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## Innovation, Skills and Investment: A Digital Industrial Policy for Europe

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# **Innovation, Skills and Investment: A Digital Industrial Policy for Europe**

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## **Abstract**

This paper identifies the main factors for Europe's delays in embracing the well proven growth enhancing effects of digital technologies. It argues that market failures, including externalities from knowledge spillovers, cybersecurity and first mover advantages justify public support. The whole value added chain of digital production is entailed, starting with infrastructure investment and R&D relevant for digital sectors, along with qualified skills of researchers and of workers, coming to skill sets provided by the education sector. Emphasis is put on the efficient leverage effects that can be achieved by combining public and private sector funds through financial instruments.

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## **1. Introduction**

Europe's sluggish growth performance and high unemployment rates in the follow up of the financial crisis is seriously worrying policy makers and economists and therefore it is not a surprise that industrial policy is now high on the political agenda. In particular, there is a revival of interest in "re-industrialisation" in consideration of the well proven productivity growth effects manufacturing is able to provide<sup>2</sup>. Indeed, many countries have formulated their own strategies of industrial policy and the European Commission has set "industrial revival" as a target: manufacturing in total value added should account again for 20% of GDP by 2020 (European Commission, 2014). This appears particularly challenging as currently this measure is close to 15%. The relevant questions therefore are whether the appropriate target has been identified and whether this is not backward oriented. The twentieth century was great for product innovation for very well identified items such as cars, aircraft, radio, TV and computers, as the related technologies led to very high labour productivity growth. But in the twenty-first century the prevailing technologies are digital, with mostly intangible goods or services that are not comparable with the tangible world of the manufacturing industry. Also the production factors change, as they are increasingly of non-tangible nature, in particular knowledge. Any meaningful

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<sup>2</sup> Rodrick (2004) has taken up this trend already more than a decade ago, though in a context of economic development. Aghion et al. (2011) elaborate such considerations for the European context, though looking more at a traditional toolbox in supporting environmental measures.

industrial policy measure should acknowledge this fact and identify any market failure that need to be compensated for.

In any case, the task of boosting measured value added share of the manufacturing industry has been proven as particularly challenging: first, because the traditional industrial policy objectives of promoting particular sectors or companies are difficult to achieve politically in terms of domestic consensus; second, because of external constraints posed by trade agreements and international organisations. At the same time, measurement issues may not fully account for the actual value added as many functions have been absorbed by the expanding service sector. However, manufacturing success is unlikely to lead to net employment growth in the sector. Productivity growth in manufacturing industry typically outpaces growth in demand for products, leading to shrinking of direct employment in the manufacturing sector (Peneder and Streicher, 2016). Employment growth is expected to rather occur in the non-traded service sector, to the extent that this is able to support the tradeable sector in an efficient manner (Summers, 2013). The sectors for which strongest expected demand growth are health care and social assistance, not least because of the increase in average age of population. Other growth sectors identified are local government, construction and education. All this is mostly related to the public sector and productivity increases may be achieved by increased recourse to information and communication technology (ICT). In any case, an efficient non-tradeable and public service sector capable of providing the key resources for a knowledge based economy is therefore of

essence to effectively support a competitive manufacturing industry. In particular, a good education system is essential to provide individuals with skills to update specific knowledge over a lifelong learning horizon.

This long term trend of decline in manufacturing does not undermine the argument that the manufacturing sector is essential for productivity growth. However, one needs to take into account the structural shifts that have occurred. The future manufacturing environment needs to be rich with knowledge assets. Several propositions are now advocating reindustrialization through industry-oriented 'integrated' policies (Aiginger, 2014; Andreoni and Chang, 2016). This should be achieved at European level by mainstreaming European sectoral policies. Countries have typically defined national strategies for industry centred on the main factor of production, or so called “competitive advantages”. As these can significantly differ across European countries, the policy preferences of countries may get into conflict. For instance, different labour market legislations may induce completely different recommendations for industrial policies leading to international competitiveness. This pro-activist stance for labour market flexibility is represented by the success of German industry in export markets in the aftermath of significant labour market reforms undertaken by government at the beginning of the century (Rinne and Zimmermann, 2012). Other countries, in particular France and Italy, are unable to elaborate a policy consensus on reform and are struggling with introducing similar measures that lead to better cost competitiveness of industry.

Labour market reform is only one of the challenges that industrial policy has to tackle. Technological change is another factor that has a differentiated impact on countries. All countries have in common that industry is undergoing a deep transformation, driven by the pervasiveness of digital technologies. The impact of digital technologies and their applications is no longer confined to early adopters in key sectors, such as telecommunications, electronics and automation. The internet, e-commerce, mobile broadband, social media and big data have started to penetrate all sectors and countries benefit to a varying degree of them, depending on the relative size sectors and innovation absorption capacity of the industrial structure. New buzz-words have been coined such as “Industry 4.0” referring to the fourth industrial revolution: after the steam engine, electricity and robotics automation, it is now the turn of digital technologies to connect devices in an integrated industrial setting to set the scene for future manufacturing opportunities<sup>3</sup>. In the context of economic activities, this induces a fundamental change. The Internet enlarges the information sphere and allows for an almost immediate match of demand and supply. This poses challenges for traditional industrial policy: firms are increasingly operating on online platforms and can cater for a large variety of real or virtual services both for suppliers and for buyers. Such firms become able to exploit a position in the middle of a multi-sided market setting and thus shape the conditions under which the markets function. As information is the “raw material”, the ensuing low transaction costs challenge many of the main

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<sup>3</sup> This concept has been greatly discussed in international fora such as the World Economic Forum in Davos. See also Schwab (2016).

tenets of the traditional theory of firm, blurring also the boundaries of producers and consumers. Because the economic value of firms involved in the supply of such services does not depend on the actual sales, but rather the perceived value and potential of the network, an astonishingly rapid growth of indicators such as market capitalization could be observed. Several internet based companies that did not even exist 10 or 20 years ago are now in top positions in the world rankings of market capitalisation ahead of industrial companies. US based companies are here the undisputed leaders with perhaps some exceptions. Europe is occupying lower ranks, certainly not in line with the high level of welfare that the region is currently commanding on a global scale. The problem for Europe is that the digital sector is relatively small compared to for instance the US. Europe has shown a distinctive reluctance to adopt digital technologies in the industrial sectors and to adapt their production processes to fully benefit from the network effects that come along with digital technologies. The adoption of digital technologies becomes a distinctive industrial policy goal and the failure to pick up this challenge could have wide-ranging economic consequences. In any case, it is most likely to undermine the sustainability of the European model of welfare society.

The aim of this paper is to illustrate industrial policy measures, in particular by taking advantage of the digital technologies, to tackle the lack of economic growth performance in the Europe. The paper is organised as follows. Section 2 illustrates the evolution and role of the manufacturing industry in the European economy, showing the marked trends of deindustrialisation and

slowdown of total factor productivity. Section 3 discusses the lag in digitalization of the European economy, along with the reasons for this and the consequences thereof. Section 4 looks at market failures that may emerge in the digital economy and how they slow down the speed of digitalisation. Section 5 provides some suggestions for a new approach to industrial policy centred on the efficient adoption of digital technologies and the resources required. Section 6 concludes.

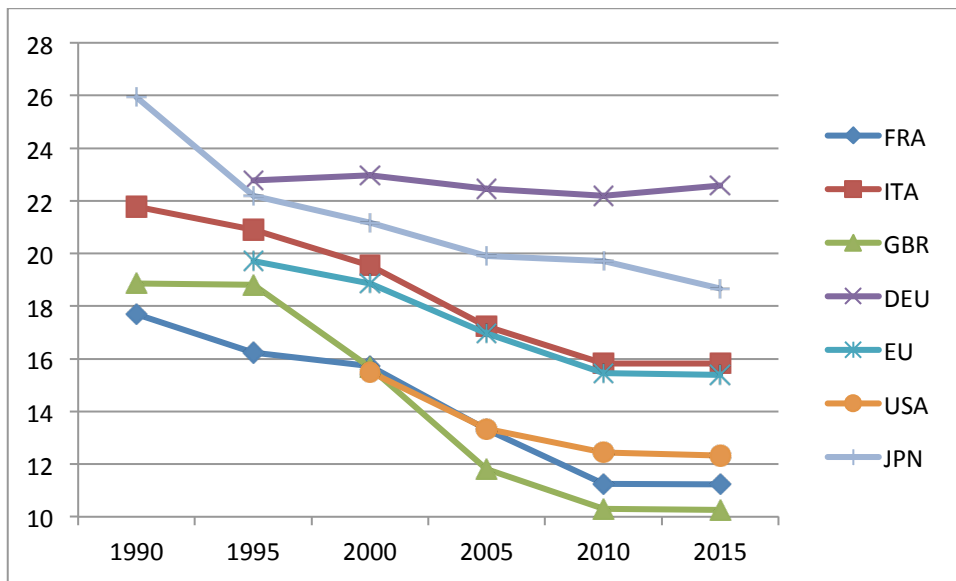
## **2. The evolution of European industry and its production factors**

The second half of 20<sup>th</sup> century is a true success story for Europe under many aspects, in particular from the point of view of economic prosperity. Until the run-up to the first oil crisis most countries in Western Europe managed to achieve unprecedented levels of economic welfare due to rapid expansion of industrial production (Eichengreen, 1996). National industrial policies were quite successful in promoting economic development of the countries as economies were still quite closed. This has also helped to preserve a large degree of heterogeneity across countries. For the several countries, such as France and Italy, the manufacturing base was hybrid of internationally competitive private sector companies and of state owned companies in a set of “strategic” industries, such as defence, steel and chemicals (Graba and Nützenadel, 2014). The industrial sector benefitted also extensively from state aid and from tariff and non-tariff protection and privileged access to finance. These policies were quite effective in providing occasionally industry a strong competitive position on export markets in low to medium technology



industries (Guerrieri and Milana, 1990). Other countries such as Germany and the UK were more based on the private sector and thus international competition was putting much earlier pressure for adjustment. In the UK this led to rapid structural change, including a drastic reduction of the manufacturing base; in Germany, the opportunities of access to world markets was picked up by the manufacturing sector through specialisation in sectors with specific competitive advantages of the countries. Figure 1 shows the evolution of manufacturing value added as a share of GDP by some selected countries. All of them see a significant decline of the manufacturing sector, which now has a share of well below 20%. The exception is Germany, where the manufacturing sector has stabilised above 22% of GDP. This may also be seen as the result of the extremely high export orientation of the German economy and where macroeconomic policies are aimed at keeping domestic consumption at a relatively low level. At the same time, this different evolution of the manufacturing share suggests that there is scope for industrial policy. The challenge consists in disentangling the main components thereof.

**Figure 1. Manufacturing value added as a percentage share of GDP**



Source: World Bank

Over the past two decades, the post-war patterns of growth of countries were challenged as macroeconomic performance became more sensitive to discrete economic policy choices taken by a country, including industrial policies (Mosconi, 2015). It required a country to elaborate a political consensus on the way forward and thus adopt the appropriate industrial policy decisions. Comprehensive, worldwide trade liberalisation along with the completion of the internal market of the EU put several models of specialisation, especially those based on medium to low technology industries, under severe pressure, as new competitors, in particular China, were emerging on a global scale. The political imperative of privatisation of state owned companies and the scrapping of state aid schemes undermined the business model of state owned companies; their captive market disappeared along with economic resources to

feed it. At the same time, the competitive private sector was faced with increasing competition from emerging countries on low to medium technology sectors putting under pressure European countries that had a strong position therein, but failed to move up the ladder to more R&D intensive activities. In general, Europe has not been able to fully grasp the growing role of production factors other than labour and fixed capital. With respect to labour, skills became crucial. For the production factor capital, soft or intangible assets, such as general knowledge and intellectual property, play an increased role. Indeed, endogenous growth models consider these as separate determinants.

The understanding of the determinants of productivity growth has greatly improved with the refinement of the definition of the production factors, in particular the introduction and quantification of “intangible” assets, such as R&D. Estimates by Corrado et al. (2009) have shown that the rate of labour productivity growth is 10-20 per cent higher when including intangibles both as input and output, in comparison with a framework that ignores intangibles. Intangible capital deepening therefore tends to become the main source of labour productivity growth (Roth and Thum, 2013). Intangible assets explain to a large degree the productivity gap between Europe and the US (Corrado et al., 2012). Intangible assets that constitute knowledge at firm level can be grouped into computerized information, innovative property, and economic competencies. The findings of this line of research lead to an important conclusion: the emphasis on business R&D as the main driver of productivity

growth is underestimating the actual growth contribution of intangible assets. The focus on productivity enhancing policies should therefore be broadened.

It is well known that the R&D expenditure of the European business sector, though increasing, is still low. It has only reached 1.60 per cent of industry value added in 2014 (OECD data) and is far below what is considered as appropriate: the US firms spend 2.59 per cent and Japanese 4.0 per cent. But the variance of European countries around this ratio has increased over time. As shown in Table 1, the business R&D/value added ratio is in any case far below that of the US and Japan. To some degree that can be explained by the different mix of industrial sectors, where in Europe R&D intensive industry plays a smaller role than elsewhere.

**Table 1 Business R&D as percentage of value added in industry**

	2000	2010	2014
France	2.15	2.37	2.54
Germany	2.60	2.87	3.09
Italy	0.77	1.08	1.19
United Kingdom	1.70	1.66	1.75
EU28	1.64	1.80	1.97
OECD	2.22	2.39	2.54
United States	2.92	2.98	3.06
Japan	3.13	3.82	4.33

Source: OECD

Another relevant factor is the skill level of the workforce. Overall, Europe is spending much less on education than the other regions. EU expenditure on education was 5.00 per cent of GDP in 2014 (OECD data) and is much below the US with 6.02 per cent.

A further element where Europe is particularly lacking is computerised information such as software and related databases and skills. This will be dealt with in more detail in the next section.

### **3. The role of digital technologies**

Digital technologies are shifting the traditional boundaries of industries. Thanks to the lower cost of communication and the ubiquitous scope for connecting devices there is a tremendous increase in flexibility for manufacturing, in mass customisation, in speed of production and in quality. These are exactly the opportunities that are encompassed by the term “Industry 4.0”. To embrace them, an economy must be prepared for it. The impact of digital technologies and their applications is no longer confined to early adopters in key sectors, such as telecommunications, electronics and automation. The internet, e-commerce, mobile broadband, social media and big data have started to penetrate virtually all sectors. Growth accounting exercises identified three channels for investment in digital technologies to contribute to economic growth: First, the productivity growth effect of the ICT producing sector, in particular through the benefits of what is known as

“Moore’s Law”, according to which nanoelectronic devices, the core of ICT, double their performance every 18 months; Second, the capital deepening effect of ICT investment as a factor of production; Third, the ICT induced productivity growth in sectors adopting ICT.

Econometric investigations have unravelled the effects of these channels and generally find that the growth effects are pervasive particularly for the first and second channel, clearly distinct pattern across countries. Nevertheless the two channels count for the bulk of the effects. It emerges that in Europe the digital sector is relatively small, both in terms of actual value added share in total manufacturing as well as in prospective given by relative of business investment in R&D. Hence there is a low growth performance. The third channel is more complex as the effects in adopting industries are more widespread, including economies of scale and network effects. As the raw material for ICT is data, substantial investment in ancillary, non-tangible assets is required for this effect to fully unfold. For instance, Corrado et al. (2013) show that Europe invests much less in such digital assets than the US and the combination with lower propensity to invest in ICT leads to a less effective exploitation of ICT (Van Ark et al, 2008) and hence lower growth performance.

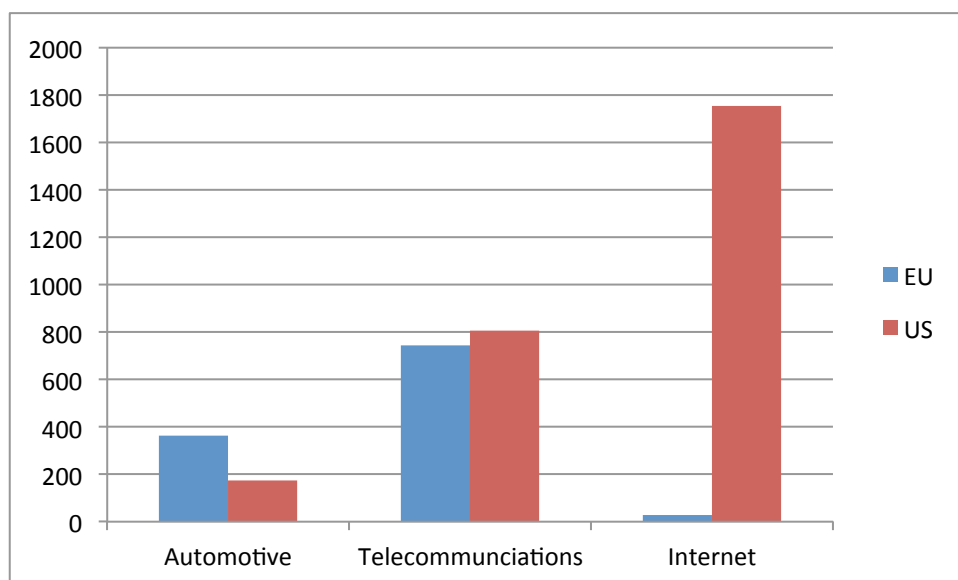
Access to communications infrastructure and its widespread adoption is a fundamental prerequisite for industrial competitiveness. The failure of many European countries to acknowledge this is a fundamental part of the problem. Economic research has shown that such infrastructure leads to higher growth

(Czernich et al. 2011) and Europe is lagging in the investment in such infrastructure.

This manifests itself in the market structure of the digital sector at a worldwide level when looking at the main corporate actors involved. Digitalisation has a profound impact on the main players in the corporate world. Comparing on the today's most capitalised companies with those 10 years ago illustrates a profound reshuffling of positions. Many of the today's top firms are relatively new firms and barely existed ten years ago. In 2016, the top 3 firms in the *Forbes* ranking were *Apple*, *Alphabet* (Google) and *Microsoft*. Ten years earlier, the ranking was *ExxonMobil*, *General Electric* and *Microsoft*. However, these large firms in the digital sector mostly originate from the US, while European firms play a marginal role in the top ranks.

These structural changes become even more evident when one compares the cumulative market value of the top 10 firms in some specific sectors in the EU and the US. Figure 2 compares the car sector, a stronghold of European industry with the digital sector. It shows not only a striking asymmetry in the relative strength of the sectoral specialisation, but also the overwhelming economic size of US based firms in the internet domain.

**Figure 2. Market capitalisation of top 10 firms by sector and origin (in EUR bn, April 2016)**



Source: Internet Foundation

The rise of importance of digital sector companies is part of a trend that has its well-founded seeds in the resources devoted to R&D. Tracking the world's largest R&D spenders over a period of over 10 years (2005-2016)<sup>4</sup> shows a distinct reordering of the leading positions: in 2005 there was only one digital firm among the top five firms (Microsoft); in 2016 there were four (Samsung, Amazon, Alphabet, Intel). Moreover, digital firms account for 40 per cent of the total R&D expenditure of the sample, followed by healthcare with 22 per cent and automotive with 15 per cent. Within these R&D budgets, there is a pronounced shift away from expenditure from physical products to software and services. This structure of R&D expenditures requires an equivalent

<sup>4</sup> <http://www.strategyand.pwc.com/innovation1000>



rebalancing of researchers skills. In other words, there is a need for Europe to create the premises for better specialisation in the digital sector by increasing the R&D skills in that domain.

#### **4. Scope for market failures**

Investments in the digital sector may be subject to externalities so that mere market incentives lead to a sub-optimum level of investment from a long term economic growth perspective. The reason why Europe invests less in digitalisation may be due to such market failures which may manifest themselves more strongly in Europe than elsewhere. It is important to investigate on them as they may lead to clues for effective policy remedies and also for justification of public interventions.

##### *Private appropriability of returns from investment*

Investment in digitalisation may be affected by problems of market failure which may manifest themselves in a similar way as investment in R&D: incomplete appropriability of the benefits of investment may lead to underinvestment. Moreover, benefits of digitalisation may need longer time to unfold than is justified by the time horizon set by private investors.

### *Cybersecurity externalities*

The intangible nature of data and the limited observability of its use provide several opportunities of misuse. Data security has the characteristics of both a private and public good (Ashgari et al., 2016). It is however very difficult to disentangle the effects: investment in security may have positive or negative externalities. Data can be acquired and used in an illegitimate way, circumventing intellectual property rights, with limited power of law enforcement. So data protection may benefit all users. However, data protection may also induce more costs in accessing data: if protection is more than actually warranted, negative externalities may set in. Because of the volatile nature of data, there is also suboptimal investment in cybersecurity, as the owner of the data may not have the same interest as the provider of the data. Investment in cybersecurity will depend on the economic consequences of abuse to the owner of data compared to the provider of the data, and there may not be an alignment of interest, especially when incomplete information on the use of the data is involved. Investment in education and capacity building are considered as the most effective means for improving cybersecurity.

### *Market size does matter.*

The success of an internet or information based business model is typically characterised by the reward of being the first to the market - “the winner takes

it all” (Shapiro and Varian, 1999). The success of US-based companies, such as Google, is to a large degree dependent on a large culturally homogeneous user population such as the US, compared to a (nationally) fragmented market for internet search engines in Europe, also because of language reasons. European national initiatives have mainly created small local copies of Google’s search functionality which has even enabled Google to achieve a higher market share in Europe than in the US. Google and other US companies have the advantage of having a large home market where completely new ideas can be tested and commercialised to the extent (if successful) that there is sufficient cash flow generated to also at a later stage launch the product on an international basis, which is easily achieved through the digital format of these types of services. This has resulted in US-based internet companies being able to simply introduce their proven products in new markets and because of this head start immediately become market leaders. An alternative to Google’s search engine, such as the Franco-German joint venture Qwant has to overcome national fragmentation and needs to establish itself as unique future European-wide search engine tailored to the local needs of European end users and ad placers. The challenge however for such a start-up is that it is not possible to catch up with Google’s enormous advantage in terms of data processing capacity and its search index. Google’s higher market share in Europe derives from the fact that it managed to establish itself as uniform European wide search engine crossing though national markets (Lewandoski, 2015). Qwant has however managed to get valuable support from a series of European actors. First, the German publishing company Axel Springer, which

is heavily investing in converting its business on digital platforms, is a key shareholder in Qwant. Second, the French government has committed to install Qwant as the default browser in computers of the public sector. Last, but not least, Qwant has attracted risk capital from the European Investment Bank. Such concerted action should be usefully extended to a broader base in the digital sector.

## **5. Building blocks of a digital industrial policy**

The literature reviews show that the notion of industrial policies typically has different meanings, depending on who looks at it and when<sup>5</sup>. This section illustrates how concerns of the digital sector have been neglected in the European policy debate. In the current policy context in Europe, the industrial policies are of course looked at on their potential for solving pressing problems such as low growth and (youth) unemployment. Experience has shown that targeting too narrowly specific sectors risk to provide little scope for furthering widespread economic growth opportunities and boosting employment. Policies aimed at supporting industry should therefore be rather broad based and further international competitiveness. The beneficial effects of such transversal policies would then trickle down in due course to the firms able to embrace the opportunities. Such “integrated approaches” however need to be developed further. In the current European policy context this is broached within a “green” and “sustainability” focussed argumentation, i.e.

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<sup>5</sup> See Aiginger (2014) for a survey of the approaches at different times.

very much about the energy intensity/efficiency of the manufacturing sector and the type of energy generation.

European industrial policy makers should make a critical inventory of the set of instruments they can rely on. There are the traditional instruments of prevention of market abuse, such as the regulation on enforcement of competition in the common market that includes merger control, state aid and competitive behaviour. Generally these instruments are used to ensure static efficiency, based on traditional models of general market equilibrium. These instruments may however reveal themselves as occasionally inappropriate, especially when dealing with digital markets where deviations from traditional static competitive settings are endemic: with digital markets competition is not *within* markets, but rather *for* markets where the winner takes all. Indeed, the diffusion of digital technologies has strongly affected the mode of competition and innovation. In the mechanical world, firms were competing inside industries in a silo-fashion. In the digital world, firms are competing across industries rather than within them, blurring the boundaries. Recent examples of structural business reshuffling are *Amazon* for book retailing, *Uber* for taxi and *AirBnB* for accommodation services. All of them have shaken up the traditional markets and changed the services are provided, involving much more the customer in the provision and in gathering information about preferences.

The large and leading companies in the digital world such as *Google*, *Amazon*, *Facebook*, *Microsoft* and *Apple*, are typically not much older than 20-30 years

and they have overtaken the traditional large corporates in terms of market value. In the digital world, market dynamics are much faster with product cycles unfolding much quicker and the traditional notions of competition policy must be updated. Broadly speaking, market entry into new markets tends to be much easier; market dominance can be achieved and challenged much quicker than exit. Abuse of market power can also occur in these industries and to effectively deal with them the parameters of competition policy must be updated. In the same way, there are several new domains where digital industrial policy can focus on. For instance, public procurement can have an important role in providing first mover advantage. However, there are also other areas which are discussed in the following.

### *Digital infrastructure*

On innovation and growth enabling infrastructure such as telecommunication networks Europe is trailing far behind. Even though the region was worldwide leading in the development adoption of second generation mobile telecommunications in the early 1990s (Gruber, 2005), this success could not be replicated with broadband communications infrastructure, neither on the mobile side (e.g. third and fourth generation mobile), nor on the fixed line side (fiber to the home). European sector regulation, putting emphasis on inducing service competition and low retail prices, stifled the opportunities for private sector investment and further sector development (Gruber, 2012). As a result, broadband infrastructure is being built at a much too low a pace. But this lag is

not only limited to broadband infrastructure; the adoption indicators of ICT applications published by OECD suggest that European industry is definitively lagging compared to its peers, which constitutes a competitive disadvantage (OECD, 2015). Access to communications infrastructure and its widespread adoption is a fundamental requisite for successful industry performance. Thus the European Commission launched the Digital Agenda for Europe as a policy initiative to provide Europe with broadband coverage targets. This has been complemented by the Digital Single Market initiative. The deployment of such digital infrastructure needs considerable investment support, in particular in rural areas (Gruber et al., 2014). Appropriate sector regulation may induce efficient investment in infrastructure, which can then be appropriately complemented by public support in a framework of financial instruments, such as project bonds or specialised investment funds.

### *Role of intangible assets*

This discussion on industrial policy in Europe has overlooked to a large degree the dematerialisation of productive assets and products. Policy makers are well aware that intangible assets such as R&D are a key driver for economic growth and the creation of new job opportunities. However they do not seem to take into due account the role of other equally important intangible assets, such as computerised information, organisational capacity, training of staff or designs and branding. Recent research is shedding more light on this. Chan et al. (2014) show by using sectoral intangible investment data that intangible

assets are a significant determinant of labour productivity growth. Moreover, intangible assets appear to be significantly more productive in ICT-intensive sectors. This finding aligns with previous firm-level studies that place emphasis on the complementary role of intangible assets in ICT investment.

Europe invests much less in intangibles than the US (Corrado et al., 2012) although intangibles still account for between one fifth and one fourth of the average growth of market sector labour productivity in Europe. The problem is that the role of tangible assets and their measurement as a source of growth is not sufficiently recognized, which hampers the formulation of sound evidence-based policy making in this area. First of all it is important to define intangibles better in the statistical data, going beyond the records a range of intangibles as investments, such as R&D, software and databases, by including also spending on training, market research, organizational capital, new financial products and similar. For national accounts this would have relevance in budget policy and prioritization of policies in the context of budget reviews. In addition to improved measurement, advanced countries need to build a deeper understanding of the returns to intangible assets and of the role intangibles play in the national and international innovation diffusion process. This would help to assess to which extent there is a public interest in publicly supporting investment in intangible assets.

### *Education*



The issue of training and skills in digital technologies is a complex one as European countries differ quite significantly in their education policy and performances (as they do generally on availability of skills). On some accounts, some European countries have top performance on a worldwide basis, but taken all together Europe is lagging behind other regions such as the US and leading Asian countries. This is also the result of a relatively low investment in the education sector. In 2013 the EU spent 5.0% of GDP on education, which is below the OECD average of 5.2% and the US with 6.2% (OECD, 2016).

In the EU, the responsibility for education lies mainly with the Member States themselves. Though coordination of the national policies at EU level was strengthened in 2009 with the adoption of a strategic framework for cooperation in education and training (ET2020), new approaches are required in a rapidly changing world. Lifelong learning has been identified as a priority for the future since it is the key to maintaining the employability of people and, thereby, their ability to participate fully in an ageing society. These targets imply a considerable reorganization of the education sector in Europe in the medium term, and in several countries with a substantial increase in financial resources for the education sector. In particular, there is the need to increase the skills level for digital technologies.

*Public sector as lead innovator*

There may therefore be two reasons for public support of private investment in digitalisation. First, the public sector has the possibility to act as pioneer, in particular through pre-competitive procurement policies. Not by chance, a number of fundamental digital innovations were made by public sector or related entities (transistor, internet, MP3,...). Second, act as investor, to compensate for risk aversion. In Europe, there may be an intrinsic difficulty for raising risk capital for investment in an innovative and particularly risky sector such a companies linked to the digital sector. Investors in Europe have knowingly a greater risk aversion than investors in the US. The public sector may hence act as “strategic investor” in digital companies. Clearly, this requires an appropriate design of financial instruments and efficient public investment decisions. An interesting and successful example in this respect is IMEC, the international research institute for nanoelectronics in Belgium. It was set up in 1982 by the Flemish regional government, together with the university of Leuven. IMEC is today one of the most advanced actors in semiconductor technology research in the world, mostly funded by private capital.

#### *Support to industrialization of R&D outcomes*

A predominant part of public funding of pre-competitive R&D for the private sector is undertaken at European level with allocation decided by the services of the European Commission. The main instrument is matching grants through a multi-annual program (Horizon 2020). This ensures efficient funding of

precompetitive R&D and which is delivering good results. However, there is the problem of adoption of innovation in the industry, leading to the paradox that often the benefits of research results are picked up by firms outside Europe. Europe is generally slow in transforming R&D breakthroughs into commercial successes. On the other side, the US have been very successful with creating a venture capital industry, particularly designed for supporting innovators in early stages of setting up activity. Most of the current market leaders have relied initially on such funding sources. For such financing an environment of trust and risk taking is essential (Bottazzi et al., 2016). For intangibles to well spread as factor of production requires a good scope for reliance on trust in the business environment and a good enforcement of law and regulations.

. Several European initiatives have been undertaken to remedy this, allowing the public sector funding also for continuing some public support to R&D undertakings also for phases closer to the market. For instance, Key Enabling Technologies (KETs) are a group of six technologies as defined by the European Commission, that have a wide range of product applications such as developing low carbon energy technologies, improving energy and resource efficiency, and creating new medical products. For such technologies, support can extend up to first manufacturing. This initiative shows that European level funding for specific sectors can be mobilized if there is a widespread policy argument that speaks in favor of the European interest for public support. The

challenge is to define appropriate technology domains in the digital sector that could benefit from such provisions.

### *Overcoming hurdles to financing the digital sector*

With current public sector budget constraints the scope for targeted industrial policies underpinned by public financing remains limited and thus the public sector should rather concentrate on regulatory domains or actions that have significant impact on key inputs for industries considered as “strategic”. Industrial targeting has been phased out as industrial policy tool as result of international state aid roll back agreements within the international organisation such as the World Trade Organisation (WTO) and the preference for horizontal measures. However, also the Treaty of the European Union foresees that possibility of targeted industrial policy, in particular in the context of “Important Project of Common European Interest” (IPCEI). If a project is considered in line with IPCEI, traditional state aid rules may be suspended. To qualify, “the project must contribute in a concrete, clear and identifiable manner to one or more Union objectives and must have a significant impact on competitiveness of the Union, sustainable growth, addressing societal challenges or value creation across the Union.”<sup>6</sup> Moreover, partners from at least two Member States must take part in the project. There is only one example that has successfully transposed this proposition: Airbus, for commercial passenger airplanes. The digital economy sector is expected to

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<sup>6</sup> COM (2014/C 188/02)

be one of the main candidates for which this instrument, which has been only recently reviews and updated in the qualifying principles, should be adopted. There are two digital economy projects under preparation: nanoelectronics and high performance computing.

Clearly, if for such projects traditional state aid rules can be suspended, a broader range of financial instruments becomes possible, along with such projects be able to raise resources in the private sector through commercial provision of goods and services. To strengthen the competitiveness of Europe's industry requires a concerted approach that looks at enabling factors as well as direct innovation performance. Widely advocated structural reform and appropriate regulation to ensure competitive, flexible and efficient markets for products, labour and finance are essential. But also public financing intervention that addresses market failures and catalyses private sector finance is important and the role of financial instrument should be emphasised. Financial instruments significantly leverage public funding for common interest purposes, involving private financing. It can on one hand provide the breathing room for the long term view because of the public sector resource and on the other hand it can deliver the implicit financial discipline on performance because of private sector interest.

For instance, the European Investment Bank has also developed in partnership with the European Commission a number of such financial instruments. Using funds set aside in the EU budget, these joint financial instruments allow the Bank to take on greater risk, such as the "Project Bond" initiative that aims to

encourage long term investors to back project management companies. These companies are able to issue investment-grade bonds that are attractive for this class of investor thanks to the EIB providing riskier tranches of funding backed partially by pre-defined EU budget funds. Also the European Fund for Strategic Investment (EFSI) is leveraging financial resources from EU sources (mainly funding from European Commission budget and from the European Investment Bank Group). The working principle of EFSI is mostly based on leveraging private investment. However, by properly prioritising the policies, there is considerable potential for using this fund in support of industrial policy, especially when geared toward mobilising strategic resources for industry, such as applied R&D, innovation enabling digital infrastructure and education. National governments have been solicited in proposing investments for these purposes. However, the reactions to these have been mixed and in particular the private sector has been generally reluctant in endorsing them with complementary investments.

To successfully absorb these financial resources available the challenge of industrial policy is to coordinate the long term programming of private sector research activity. Technical assistance is widely available through instruments such as Jaspers for projects eligible for regional development support and the European Investment Advisory Hub (EIAH) for projects to be funded by EFSI. Private sector R&D needs to be enhanced.

Last but not least, the value of public investment should be rated. The role of the public sector in supporting innovations that has been fundamental in

shaping the digital sector has been well documented: the transistor as key building stone for digital sector hardware to the internet protocol have all been generated by public sector research. It is therefore most likely that this role is not to abate, even though there is an increasing call for greater private sector involvement in the face of increased public sector funding constraints. This needs to be seen in a much more general debate on what should be priorities in public sector expenditure: investments for future productivity growth or redistribution of current resources for consumption along with the risk that they lead to further declines in the growth prospect.

## **6. Conclusions**

This paper has made an effort to identify the main factors of why Europe is late in embracing the growth enhancing effects of digital economies. A number of factors that inhibit the adoption of digital investment and innovation come with market failures and thus justify public support: they may refer to externalities from knowledge spillovers, cybersecurity and first mover advantages.

There is the need for Europe to adopt industrial policies that make better leverage of the growth enhancing features of digital technologies. This is in line with the European policy approach of the European Commission in looking at the transversal elements that technology support needs to satisfy. Indeed the whole value added chain of production is entailed, starting with

infrastructure investment and R&D relevant for digital sectors, along with qualified skills of researchers and of workers, coming to skill sets provided by the education sector. Moreover, the public sector has an important role in procurement and setting or promotion of standards. Last, but not least, financial support for the digital sector should be used with particular emphasis on the efficient leverage effects that can be achieved by combining public and private sector funds through financial instruments. Europe is making available substantial resources for the development of the digital sector, but it is still missing the ability to conceive projects that could efficiently absorb these resources. Entrepreneurship and abilities in designing innovative business plans are essential to meet the challenges and opportunities posed by digital technologies.



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