\_and\\_Evaluation](https://www.researchgate.net/publication/316738521_Swedish_Innovation_Policies_-_Design_Selection_and_Evaluation).
- Dettmann, E. et al. (2018), “Heterogeneous effects of investment grants – Evidence from a new measurement approach”, *IAB Discussion Paper*, Volume 15/2018.
- Gustafsson, A. et al. (2018), “Subsidy Entrepreneurs”, *Ratio Working Paper*, Volume 303, <http://ratio.se/publikationer/working-paper-no-303-subsidy-entrepreneurs/>.
- Gustafsson, A. et al. (2016), “The ‘sugar rush’ from innovation subsidies: a robust political economy perspective”, *Empirica*, Volume 43, pp. 729-756, <https://doi.org/10.1007/s10663-016-9350-6>.
- Hall, Bronwyn. (2002), “The Financing of Research and Development”, *Oxford Review of Economic Policy*, Volume 18, pp. 35-51. <http://dx.doi.org/10.1093/oxrep/18.1.35>.
- Hubbard R.G. (1997) *Capital-market imperfections and investment*, Technical report, National Bureau of Economic Research.
- Iacus, S.M., G. King and & G. Porro (2011), “Multivariate matching methods that are monotonic imbalance bounding”, *Journal of the American Statistical Association*, Volume 106 , Issue 493, pp. 345-61.
- Iacus, S.M., G. King and & G. Porro (2012), “Causal inference without balance checking: Coarsened exact matching”, *Political analysis*, Volume 20, Issue 1, pp. 1-24.
- Jones, R. and J. Lee (2018), “Enhancing dynamism in SMEs and entrepreneurship in Korea”, *OECD Economics Department Working Papers*, No. 1510, OECD Publishing, Paris, <http://dx.doi.org/10.1787/ced4b0e9-en>.
- Lerner J (2009) *Boulevard of broken dreams: why public efforts to boost entrepreneurship and venture capital have failed—and what to do about it*, Princeton University Press, Princeton.
- Maffini G, J. Xing and M. P. Devereux (2016), “The impact of investment incentives: evidence from UK corporation tax returns,” *Working Papers 1601*, Oxford University Centre for Business Taxation.
- Nelson, Richard, (1959), “The Simple Economics of Basic Scientific Research”, *Journal of Political Economy*, Volume 67, page 297, <https://EconPapers.repec.org/RePEc:ucp:jpolec:v:67:y:1959:p:297>
- Niskanen, W. (1975). Bureaucrats and Politicians. *The Journal of Law & Economics*, Volume 18, Issue 3, pp. 617-643, <http://www.jstor.org/stable/725050>.
- OECD (2019), Hedonic Price Measures for Fixed Broadband Services: Estimation across OECD Countries, *OECD Digital Economy Papers*, forthcoming, OECD Publishing, Paris.
- OECD (2018), *International Migration Outlook 2018*, OECD Publishing, Paris, [https://doi.org/10.1787/migr\\_outlook-2018-en](https://doi.org/10.1787/migr_outlook-2018-en).

## *End Notes*

<sup>1</sup> The OECD definition of ICT supplying industries (2011) is based on the International Standard Industry Classification Revision 4 (ISIC Rev. 4) and includes Computer, electronic and optical products (ISIC 26); Software publishing (582); Telecommunications (61); and IT and other information services (62-63.)

<sup>2</sup> Australia, Austria, Belgium, Brazil, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, People's Republic of China, Poland, Portugal, Russian Federation, Singapore, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom.

<sup>3</sup> Australia, Austria, Belgium, Brazil, Canada, , Costa Rica, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, People's Republic of China, Poland, Portugal, Russian Federation, Singapore, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

<sup>4</sup> In one project, the software developed within the project is now used worldwide by the OECD, Eurostat and SMHI (Swedish Meteorological and Hydrological Institute) for visualisation.