Chapter 11

The influence of innovation and education policy on inclusive growth

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11.1 Introduction

Linked indissolubly to the rise of ICT, the technological revolution has appreciably influenced advanced economies. Since the 1980s, firms relocate upstream or downstream the global value chains to face international competition from developing countries more effectively. The uncertainty in technological trajectories and the high degree of specialisation required to design new products and services has influenced innovation realisation. The conception and development of innovative products are no longer just the result of large firms' R&D investments but are fuelled by collaboration between different actors: large firms and SMEs, public and private research centres, and universities. In other words, the paradigm of open-innovation (Chesbrough, 2003) has steadily established itself and innovation is increasingly becoming a social construction (Trigilia, 2007).

In this scenario, the role of education and training institutions, and their relations with cutting-edge knowledge is becoming progressively more important. Universities' awareness to applied research demands, on the one hand, and firms' readiness to recognise the opportunities arising from the advancement of scientific research, on the other, are fundamental for generating innovation (Etzkowitz & Leydesdorff, 2000; Lawton-Smith, 2006; Gherardini, 2015). This has also changed the role of public policies for innovation. Today, governments actively support firms' basic and pre-competitive research by supporting investments, implementing network-building policies between firms and public research, and protecting intellectual property.

Hence innovation and education policies (IEP) have become increasingly fundamental development levers within the national political economy (Burroni, 2020). A country's level of welfare is conditioned by productivity, which in turn is closely linked to the innovative capacity of businesses and levels of education. Second, the sustainability of welfare systems, ever more costly due to the exacerbation of old social risks and the emergence of new ones, is influenced by the stability, if not the growth, of the financial bases of states, deriving from the taxation of the incomes of firms and individuals. But

DOI: 10.4324/9781003297130-14

the capacity of firms to bear the tax burden resulting from broad and inclusive welfare systems is in turn affected by the presence of a localised competitive advantage, aimed at avoiding flight to countries with lower tax burdens (Castells & Himmanen, 2002; Trigilia, 2016).

The aim of this chapter is to reconstruct the changes in the IEPs that take place in the wake of a shift beyond the Fordist–Taylorist paradigm, allowing the learning society paradigm to gain a foothold through the ICT revolution. In the following four paragraphs, the IEPs of the eight countries considered will be explored in depth. The sixth paragraph is devoted solely to education policies.

11.2 The Nordic countries

The economies of Sweden and Denmark at the beginning of the 1980s were in highly different conditions (Edquist & Lundvall, 1993; Fagerberg, 2016). While Denmark represented the paradigmatic case of the "small country in big trouble" because it was characterised by a fragile production system, chiefly rooted in the primary and agri-food sectors (Schwartz, 1994), the Swedish case was taken as a model of innovation-based development by international think tanks (OECD, 1997). Indeed, from the mid-1970s, Sweden began to lay the foundations of its systemic approach to innovation. However, in the early 1990s, both Scandinavian countries need to identify new development strategies.

11.2.1 The Danish responses to the challenges of the 1990s

Since the post-war period, the Danish economy has been governed by a dense network of horizontal and vertical relationships between policymakers, social partners, local stakeholders, and firms. For this reason, Denmark has been described as the country of the "negotiated economy" (Nielsen & Pedersen, 1991). A key feature of the Danish economic governance is the preponderance of organisations representing the interests of capital and labour, which use dialogue and compromise as the main instruments for resolving disputes at the central and, above all, at the local level. The state plays the role of intermediary and arbitrator. The development of the negotiated economy is closely linked to the particular Danish production structure, which consists mainly of networks of small enterprises, many of which are organised into cooperative societies (Kristensen, 1996; Iversen & Andersen, 2008). Moreover, interest representation organisations played a role in transforming Denmark into an innovation-driven economy. Darius Ornston (2012) coined the term "creative" neo-corporatism to describe social partners' involvement in creating the condition for Danish firms to enter high-tech markets.

While in other European countries, concertation served to defend constituent interests against external pressures, from the 1980s onwards in

Denmark it defined development strategies based on R&D training and support. This approach was inaugurated during the "blue period", namely, a decade of centre-right governments from 1982 to 1993 (Amin & Thomas, 1996) that continued after the return of a social-democratic coalition to government (1993–2001). Notwithstanding government alternation, this style of political economy has been not substantially altered, and now thus represents a strongly institutionalised practice.

The main achievements of creative corporatism were accomplished during the "blue period". One of these was to move beyond the sectoral and local approach to innovation using system-oriented national policies that promoted technology foresight (Amin & Thomas, 1996). Another successful feat involved the public support offered to the establishment and reproduction of local networks, both inter-firm and between firms and research centres, via the four-year Strategy 92 programme, launched in 1989 and developed by the Danish Technological Institute (Amin & Thomas, 1996, 267; Ornston, 2012, 109). This was the first of many clustering initiatives. Over time, succeeding governments have sought to build virtuous relationships with universities and technological assistance and training institutions (Edquist & Lundvall, 1993, 280; DASTI, 2016; Gergils, 2006). Finally, policies aimed at supporting start-ups in high-tech sectors were designed to create or attract venture capital funds, notably through the activation of private pension funds (Grimpe, 2015).

These interventions created some of the preconditions that would later give rise to the economic miracle of the early 2000s. Denmark witnessed the flourishing of high-tech companies, especially in the biotechnology and ICT sectors. The share of exports in highly innovative segments grew by 81% between 1985 and 2000 (Ornston, 2012, 94).

In more recent years, the Liberal government of Rasmussen launched the Danish Globalisation Strategy (2006) to increase the quality and international profile of Danish scientific research and its spillovers. This objective was pursued through the implementation of various strategies: increasing the share of competitive funding, upgrading doctorates and industrial doctorates, investing in long-life learning, merging processes between universities and, finally, the establishment of three "antennae" in highly innovative regions (Silicon Valley, Shanghai, and Munich), capable of offering internationalisation and opportunities for exchanging knowledge to Danish companies (Klitkou & Kaloudis, 2009; DFiR, 2018, 27; Aagaard & de Boer et al., 2017). The following Social Democratic government led by Thorning-Schmidt introduced the "Denmark–A Nation of Solutions" strategy (2013). In this case, the government first identified the general challenges (environment, energy, ageing population and digital security), and then the policy instruments, both in the innovation and tertiary education arenas, necessary to address them and, at the same time, promote economic growth and employment (Grimpe, 2015; Larousse, 2017). In both cases, the aim was to expand public investment in research and development from 0.7% to 1% of GDP.

Both strategies were the result of complex negotiation processes between the main actors of the national innovation system.

11.2.2 Innovation policy in Sweden

Due to the financial crisis of the 1990s and the subsequent takeover of many large Swedish companies by foreign multinationals, Sweden was forced to transform its governance style, passing from a sectoral to a systemic approach to innovation. The shift produced the Research and Innovation Act of 2008 and the Swedish Innovation Strategy of 2012. In both cases, these plans were drawn up following long preparatory phases of discussion between ministries, agencies and social actors. The first plan aimed to increase competition in the allocation of research funding (albeit in a context of increased ordinary funding), to push further towards the commercialisation of public knowledge and to fund strategic research areas (OECD, 2013; 2016), giving rise to a number of thematic policy-networks comprising universities, research centres and companies. By way of example, in the context of the so-called 4.0 transformations, a network (*Produktion 2030*) was set up between *Teknikföretagen* and IF Metall, i.e. the employers' associations representing respectively companies in the engineering and metalworking sectors, some multinationals in the technology and automotive sectors (including ABB, Alimak, Ericsson, Saab, Scania, and Volvo), many SMEs, and some universities and research institutions. In this case, the network aimed to develop innovation projects, disseminate the results to SMEs, provide vocational training, and learn about and disseminate good practices at a national level (Digital Transformation Monitor, 2017).

Swedish universities have a key role in the national innovation system. Public research closely adhered to the triple helix paradigm due to the centre-right government's 1992 Universities Act. The Act supported the promotion of university-industry consortia, entrepreneurship among university students and high-tech clusters (Etzkowitz, 2008). In terms of governance, this was achieved by activating national research funding foundations and venture capital funds. Universities and regional governments also gradually set up their own technology transfer foundations. Besides these, regional development agencies (*VINNOVA* and *Tillväxtverket*) were also included.

11.3 The countries of Continental Europe

France and Germany responded in markedly different ways to the major challenges of the end of the Fordist era. In France, the deindustrialisation process was more pronounced, similar in scope to that of the NIG countries. As will be seen, this initiated a public debate on re-industrialisation, which would have, above all, the effect of limiting the relocation of the R&D departments of French firms to other countries (Mustar, 2016). In contrast, in

the 1990s, the German manufacturing system faced a competitiveness crisis. Here, governments used innovation policies to stimulate the development of high-tech sectors and limit the traditional propensity of German firms for incremental innovation, within a more comprehensive scenario of enhancement of the manufacturing sector.

In terms of policy trends, both countries introduced new approaches – clusters, the triple helix, strengthening entrepreneurship – but France showed more discontinuity with the past than Germany, radically changing its approach from *technological colbertism* (Chesnais, 1993) to an *innovation-pull* approach. In Germany, on the other hand, the changes were less radical, and, albeit there are recent changes, it still conserves a *manufacturing-led* approach.

11.3.1 The great transformation of French innovation policy

The aforementioned innovation-pull policies, which aim at supporting the R&D activities of companies, represent a key feature of the French approach to innovation today. These chiefly take the shape of direct fiscal incentives to companies, mostly tax offsets or credit support from public investment funds. However, there are also other measures such as policies for high-tech clusters and support for technology transfer.

All these measures have engendered a discontinuity from the 1980s (Larédo, 2016). In the past, public investment was indeed driven by sectoral investment programmes (Larédo & Mustar, 2001, 452). The model was that of technological colbertism, characterised by the state's dominant role in basic and applied research (Chesnais, 1993). However, exogenous pressures, such as the process of European integration and the constitution of the World Trade Organization (WTO), have weakened the driving force of dirigisme, bolstering the dismantling of sectoral planning and the privatisation, albeit tempered, of national champions (Cohen, 2007).

The sharp downtrend in military spending on R&D, falling from 40% to 18% of total public expenditure on R&D between 1990 and 1999 (Mustar & Wright, 2010), brought about the decline of technological colbertism. Nevertheless, the transformation took effect gradually. Already back in 1983, under the Mitterrand presidency, the main instrument of the new policy trend had been introduced: the Research Tax Credit. Even today, the CIR (*Crédit d'impôt recherche*) constitutes the main lever for promoting private innovation and is a significant locational factor for R&D departments of international companies (Mustar, 2016). After the 2004 CIR reform, France became the first country in the world in terms of volume of funding to support business R&D (OECD, 2014, 187).[1] By way of enhancing the logic of indirect R&D support, the year 2013 saw the introduction of two other instruments designed to support SMEs: the innovation tax credit (CII) and Bpifrance, the public investment bank offering innovation loans and venture capital.[2] In addition to the CIR, French governments also adopted other types of policies, though

financially more limited. The best known is the *Pôles de compétitivité*, launched in 2004 to promote "innovation clusters" between companies and research centres, on the model of Silicon Valley (Larousse, 2017; Grivot, 2017).

France also boasts a long tradition of upholding the "valorisation" of public research results. In 1974, the National Agency for the Valorisation of Research (ANVAR) was created; in 1981, the structure and role of the CNRS (National Centre for Scientific Research) was modified, opening up the way for partnerships with private companies (Larédo & Mustar, 2001, 464). Nevertheless, it is since the end of the 1990s that these interventions have become firmly established (Bianchini & Llerena, 2016). The Allègre Law (1999) defined the regulatory framework for the transfer of research products from universities and public research institutions to enterprises. It gave researchers and academics to collaborate with firms, allowing the establishment of incubators and technology transfer offices (Muller et al., 2009), while the setting up of seed capital funds was facilitated (Gallochat, 2003; Mustar & Wright, 2010). A few years later, in 2006, the French government created the "Carnot" label, which endowed the collaborations for applied research between public R&D centres and companies with prestige and resources. To date, these centres continue to receive funding that is effectively comparable to the German Fraunhofer – institutes that inspired the Carnot policy – although their efficiency is still rather limited by comparison (Legait, Renucci, & Sikorav, 2015).

After the economic crisis of 2008, the French government increased investment in public resources and elaborated a systemic strategy for technological development. In December 2009, the Sarkozy presidency launched the *Programme d'investissement d'avenir* (PIA). The PIA was a heterogeneous plan in terms of its potential beneficiaries – universities, research centres, and businesses. It is also highly diversified as regards the financial instruments used (i.e. subsidies, loans, and direct investment managed by Bpifrance) and its aims, spanning from the development of new products to the creation of clusters (OECD, 2014).[3]

11.3.2 Manufacturing innovation in Germany

It is well known that German competitiveness is the rewarding outcome resulting from the coordination between private activities and public institutions (Hall & Soskice, 2001). Much has been written about the institutional factors that contributed to accomplishing this variety of capitalism (vocational training, industrial relations, corporate governance). However, less attention has been paid to collaborative networks between productive activities and public research, despite these having accompanied and shaped the emergence of German capitalism. This institutional framework allowed the large chemical and engineering companies to flourish, taking full advantage of in-house industrial research. At the same time, it also helped the rise

of medium-sized companies (*Mittelstand*), whose competitiveness was based on a "learning by doing" approach.

The 1980s and 1990s represented a long period of economic difficulty for a development model that was institutionalised but tardy in responding to exogenous challenges, and which was burdened by the country's reunification (Giersch, Paqué, & Schmieding, 1992). In net contrast, the 2000s were a period of strong economic development. One of the key features to distinguish this rapid development was the high expenditure of German companies on R&D,[4] supported and stimulated by the actions of various governments. These can be divided into three different seasons: (1) the traditional manufacturing-led interventions (until the 1990s); (2) the policies for the promotion of high technology (1993–2003); and finally, (3) the more recent phase of extensive public spending in innovation strategies.

In the first season, few sectors and few large companies were parties to public intervention. As in France, together with a few large private companies, the state intervened to support the development of a limited number of strategic sectors (aerospace, telecommunications, the railway system). At the same time, those years saw the buttressing of research bodies that served the production system. These were the Fraunhofer, Helmholtz, and Leibniz institutes which, together with the university system and the Max Planck Institutes, increasingly constituted an essential resource for knowledge transfer to the production system (Schmoch, 2011).

The second season saw governments focus more on supporting high-technology sectors, which were underdeveloped compared to the United States. During the 1990s, policies promoted the emergence of start-ups in the new economy and in the field of biotechnologies. To this end, the government encouraged new entrepreneurship through support for specialised financing. In the same vein was the experience of the *Neuer Markt*, established in 1997 as a section of the Frankfurt Stock Exchange, inspired by the American Nasdaq. However, these instruments had less success than was expected (Vitols & Engelhardt, 2005).

As an initiative for promoting high technology, the technology cluster policy was more successful. Launched in 1995, the BioRegio programme was an effective model for the many clustering initiatives that followed, helping to establish some of Germany's leading biotechnology clusters (Dohse & Staehler, 2008). Lastly, the German government also focused on the triple helix model of innovation with the Exist programme (1998). The aim was to promote spin-offs from public research, help research organisations exploit the results of their research, and disseminate the entrepreneurial spirit among their students (Kulicke, 2014). Even today, it is still an active programme that has generated numerous entrepreneurial initiatives (EFI, 2019).

The third season began in 2004, with the second Schröder government (SPD) inaugurating the Year of Innovation. In the same year, it promoted the "Innovation and Future Technologies for SMEs" initiative, aiming to improve

access to venture capital and increment interaction between businesses, research institutions and universities. However, it was not until the next Merkel government that a real strategy based on the close integration of innovation and industrial policies was launched. After a consultation with industrial and academic stakeholders, the first High Tech Strategy was introduced in 2006, a plan encompassing the three axes of German innovation policies: supporting new entrepreneurship and SMEs, increasing cooperation between science and industry, and enhancing human capital. To this end, the German government set itself the target of raising expenditure on research and development to 3% of GDP. This threshold was reached in the space of just a few years, and as such, the third High Tech Strategy, launched in 2018, would then raise the target to 3.5% of GDP. The main novelty of this policy approach lay in the definition of public–private roadmaps to bring innovation to some strategic regions for society (energy, health, mobility, security, and communication), combined with the high involvement of stakeholders in the decision-making and implementation process. With the 2006 strategy, formalised channels for dialogue between government, industry, and science were inaugurated (e.g. the *Innovationsdialog*, the Industry-Science Research Alliance, and the EFI-*Expertenkommission Forschung und Innovation*).

Several initiatives coalesced under the collective umbrella of the High-Tech Strategy, one of which was the *Excellence initiative* (active from 2005), inducing a radical reform of the public research system by promoting its internationalisation, the qualification of doctorates, competition between universities, academic entrepreneurship, and technology transfer. A second intervention included in the High-Tech Strategy was the *Industrie 4.0* initiative. Launched in 2011, the initiative aimed to upgrade the technology of German manufacturing by integrating cyber-physical systems and the "Internet of Things" into the production process. In this case, funding was earmarked for joint research projects between universities and businesses, for the creation of 15 competence centres and for co-financing projects by individual companies.

Yet the challenge for high-tech development was no longer only about promoting new entrepreneurship, as in the 1990s, or supporting manufacturing, but also about a new direct engagement of the state in creating new technologies. By way of illustration, in 2018 the Agency for Radical Innovation (under the control of the Ministry of Education and Research) was created on the model of the American DARPA, along with the Agency for Cybersecurity (EFI, 2019).

11.4 Southern European countries

Spain and Italy show the lowest public and private commitment to R&D and the lowest investment in the educational system among growth and inequality models. Nonetheless, they present appreciable differences from a qualitative standpoint. The two countries entered the 1980s with very different

innovation systems. Spanish policymakers largely overlooked the support of firms' innovation during the Franco regime and the aftermath of the transition to democracy (Buesa Blanco, 2003). No specific item of expenditure in the general state budget was devoted to innovation up to 1986 (Muñoz, 2001, 364).

In contrast, Italy had two independent innovation systems at the same time (Malerba, 1993). The first system comprised large state-owned companies targeted by direct state investment in R&D and entailed collaborations with universities and public research centres (Antonelli, 2005). The second system was constituted by networks of SMEs located in industrial districts. This system lacked central state support but relied on territorially embedded resources. Local milieus provide SMEs with collective competition goods. SMEs triggered incremental innovation by deploying externally developed technologies through learning by doing processes.

Italy and Spain can therefore be said to have lacked in institutionalising the innovation system, yet without forestalling the innovativeness of many companies, which might be considered "hidden champions" (Donatiello & Ramella, 2017).

11.4.1 Italy from the 1990s to the present

In the 1990s, the two-engine growth model lost its propulsive capacity, thus initiating a slow but progressive decline (Toniolo, 2013). The abrupt privatisation of state-owned enterprises in the early 1990s weakened the innovation system based on large firms and public research centres (Artoni, 2013; Lucchese, Nascia, & Pianta, 2016). On the one hand, external pressures for a redefinition of state aid rules by the European Commission and European integration acceleration imposed a reduction of the national debt that was realised through state-owned firms selling. On the other hand, the disruptive landslide of the institutional and party system triggered by the *Tangentopoli* scandal changed public support for the State's direct presence in the economy. However, industrial districts displayed a capacity to adapt to the global challenge by rationalising the number of firms and consolidating some leading enterprises (Bellandi & Caloffi, 2014; De Marchi & Grandinetti, 2014; Belussi, 2015). In the years in which the country's competitive foundations were being redefined, incentives for business R&D were increasingly implemented in Italy, extending an approach already adopted with the reform of public R&D investment instruments. Governments, therefore, opted for incentives for industrial and pre-competitive research, or the support of highly skilled employment. Incentives, e.g. tax credits, were also employed to promote collaborations between firms and public research centres. Accordingly, from the 1990s onwards, Italy adopted an innovation-pull approach to innovation policies. However, the growing support for private and public innovation investments lacked a comprehensive strategic vision. The horizontal

distribution of political competencies for innovation and research between several ministries hindered the emergence of a shared and coherent national strategy for innovation. The decentralisation of policy competencies to the regional and local levels contributed to fragmenting the policy supply to support innovation and thus increasing territorial inequalities.

In the 2000s, despite the steady expansion of funding, Italy failed to reach expenditure levels comparable with other countries, revealing a trend that was conditioned by the need to consolidate public spending. Nevertheless, at least three policies can be identified in this period to create a more articulated regulatory framework than the innovation-pull approach. First, "*Industria 2015*", a policy adopted by the Prodi government (2006), was inspired by the manufacturing-led model. The policy was aimed to facilitate the innovative leap of Italian SMEs operating in the automotive industry, household goods and green economy. The Ministry undertook to select and award "Industrial Innovation Projects" presented by partnerships between companies, universities and public research bodies that intended to invest in joint initiatives with a medium- to long-term horizon. Although *Industria 2015* was designed to be consistent with the characteristics of the Italian production system, it encountered significant obstacles in terms of implementation that were already endemic to national industrial policies, such as administrative stringencies in the assessment of projects and their application (Di Vico, 2014). The volatility of successive governments during the implementation phase and the effects of the economic crisis on public finances only added to the difficulties.

The second intervention was the Growth Decree 2.0 in 2012. It was introduced to support the creation and development of innovative start-ups through a set of tax benefits, incentives for capital investments, and ad hoc legislation on labour relations. In this case, the technical government led by Mario Monti reorganised the regulation of the new entrepreneurship sector within a more general framework through the retrenching of resources to the research system and rationalisation of tax incentives for R&D.

Finally, the last innovation policy intervention, launched by the Renzi government, also found continuity in the governments to follow. This was the manufacturing-led policy known as the 2017 Industry 4.0 Plan (Ramella & Manzo, 2021). The Plan was welcomed by companies and proved to be a success. In contrast with *Industria 2015*, in order to facilitate the smaller companies also, the government created streamlined measures consisting chiefly of incentives and tax breaks for those investing in 4.0 technologies, to which access was automatic. However, although the Plan with its set of concessions did effectively contribute to increasing investments in capital goods, it lacked the more general need to introduce radical innovation, generating instead effects that were, for the most part concentrated, in a few productive sectors (such as the metalworking sector) and in the most dynamic territories (Onida, 2017; Gherardini & Pessina, 2020; Ramella & Manzo, 2021).

11.4.2 The steady growth of the Spanish innovation system

The turning point of Spanish innovation policy was Law 13/1986, the so-called Law of Science. The law was created to endow the country with a national system of innovation that had largely been underdeveloped and inefficient during the years of the Franco regime (ERAC, 2014). It established new institutions to support public and private research (such as the CDTI), inter-ministerial coordination (CICYT –Interministerial Commission of Science and Technology – and the CACTI – Advisory Committee for Science, Technology and Innovation) and vertical coordination, following the attribution of shared competence in innovation to the Autonomous Communities (CCAA). The law also gave responsibility to the government to draft the National Plan for Scientific Research and Technological Development, which contained the government's multi-year objectives to coordinate national and regional programmes designed around R&D (health, defence, universities, infrastructure, and industry). However, this coordination activity was highly problematic and unstable (Gómez & Puente, 2007). The national plans were not binding for the CCAAs, and funds were allocated annually in the budget laws, contingent on the capacity of the parties involved (national and regional authorities) to respect the agreements stipulated in concertation, as is still the case today.

Nevertheless, as with Italy during the 1990s, the need to respect the parameters set down in the Maastricht Treaty induced a downtrend in spending. In Spain, convergence was achieved by using tripartite concertation to contain wage fluctuation and pension expenditure and introduce flexible forms of work (Molina & Miguelez, 2013).

Discontinuity in innovation policy characterised the 2000s. In 2005, the centre-left of Zapatero (PSOE) implemented a system-oriented policy called "*Ingenio 2010*" in response to the Lisbon Strategy (2000). *Ingenio* consisted of four programmes designed to improve collaboration between public research and business, basic research, and physical and digital infrastructure. The programme constituted an intermediate step in expanding public investment in innovation, which culminated in 2011 with the approval of the "New Science Law". This remodelled the governance of the Spanish system, qualifying it as a "system of systems", in view of the fundamental role attributed to policies at a regional level within national coordination instruments, such as the long-term Spanish Science and Technology Strategy (EECT), delineated in the three-year State Plans of Scientific and Technical Research and Innovation (Mineco, 2017).

In 2013, the Rajoy government (PP) implemented the Law to support entrepreneurs and firms' internationalisation. One of the key objectives was to disseminate entrepreneurial culture through the university system. Finally, the *Industria Conectada 4.0* Strategy revived the development of Spanish innovation policies after the interruption generated by the public debt crisis

resulting from the global economic crunch. Strongly influenced by Germany's *Industrie 4.0*, the Strategy was based on an analysis of the Spanish manufacturing sector and its weaknesses, indicated in the dependence of SMEs on imported technologies from abroad. It represented part of a more comprehensive plan for developing the Spanish industrial sector, the Agenda for the Strengthening of the Industrial Sector in Spain (2014), which interacted, in turn, with both the Digital Agenda and the EECT. Despite the government's inclusive approach, the Strategy's budget was considerably lower than that of other similar interventions launched by other countries, including Italy (around €700 million over the 2016–2018 three-year period).

Lastly, the two Sanchez governments (PSOE) have recently signalled their wish to maintain a strategic approach about the Strategic Framework 2030, which incorporates 15 sectoral agreements signed by the previous governments and employers' organisations. The agreements set out a series of short- and medium-term measures, including those to further deploy 4.0 technologies in the Spanish economy.

11.5 The Anglo-Saxon countries

The United States and the United Kingdom crossed the threshold of the 1980s with two very different innovation systems underway. In the face of the challenge posed by the Cold War, the USA developed supremacy in all possible technological fields, with significant repercussions on the production system. This unfolded within the framework of the national security state (Weiss, 2014) under the massive funding of federal agencies – including NASA, the Department of Energy, the Department of Defence and the Defense Advanced Research Project Agency (DARPA) – which had the task of overseeing the technological frontier. Nevertheless, these agencies did not work in isolation but interacted with large technology companies and the research system. Justified by the need to ensure national security before economic development, the constant pursuit of technological and military hegemony thus indirectly created the basis for a comprehensive and highly connected innovation system that supported modernisation at all stages, from basic research to product commercialisation (*the extended pipeline model*).

In contrast, before the 1980s, the British government had intervened less systemically, supporting mainly the capitalisation and activities of large strategic firms, such as the General Electric Company, Imperial Chemical Industries and the military, aerospace, and pharmaceutical industries (von Tunzelmann, 2003). With the end of the Cold War and the liberal turnaround of the Reagan and Thatcher governments, a *laissez-faire* approach became the hallmark of economic policy in both countries (Wallace, 1995). Expenditure on research and development was progressively retrenched, accompanied by cutbacks in all interventions that were not aimed at primary and pre-competitive research, i.e. to solve market failures.

However, the two countries' positions at the pivotal moment of the 1980s were completely different: the United States could pride itself on highly competitive companies interconnected with public research and a highly developed financial system, all preconditions for the take-off of Silicon Valley and other high-tech districts. Inversely, high-tech firms in the United Kingdom lacked competitiveness while in the meantime, a surreptitious mistrust of technological development was progressively taking hold in the country in the wake of numerous nuclear accidents, the failure of the Franco-British Concorde project and concerns regarding bovine spongiform encephalopathy (or "mad cow disease").

11.5.1 The United States

At the turn of the Cold War, the innovation policies designed to counter the Soviet challenge became less relevant in the States. The Reagan presidency was determined to meet the challenge of the competitiveness of Japanese technological intervention with the boost of the *state-less political economy*. The cornerstone of this regulatory state approach comprised two acts: passing the Bayah-Dole Act (1980), which allowed universities to license intellectual property obtained through scientific research to companies (Mowery & Sampat, 2004). The second was the Presidential Commission on Economic Competitiveness in 1983, chaired by John Young, CEO of Hewlett-Packard, which further enhanced the protection of intellectual property for the protection and growth of the competitiveness of the US companies on an international scale. In 1986, when the Commission created the Council on Competitiveness (which still exists today), the second phase of support for precompetitive research was inaugurated through public–private partnerships to develop new technologies for innovation, computers, and energy and manufacturing. This approach would seem to tie in with the previous line taken by the government, namely the extended pipeline model, where the Department of Defense (DOD) supported innovation not only in the design phase but also in subsequent phases up to the potential purchase of the prototype. According to Bonvillian and Singer (2017) this model facilitates the combination of advanced research and technology implementation.[5]

The interventions implemented by the Clinton administration largely persevered with the programme of support for technological advancement initiated by the previous presidency. In those periods, the style of policy-making changed as several initiatives were taken with the explicit intention of consulting close to the industry and with a perspective to "regulatory negotiation" (Wallace, 1995). Moreover, the impact of the public and private investments of the previous years became apparent in this period. In fact, many high-tech districts, such as Silicon Valley, entered their phase of maturation and, in a short period, captured the attention of startups and the international community towards policies for innovation. (Audretsch, 2021).

Following the attack on the Twin Towers (2001), the issue of national security returned to the forefront of public discourse and, with it, the national security state approach. From 2001 onwards, spending on innovation policies increased. In parallel, the Department for Homeland Security was established, which also had the research and development of technologies to improve homeland security among its various responsibilities (Weiss, 2014).

In the following decade, the new "Asian challenge" replaced the challenge of terrorism. This time, China posed as a significant economic competitor and, at the same time, as the new contender for global hegemony. The Chinese threat was at the origin of the most recent debate in the United States on innovation and the adverse effects of the "invented-here, produced-there syndrome" (Bonvillain & Singer, 2017). These were the years of rising unemployment in manufacturing, a cause of concern for policymakers. Between 2011 and 2015, the Obama government made efforts to defend domestic production and face the challenge of re-shoring strategic manufacturing activities.

The debate on manufacturing had been initiated in previous years by MIT President Susan Hockfield (formerly on the General Electric board) together with Jeff Immelt (CEO of General Electric) when, in March 2009, an interdisciplinary working group comprising representatives of the 11 MIT faculties was set up. The debate continued, and from 2010 onwards, there were ideological divisions within Congress that decelerated (and at times stalled) decision-making. Despite this, Congress was able to pass one measure to support manufacturing on a highly bipartisan basis (ibid.). This was the establishment of the Advanced Manufacturing Partnership (AMP) to develop detailed plans to fortify the competitive advantage in advanced manufacturing. The aim, therefore, was to ensure US leadership in emerging technologies with the ultimate goal of creating high-quality manufacturing jobs and improving US global competitiveness.

Regeneration of the manufacturing industry was also one of the central points of Donald Trump's election campaign. The institutes supporting the advanced manufacturing requested by Obama continued to receive funding for 2017. From 2018 onwards, their future was not so clear. The government implemented the first cutbacks for several federal agencies with research, science, and technology programmes. In institutes on manufacturing, curtailment was not direct but rather a consequence of the downsizing of the departments with which the institutes of the NIST network were correlated.

11.5.2 The United Kingdom

The processes of privatisation that began in the 1980s in the UK had a different time scale and scope from those on the continent, giving rise to a model of a "regulatory state" that was reluctant to intervene directly in determining industrial choices, except in cases related to the defence sector (Thatcher, 2003). The industry support fell from about £20 billion in the late 1970s to

around half a billion in the late 1990s. The Conservative government's answer to the loss of competitiveness was a policy by default and limiting support for private research and development to tax breaks for pre-competitive research. In those years, about half of public spending on R&D was absorbed by the Department of Defence, which then outsourced these activities to private firms, in what Edgerton (1991) called liberal militarism.

During the Thatcher administration, the government continued to fund some technology development programmes, such as the Product and Process Development Scheme (PPDS) and the Alvey Program, to develop microelectronics, telecommunications and robotics, albeit in a context of non-commitment. However, in 1988, the support was suspended when the government decided that these innovative actions had to be funded by industry rather than the government.

In the first half of the 1990s, the white papers on competitiveness published by the John Major's administration highlighted the government's approach in the three keywords: liberalisation, privatisation, and de-regulation (Sharp, 2003). Thus, the push for innovation as a driving force of competitiveness was not accompanied by public policies except through some incentives. On the contrary, the country's competitiveness was sustained by the investments of multinationals. The UK was the country that attracted the most foreign direct investment in Europe, a position that was stimulated by policies explicitly designed to invite capital (UK Trade and Investment 2015). By the mid-1990s, foreign-owned companies operating in the UK contributed 30% to output and 20% to employment in the manufacturing industries (Sharp, 2003).

At the same time, the government also came under increasing pressure to bring universities and industries closer together. The LINK programme (introduced by the Thatcher government to build research networks between business and universities) was complemented by two new programmes: the Teaching Company Scheme (TCS), stipulating those academics could work in innovative companies; and the Cooperative Awards for Science and Engineering (CASE), which funded doctoral scholarships on subjects chosen by private companies. Both programmes targeted companies and higher education research institutes to build partnerships and stimulate active participation in the technology transfer network and, at the same time, designated the companies as the ultimate beneficiaries of research funding. According to OECD data, the share of private research funding was higher than in the United States in those years.

Over the years, the Major government veered away from rigorous Thatcherism. The Minister for Science, William Waldergrave, launched a wide-ranging consultation that in 1993 gave rise to "Realizing our Potential: A Strategy for Science, Engineering and Technology", a programme which set out reforms to support biotechnology life sciences and manufacturing in general. The aim was to stay abreast of global technological change. To do this, "Fifteen Foresights Planning mechanisms" were set up to identify

those areas in which new developments in science and technology opened new market opportunities and adopted a long-term perspective for investing in innovation.

The Blair government took a further step towards enhancing innovation in 1997 to create a new modernisation unit within the Treasury. The government identified five drivers of productivity: investment in physical capital, enterprise and innovation, education and skills, competition and regulation, and public sector productivity (HM Treasury, 1999). The Blair government made a mark, however, by setting up Regional Development Agencies (RDAs) in 1998, which were placed in charge of regional development policies, with particular reference to upgrading workers' skills and attracting foreign investment (FDI), also through the management of European structural funds. Industrial and innovation policies were thus integrated into the regional policy framework (Berry, 2016).

As in other European countries, from the 2000s onwards, the innovation agenda began to be influenced by the criteria for allocating European funds. Technological programmes promoting collaboration between science and industry (Callon et al., 1997) were enhanced, and at the same time, the tax credit dedicated to SMEs was incremented (Cunningham et al., 2016). In the meantime, following the model of the Manufacturing Extension Partnership (MEP) in the United States, the Manufacturing Advisory Service (MAS), commissioned by the Department of Trade and Industry (DTI), was established in England in 2002. The programme was managed at the regional level by the Centres of Manufacturing Excellence and was primarily aimed at supporting the SMEs.

Following Gordon Brown's appointment as prime minister in June 2007, public spending on R&D increased significantly. However, it did not (and would not) reach the levels of the pre-Thatcher period and remained below the expenditure invested in both the US and the inclusive growth countries. In the few years that Brown was prime minister (2007–2010), he endeavoured to change British innovation policies. In the first place, the Department of Education and Skills and the Department of Trade and Industry were merged into the Department for Innovation, Universities and Skills (DIUS). DIUS also worked closely with the new Department for Business, Enterprise and Regulatory Reform (BERR) until they merged in 2009. In terms of substance, the Brown government adopted a neo-Keynesian approach set out in the green paper "New Industry, New Jobs" (HM Government, 2009).

The considerable change imposed by the Cameron government entailed a reorganisation of the decision-making levels of government and, consequently, allocation of funds. Management control at the local level was "disrupted" by the abolition of RDAs in 2010. This consequence for manufacturing was a retrenchment of funding for the Centres of Manufacturing Excellence. In addition, the closure of the RDAs led to the transfer of

functions (but not funds) to the Local Partnerships Enterprise (LPE), responsible for concluding agreements between local institutions and enterprises at the local level.

In 2012, the Cameron government launched the Advanced Manufacturing Supply Chain Initiative plan to strengthen collaborations between companies and universities for joint resources, funded first by the public and then by the private sector. In that year, 72% of total research and development spending was in manufacturing compared to 25% in services. The new strategy "Our Plan for Growth: Science and Innovation" (HM Treasury, 2014) ambitiously aimed to cast the UK in the role of the best country in the world for science and business through the implementation of six levers, among which also "Catalyzing Innovation" that included programmes to support SME research and development (High-Value Manufacturing Catapult).

Within a complex system of government-supported networking actions, university-industry links persisted. In 2015 the government promoted the Knowledge Transfer Network (KTN) programme operated by Innovate UK (formerly the Technology Strategy Board), the aim of which was to build better links between science, creativity, and enterprise by bringing together companies, entrepreneurs, academics, and funders to develop new products, processes, and services.

In June 2016, the British political landscape changed radically with the outcome of the referendum in favour of Brexit and the arrival of Theresa May in government. As Prime Minister, May proposed to integrate the competencies of the Department for Business, Innovation and Skills (BIS) and the Department of Energy and Climate Change (DECC) into the Department for Business, Energy and Industrial Strategy (BEIS). From the perspective of actions, it seems to have followed the line of the previous government: post-crisis industrial policy innovation was one of the critical points of the political discourse narrative not to be followed by substantial reforms, thus affording in practice more attention to the financial core of the country's economy, to the detriment of manufacturing (Berry, 2016).

11.6 Education policy

While innovation policy supports the economic system in its technological upgrading, the role of education in sustaining growth and reducing inequality is twofold. On the one hand, education systems affect firms' innovative capacity by providing qualified personnel. On the other hand, education fosters social mobility upward and can help reduce social inequalities by facilitating access to better-paid jobs. Nonetheless, this capacity depends on the education system's accessibility for students and their families, i.e. whether participation is guaranteed for all or limited to a proportion of citizens. However, this is true if the production system expresses a generalised demand for educated

personnel. If this is not the case, the advantage of having a tertiary qualification is greatly diminished. Although the position in the labour market is more advantageous for graduates in all the models,[6] the countries with more traditional production systems have a higher share of skilled workers in jobs for which the skills they possess are not needed (OECD, 2015a).

This section focuses on selected countries' tertiary education, with particular attention to the means of access, the contribution required for enrolment and the resources invested by the public and private actors. Finally, we will look at the impact of any mismatch in skills.

In the EIG countries, an "education for all" approach, i.e. a system that aims to ensure that knowledge and skills are widely accessible, has prevailed for many years. The educational systems of Sweden and Denmark are characterised by some distinctive features. First, schooling is compulsory until the age of 16 and access to tertiary level education is not segmented, i.e. contingent on having chosen particular secondary education paths. In addition, university programmes are free for EU citizens, and a generous scholarship system to help defray the costs of student life for the less well-off exists in both countries. In recent years, the degree of universality in the Swedish university system has been significantly reduced: since 2014, Swedish universities could impose tuition fees reserved for non-European students only (Pinheiro, Geschwind, & Aarrevaara, 2014).

In NILG countries, there is a financing system in which students' contributions are proportional to their family household income. The average tax level is EUR 1,747 in Spain and EUR 1,926 per year in Italy – the highest level among the countries under scrutiny if the NIG countries are excluded (OECD 2019a). Moreover, the scholarship system is poorly funded and residual, linked mainly to the student's income (Viesti, 2016).

In France, the Ministry of Universities annually sets the amount for enrolment fees in three-year courses at public universities, which retain a margin of autonomy in determining the fee levels of subsequent pathways. In the 2019/20 academic year, the Ministry set the tuition fee for three-year courses for EU students at EUR 170 per student.[7] In the other DIG country, Germany, university enrolment is free.

NIG countries show significantly higher tuition fees for university courses than other models.[8] In the US, a variety of need- and merit-based scholarship programmes are implemented, reducing fees for around 89% of the student population in order to ensure access to more students (OECD, 2019). Despite this, the cost of enrolling in universities remains higher than in European countries, a factor that drives many students into private debt.

Resources for the tertiary system come from public budgets or private contributions. In NIG countries, most of these resources come from the private sector. In the US, household expenditure amounts to almost half of total funding (46.1%), as well as in the UK (49.1%), while the share of other private funding is just under 20% (OECD 2019a). The other two countries where

households significantly finance the university system are Spain (29.2%) and Italy (29.9%), followed by France (11.2%). In the other countries considered, a household contribution is absent. EIG and DIG countries have significantly higher levels of expenditures on GDP than other countries.

The accessibility of the university system is not only conditioned by the level of the contribution required of students. It is also the design of the education system that allows access to a greater or lesser proportion of the population. Although there are no tuition fees in Germany, the design of the education system does not allow access to university for vocational school graduates, except in a few cases. This is also one of the reasons why the number of people with a university degree out of the total population (29.1% in 2018) is lower than the average for OECD countries (37.0%). The explanation for such a low level of degree attainment can be found in some of the elements inherent in the education system, which ascribes a series of responsibilities relating to education to the Länder (Powell and Solga, 2011; Döbert, 2015). The first is the distribution of students at the time of entry into lower secondary school, which guides their subsequent educational careers. Access to the different types of secondary school is determined by the results obtained during primary school, which ends at the age of 11. The early placement of students in pathways that prevent them from entering the tertiary system makes it more difficult for those from families with a low educational profile to access university, as they have more difficulty in achieving the results needed to enter grammar schools that grant access to university (Döbert, 2015). However, until recent years, the impact of this segmentation on inequalities was limited. Indeed, the vocational training system guaranteed access to well-paid jobs in the manufacturing sector. However, it is largely dependent on the willingness of enterprises to offer training to students, an element which has diminished over the years, with adverse effects on the system's ability to retrench disparities in wealth (Thelen, 2014).

In France, the tertiary education system is divided into two pillars: the university system, on the one hand, and the polytechnics and Grandes Écoles, on the other. The two sectors have different mechanisms of access, governance, and level of funding and confer different social prestige to those who attend them. A highly selective national examination regulates access to Grandes Écoles since they are responsible for the training of the French ruling class – i.e. public and private executives, high-profile professors and technicians. On the other hand, admission to universities is open to anyone with a secondary school diploma. Universities are also the preferred choice for those who fail the entrance exams to the Grandes Écoles (Hörner & Many, 2015).

Access to the best universities, therefore leading to higher wage expectancy, is based on both wealth and meritocracy in NIG countries: it is contingent on the possibility of paying high tuition fees or accessing scholarships based on merit or family income. In recent years, the economic burden of university education has increasingly shifted towards household savings

and indebtedness. In the United States, national government allocations to public universities – those most affordable in terms of tuition costs – have fallen since 1992: spending per student has fallen in public colleges and universities by around 8%, while revenue (per-student tuition) has increased by 96%.[9] Likewise, in the UK the exponential increase in tuition fees has been matched by an overall decrease in exemption recipients and a marked increase in students applying for honour (or trust) loans (Bolton, 2018).

Except for Germany and Italy, where only 19.3% of 25–34-year-olds have a university degree, the other countries have a higher percentage of graduates in the total population than the OECD average. The other NILG country, Spain, now registers a value comparable to the average of the OECD countries (37.3%), because of the strong increase in graduates between 2000 and 2018 (14.6%), while in Italy this value was more contained (9.9% over the same period). Conversely, the United States, the United Kingdom, and Sweden show values that are strongly above average at just under 50% of the population.

Finally, it should be noted that not all national labour markets receive graduates in the same way. The NILG countries, along with the United States, have the lowest employment rates of graduates compared to the other countries considered. In 2018, Spain and Italy recorded an employment rate among those with a university education of 81.6% and 81.1%, respectively; in the United States, it is 82.2; while in the other countries considered, the value is in line with or higher than the OECD average value (85.3%). The productive fabric of the NILG countries, which is specialised in low-tech sectors and in which personal services prevail, requires few graduates. Spain and Italy are thus the two countries where the skills mismatch is most relevant (Burroni et al., 2019). The effects for the labour market are under-skilling (i.e. a workforce with skills lower than required), while the reflection on the education system is the abandonment of studies before graduation. The low

Table 11.1 Tertiary education policies in different growth models

Growth model	*Countries*	*Education policies*				*Mismatches in job market*
		Access	*Student contribution*	*Resources*	*Study grants*	
NIG	United States United Kingdom	*Income-related*	*High*	*Private*	*High*	*Medium-low*
EIG	Sweden Denmark	*Universalistic*	*None*	*Public*	*High*	*Low*
DIG	Germany France	*Fragmented* *Meritocratic*	*None* *Low*	*Public* *Mainly public*	*High* *High*	*Low*
NILG	Italy Spain	*Universalistic*	*Medium*	*Mainly private*	*Low*	*High*

presence of graduates in firms then also has effects on economic development in terms of low productivity and low capacity to absorb knowledge from other organisations.

11.7 Concluding remarks

The review of the IEPs adopted in the four growth models has disclosed a variety of repertoires of action. Nevertheless, many elements of similarity emerge, both across and within models. Similarities arise from two types of factors. The first is that economies are subject to shared exogenous pressures. All European countries had to markedly discontinue aspects of their innovation policy models upon accession to the European Union in the 1990s. In those years, European legislation regulated the possibility for national governments to intervene directly in the economy through public enterprises or state holdings. From this point of view, the most striking example is the French case, which relinquished the approach of technological Colbertism in favour of an approach based on tax incentives. In addition, the European Council's soft policies, such as the Lisbon Strategy and Europe 2020, have promoted the repositioning of member economies in the most valuable stages of global value chains, with a focus on enhancing the skills possessed by the workforce. Finally, the programming of the European structural funds has also had common effects on the choices of the various countries, such as the regionalisation of innovation policies or the request to construct policies around societal challenges.

The second type of influencing factor revolves around the concept of "mimetic isomorphism" (Di Maggio & Powell, 1983), i.e. imitating other organisations as a cognitive shortcut to cope with situations of uncertainty. As illustrated, in an open and competitive economic system, national governments have been called upon to intervene in support of economic development. However, this intervention seems to have been influenced by a country's attempt to recreate the conditions that succeed in generating economic innovation in the most dynamic countries. Thus, the phenomenon of transferring policies from one context to another was fuelled, among other things, by international organisations, such as the OECD. The circulation and support of "good national practices" fostered the hybridisation of innovation policies.

The analysis of national cases has afforded the possibility to determine several waves of similar interventions adopted in different countries. For instance, since the second half of the 1990s, the main reference model has been that of the American high-tech districts. Clustering policies to support new entrepreneurship and, in parallel, the promotion of knowledge exchanges between universities and businesses have thus become widespread. Similarly, the publication in 2003 of the first international ranking of universities, drawn up by Shanghai Jiao Tong University, drew attention to the lower competitiveness

of European research models. It was a real "Shanghai shock", which prompted substantial reforms in the financing and evaluation of the higher education system. Lastly, the brilliant performance of the German economy and the American "invented-here, produced-there" syndrome have more recently triggered the rediscovery of the strategic nature of manufacturing, hence promulgating initiatives to support industry, inspired precisely by the German *Industrie 4.0*.

These drives towards convergence have been moderated by the institutional specificities of individual countries and their economic structure (see Table 11.2). The EIG countries feature increasing public spending on research and development and a systemic approach to innovation policies, which evolves from strategies shared with key national stakeholders. The approach of creative corporatism, a style of the political economy adopted in the 1990s in EIG, has often withstood even the changing colour of governments. The innovation system's actors, especially universities, are at the centre of a coherent, cohesive and constant flow of policies. Regardless of the mode of implementation – more through agencies in Sweden, more characterised by project networks in Denmark – policies originate from forward-looking strategies and are implemented by highly collaborative public and private actors. The effects on the economic system have been distinctly positive, especially in Denmark, where the change of pace in promoting innovation in the 1990s was one of the prerequisites for the economic miracle of the following decade. The recent impact of Swedish interventions has been rather ambivalent. Despite the solid governmental impulse favouring innovation, the highly internationalised

Table 11.2 Innovation policies in the various growth models

Growth models	*Countries*	*Innovation policies*			*Integration with education policy*	*Type of state*
		Public spending	*Governance*	*Policy pattern*		
NIG	United States	*High*	*Federal agencies*	*Extended pipeline*	*Low*	*Innovator*
	United Kingdom	*Low*	*Minimal*	*Regulation*	*Low*	*Regulator*
EIG	Sweden	*High*	*Strategic negotiated*	*Systemic*	*High*	*Negotiator that leads*
	Denmark	*High*	*Strategic negotiated*	*Systemic*	*High*	
DIG	Germany	*High*	*Coordinated*	*Manufacturing-led*	*High*	*Institutionalised*
	France	*High*	*Minimal*	*Innovation pull*	*Average*	*Useful*
NILG	Italy	*Low*	*Fragmented*	*Hybrid*	*Low*	*Wasteful*
	Spain	*Low*	*Fragmented*	*Hybrid*	*High*	

companies seem to respond less and less to national regulation.[10] Overall, we have a *state that directs* innovative activities through *negotiated policies*.

Also, the DIG countries have seen an increase in innovation policy efforts over the years, especially in the wake of the 2008 economic crisis. In this case, France and Germany came from very different innovation policy traditions, respectively, *technological colbertism* on the one hand, and the *manufacturing-led* approach on the other. Already in the second half of the 1990s, both countries tried, with dubious success, to promote high-tech sectors and, more generally, the competitiveness of their firms. Although some of the instruments used are similar, the two approaches are still very different. French innovation policies revolved around R&D tax incentives, the aim of which was to invite and hold on to the most valuable activities of large firms in the country. In this case, governance was therefore *minimal*, and the state had the function of *facilitating* innovative activities. The German policies focused more on collaborations between companies and the many institutions for applied research. It is a decidedly *institutionalised* innovation system with *highly coordinated governance*, especially in manufacturing. Nevertheless, both countries have shared a progressive increase in public commitment to supporting innovation and the involvement of stakeholders in multi-year development strategies.

In contrast to the inclusive growth models, low levels of R&D expenditure, both public and private, distinguish the NILG countries, despite significant growth since the 1980s (although this trend was interrupted by the crisis in 2008). A second distinctive feature is the *fragmentation* of the innovation system, both on a horizontal level, between ministries responsible for innovation and research, and vertically between central and regional levels. Consequently, the resources allocated are fewer and subject to greater *dispersion*. In Italy, this fragmented system was not matched by a shared strategic vision of development. Moreover, relations between universities, research centres and businesses have also remained underdeveloped. The result is the persistence of divergence between businesses and the world of research, which hurts the inclination of companies towards innovation.

In the 1980s, the two NIG countries shared only one element in common regards innovation policy implementation – that of a period characterised by the mutual objective of withdrawing the state from supporting economic development. However, before and after the neo-liberal turning point, the two sides of the Atlantic were poles apart. In the United States, innovation policies significantly influenced the commercial success of American entrepreneurs in the sectors of telecommunications, biotechnology and digitalisation. However, federal investments in technology and innovation, fostered by a bipartisan commitment to national security were undermined by the waning of the Soviet challenge and the Reagan approach. Nevertheless, even in the 1980s, US innovation policies remained central to the development model, albeit with a shrinking budget, at least until the 2000s, when the new terrorist

challenge reinstated the *extended-pipeline* model. The years of the Obama presidency nurtured a new approach that could justify federal spending on innovation policies from a bipartisan perspective: support for manufacturing in the face of competition from China. On the other hand, Trump's election led to a retrenchment of federal expenditure, including innovation policies, which did not fall below the lowest point reached during the Clinton and Bush presidencies. The state continues to play an important role in private innovation.

In contrast, Thatcherism had more persistent effects in the UK. This is especially so because the previous season of innovation policies had not produced a competitive innovation system. In this case, public spending on R&D fell dramatically, albeit with a slight reversal in the years of the Blair government's regional policies and, especially, in the post-financial crisis interlude handled by the Brown and Cameron governments. Thus, the state mainly developed a *regulatory* function, even though the government recently gave change signals by bolstering regional innovation systems.

As far as education policies are concerned, countries can be classified according to their characteristics in terms of conditions of access to universities, levels and origin of funding contributions and the spread of scholarships (see Table 11.1). At one extreme, EIG countries combine universalistic access, high spending and high levels of education. University enrolment is free and generous. Widespread subsidies that support students' living standards. This alone is enough to appreciate that the positive effects of policies aimed at economic growth are combined with more favourable conditions for greater upward social mobility in this model. On the other extreme, the NILG countries are characterised by similarly universalistic access but with high taxation, few and parsimonious scholarships. In these contexts, the university system is therefore seen to be more oriented towards the reproduction of inequalities than towards social mobility.

The DIG countries come between these two extremes. From the perspective of student expenditure on tuition fees and public expenditure in support of tertiary education, these countries resemble the EIG model, but rather tend towards the NILG countries in terms of the spread and generosity of scholarships. However, unlike in France, in Germany, access is not universal and produces labour market dualisation effects. Here, the early channelling of students into a segmented education system prevents the most disadvantaged students from reaching the highest levels of education. As a consequence, especially in more recent years, the contribution to social mobility is smaller.

Lastly, the NIG model shows a high incidence of graduates, although public spending is low, and the financing of studies is mainly left to the students themselves. Moreover, choosing the most prestigious universities, those that guarantee access to the best-paid jobs, depends on merit and/or the availability of significant private savings or capacity to incur debt.

In conclusion, the review of the policies on education and innovation shows the importance of the state's role in upholding economic development. Where innovation policies have been more intensely implemented, economic systems have reacted with greater competitiveness and productivity has increased. Yet, it cannot be argued that innovation policies are a necessary and sufficient condition for economic growth. Among others, a necessary condition is the coexistence of a productive fabric of large enterprises (Gherardini, 2021). Not only is their capacity to embrace innovation policies greater than that of the SMEs but, at the same time, they can exert influence on executives to invest in this policy arena.

Notwithstanding this, it appears difficult to find a direct relationship between innovation policies and the curtailment of inequality. From this point of view, education policies would seem to be of greater importance, showing stability over the period, and capable of anticipating the tendency to inclusiveness of the different models.

Notes

1 In 2013, the CIR absorbed 72% of public spending on research and development (Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation, 2016) amounting to about EUR 5.5 billion annually (Mustar, 2016).

2 Bpifrance, 'the entrepreneurs' bank', is the latest development in credit support for SMEs. It was founded in 2013 as a joint venture between the business section of the *Caisse des Dépôts et Consignations*, the *Fonds stratégique d'investissement* and *Oséo*, the public agency of private law created in 2005 to support credit and innovation for SMEs.

3 The first version of the PIA (2010) mobilised EUR 35 billion in addition to the existing funding, directing it towards four main axes of intervention: higher education (EUR 19 billion), production chains and SMEs (EUR 6.5 billion), sustainable development (EUR 5 billion) and the digital sector (EUR 4.5 billion). The second and third versions of the PIA also included direct funding for scientific research (Mustar, 2016).

4 Today, the private sector accounts for about two-thirds of total R&D expenditure, making it one of the highest in advanced economies.

5 One of the many initiatives launched in the 1980s was the National Institute of Standards and Technology (NIST), which promoted the participation of small businesses in research and development funding from federal agencies through the Small Business Innovation Research (SBIR). Finally, in the last years of the Reagan government, the Omnibus Foreign Trade and Competitiveness Act (1988–1999) was first approved, establishing the Manufacturing Extension Partnership (MEP), a national network involving universities, research centres and other players, aimed at bridging the gap between advanced technologies and the needs of small and medium-sized enterprises. Second, in 1991, the Advanced Technology Program (ATP) was launched to subsidise the adoption of high-risk technologies that promised significant economic and social benefits for the country.

6 Graduates have lower unemployment rates than those with secondary and elementary education; they also have higher employment rates (OECD, 2019a, 79).
7 Data from the French Agency for the Promotion of Higher Education, services to international students and international mobility (available at www.campusfrance.org/en/tuition-fees-France, consulted 17 March 2020).
8 According to Times Higher Education, annual fees at American universities vary between $5,000 and $50,000, reaching an average value of around $33,000. Public universities generally charge lower tuition fees. In the UK, fees increased exponentially between 1998 and 2012 from a maximum of £1,000 set by the Blair government to a ceiling of £9,000 introduced by the Cameron government (Bolton, 2018). Although fees can vary from university to university, in the 2017/18 academic year, 121 of the 123 universities in the UK had raised tuition fees to the £9,000 annual cap for domestic students (ibid.).
9 Data provided by the State Higher Education Executive Officers Association.
10 For an attempt to explain the recent difficulties of Swedish enterprises in maintaining high levels of innovation, cf. Ornston (2018).

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