7

Mobilizing Human Capital for Entrepreneurship

7.1 General Principles

The creative potential of the human brain has led researchers to label it the ultimate resource (Simon and Kahn 1981; Simon 1996; Naam 2013). Indeed, the mainstream growth literature finds strong support for the notion that human capital—knowledge, skills, and social and personal attributes—matter fundamentally for economic growth (Lucas 1988; Mankiw et al. 1992; Barro 2001). Because an entrepreneurial society requires a broad variety of skills and knowledge, a key challenge lies in accumulating sufficient human capital and matching it to a sophisticated demand. This accumulation starts in school but continues throughout the working life, whether on production floors or in dedicated R&D labs.

The specific public good nature of knowledge (Arrow 1962) and the positive network externalities involved in basic human capital accumulation (reading, writing, arithmetic, shared culture and history, socialization, etc.) mean that private incentives and social returns rarely coincide. Therefore, public policy intervention is called for to create incentives to acquire, maintain, and diffuse skills and knowledge. In this chapter, we discuss proposals for institutional reform that will ensure that a sufficient level and quality of human capital is available to entrepreneurs and their ventures.

The roles of formal education and on-the-job training have shifted over time. In the early industrialization phase in the West, leading innovators seldom had much formal education; their innovations emanated from practical experience in workshops and production plants. This gradually changed when specialized engineering schools were established in late nineteenth century

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Europe and the USA, followed by the formation of R&D departments in large engineering firms in the early twentieth century (Rosenberg and Birdzell 1986; Mowery and Rosenberg 1998). Today, exceptional cases notwithstanding, most innovation emanates from team efforts that bring together skills and knowledge from different sources. The EOE perspective illustrates this through its emphasis on the need for several actors and competencies to realize the benefits of innovation. A new idea is only the first step in a knowledge-intensive innovation and commercialization process, and if new knowledge is to translate into economic growth, entrepreneurs must exploit it by introducing new methods of production or new products in the marketplace (Schumpeter 1934 [1911]; Michelacci 2003; Bhidé 2008).

In Chap. 2, we discussed reforms in the system of IPR that would increase the access to and availability of new ideas. Here, we once more embrace the principle of justifiability, since it is necessary to carefully balance private and public interests when discussing reforms to address the positive externalities involved in the accumulation of human capital and the availability of a broad and diversified pool of high-quality knowledge in collaborative innovation blocs. The principle of neutrality helps us safeguard the European value of universal access to high-quality education, whereas the principle of contestability ensures that challengers can compete for knowledge, skills, and skilled employees on a level playing field.

We should note that proposals referring to educational systems will usually be directed at EU member states, since the Union's competencies regarding education are limited (Suse and Hachez 2017, pp. 73–74). In contrast, policies supporting R&D and on-the-job human capital accumulation already make up a substantial share of the EU annual budget and have been well situated within the competencies of the EU since the Lisbon Treaty. As to innovation, the European Commission is looking into how existing regulatory frameworks in a host of relevant areas affect innovation, striving "to collect further suggestions on the relationship between innovation and regulation, indications of regulatory barriers to innovation and suggestions for simpler, clearer and more efficient regulation supporting growth and jobs" (Suse and Hachez 2017, p. 76).[1] The role and competencies of local and regional policymakers in this area are typically found at the base of the educational institutional framework in European member states.

[1] The EU may also influence member states' educational policies through coordination processes, such as the open method of coordination (OMC), recommendations, and incentive measures.

7.2 Proposals

In all likelihood, an excellent educational system from kindergarten through and including the university level would provide entrepreneurial ventures with a rich and diverse pool of human capital. Casual observation suffices to conclude that there is significant variation across the EU in how educational systems are set up, financed, and managed—as well as in how they perform. Given this diversity, one-size-fits-all reforms, such as allocating more public funds to the educational system, are not the answer.

Consider the evidence provided in internationally comparable tests of pupils' abilities and skills, the most important of which are the Programme for International Student Assessment (PISA; OECD 2016b) and the Trends in Mathematics and Science Study (TIMSS; Mullis et al. 2016). Human capital, as measured in these tests, is of crucial importance for economic growth (Hanushek and Woessman 2015), but the link between educational expenditures and test scores is far from homogenous. While high educational spending accompanies good results in Finland (especially at the beginning of the twenty-first century), it is associated with weak results in Sweden.[2] Whereas pupils in Poland and Estonia achieve excellent results despite relatively low educational spending, Romania and Bulgaria spend little and do poorly (see Table A.5 in the Appendix for details). An immediate implication is that naïvely implemented increases in educational budgets are unlikely to promote a more entrepreneurial society.

Undoubtedly, teacher quality is critical for pupil achievement on these tests (Goe and Stickler 2008), but still more critical factors are a detailed, coherent, and carefully sequenced curriculum organized around subject disciplines (Hirsch 2016b; Christodoulou 2014) and external exit exams ensuring that schools are held accountable for their performance (Woessman 2016). The exam content governs the content of teaching, provides adequate guidance to developers and publishers of textbooks and other teaching materials, and makes it possible to benchmark schools. That said, centralized exams and curricula limit diversity and possibly creativity almost by definition. As such, they may tempt teachers and pupils to "teach to the test," possibly forgetting about the cultivation of other useful skills and the preservation of a critical

[2] Granted, measuring inputs and outputs and comparing the quality of education across and even within educational systems is notoriously difficult. We focus on measures that ensure international comparability. PISA is done every 3 years and measures 15-year-old pupils' knowledge in mathematics, science, and reading. TIMSS is done every 4 years and measures the knowledge of fourth- and eighth-graders in mathematics and science. In 2015, 72 countries participated in the PISA tests and 57 countries in the TIMSS test.

attitude. Moreover, personality traits and family background matter for the performance of individual pupils (Johnson et al. 1983; Downey 1995; Magnusson et al. 2006), blurring the relationship between educational inputs and outputs and eventual success in the labor market (Winding et al. 2013). Consequently, the link from national performance in international tests to economic growth may be positive, but strong causality is hard to establish. The link to successful entrepreneurial venturing is even less evident.

The USA is a case in point. Though commonly believed to be the most innovative and entrepreneurial of all countries, government spending on education is intermediate, while private spending is substantial (2% of GDP compared to an EU average of 0.5% of GDP; see OECD 2018b, p. 207). Despite this high total spending, US pupils perform poorly in all three PISA knowledge areas, particularly in mathematics, yet they do exceptionally well in entrepreneurial venturing. The USA may be the exception that confirms the rule—or an indication that supporting an entrepreneurial mindset in education is not a matter of spending more resources or inserting business model canvassing into the national curriculum. A strong knowledge base is essential, but evidence also suggests that entrepreneurship is best taught in an experiential, learning-by-doing manner (Elert et al. 2015).

The essence of entrepreneurship is trial and error and learning from failure, hinting at the importance of fostering a positive attitude towards learning among pupils. To achieve this goal, it is important that the early stages of an educational career are characterized by positive learning experiences (Illeris 2006; Sanders et al. 2015) and that they instill a tolerance for failure and an appreciation of trial and error (Clifford 1984; Clifford et al. 1988; Metcalfe 2017). Therefore, we propose the following:

> Proposal 41: Reforms in primary and secondary education should provide pupils with a solid and coherent knowledge base and promote initiative, creativity, and willingness to experiment.

We do not propose, as some have (Griffin and Care 2014; Lazonder and Harmsen 2016), that the actual acquisition of knowledge be neglected in favor of skills training or purely curiosity-driven learning. Entrepreneurship is so broad, diverse, and uncertain that it is impossible to predict the specific knowledge that entrepreneurial ventures need. The educational focus should, therefore, be on broad and generic bodies of knowledge, rather than on highly specialized topics and fields.

Moreover, pupils and students should be challenged, not pleased: human capital of a mathematical and natural science orientation, for example, has

been shown to be important for science-based entrepreneurship (Shavinina 2013; Dilli and Westerhuis 2018). Indeed, this type of entrepreneurship typically delivers the most scalable and growth-enhancing innovations, and the most successful entrepreneurs in the world tend to have advanced technical degrees from international universities (Henrekson and Sanandaji 2014). It would seem, therefore, that an educational system that makes it easy for students to avoid challenging topics such as science, technology, engineering, and mathematics (STEM) would do the entrepreneurial society no favors. As Dilli and Westerhuis (2018) argue, early efforts to promote STEM (not least among young girls) would be a way to promote more ambitious entrepreneurship in the long run.

Similarly, because scaling a venture in Europe also often implies crossing national borders, there is a clear case for training effective international communication skills at early stages of the educational career, when such skills are relatively easy to train (Krashen et al. 1979; Collier 1995; Flege et al. 1999). In line with our principles of neutrality and justifiability, we therefore propose the following:

> Proposal 42: Promote STEM education and English as a (mandatory) second language early on and then throughout students' educational careers.

The proposal aligns well with the European Commission's Entrepreneurship 2020 Action Plan, including measures that induce students to be more entrepreneurial and encourage a focus on STEM fields. Bringing an entrepreneurial spirit to European curricula is a key ingredient in almost any strategy to create an entrepreneurial society. We stress that this should start early (Jayawarna et al. 2014), but a great deal can be done to make students in tertiary education more entrepreneurial as well.

Students typically make a crucial human capital decision at the end of secondary school when they decide whether to work or pursue tertiary education. In light of this fact, it is notable that tertiary enrolment has exploded in recent decades, which is evident from the first column of Table 7.1. The fact that the enrolment rate is high in many of the poorest EU countries, notably Greece, Bulgaria, and the Baltic countries, suggests that high enrolment rates per se are no guarantee that university studies have a high social rate of return, especially not in an entrepreneurial society.

The educational quality at the earlier levels largely determines how much one can expect and demand from students at the tertiary level. If their earlier education has been deficient, fewer students will be willing or able to choose more demanding lines of study, notably science and engineering. The second

Table 7.1 Tertiary enrolment and graduates in science and engineering in EU countries and the USA, 2016

Country	Tertiary enrolment (%)	Graduates in S&E (%)	Country	Tertiary enrolment (%)	Graduates in S&E (%)
Greece	117.4	29.9	Portugal	62.9	27.9
Finland	87.0	29.5	Czech Rep.	64.0	23.2
USA	85.8[a]	17.4	Italy	62.9	23.3
Spain	91.2	23.9	Sweden	62.3	26.0
Slovenia	80.0	25.7	France	65.3	25.3
Denmark	81.1	20.5	Croatia	67.5	25.3
Austria	83.5	30.3	Germany	66.3	36.4[b]
Netherlands	81.8	14.1	Hungary	48.0	22.8
Ireland	83.5	24.9	UK	57.3	26.1
Estonia	72.0	26.5	Slovakia	52.7	21.1
Belgium	74.6	17.4	Cyprus	60.1	15.9
Lithuania	66.0	23.8	Romania	48.0	28.8
Poland	66.6	22.9	Malta	48.8	18.0
Bulgaria	71.2	19.7	Luxembourg	19.7	13.8
Latvia	68.2	20.5			

Note: The ratio of total tertiary enrolment, regardless of age, to the population of the age group that officially corresponds to the tertiary level of education. Tertiary education, whether or not aiming at an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level. The share of graduates in science and engineering is defined as the share of all tertiary graduates in science, manufacturing, engineering, and construction over all tertiary graduates

Source: UNESCO Institute for Statistics, UIS online database (2010–2017)

[a]2015

[b]Data from http://data.uis.unesco.org/index.aspx?queryid=163 measuring "graduates from Science, Technology, Engineering and Mathematics programmes in tertiary education". In addition, Germany had 22.0% "graduates from tertiary education graduating from Engineering, Manufacturing and Construction programmes" in 2016

column in Table 7.1 confirms that such education matters more in European countries than in the USA (see also Fig. A.4 in the Appendix).

The demonstrated importance of engineering skills for entrepreneurship notwithstanding, more technical graduates in no way equates to more successful entrepreneurs. Nevertheless, universities can teach students entrepreneurial skills even when they are learning about other topics by making academic research and teaching more action-oriented and aimed at real-world experience; a mindset of trial and error and learning from failure is, after all, something all pupils should embrace (Sanders et al. 2018c). Moreover, to the extent that there are specific courses in entrepreneurship, they should be taught by people who have been involved in entrepreneurial venturing (rather

than by tenured university researchers lacking hands-on experience, as is all too often the case; see, e.g., Sanders et al. 2018a).

European educational systems differ from the USA in a fundamental respect: the private rates of return to education and analytical skills are much lower (see Table A.6 in the Appendix). Consequently, Europe cannot finance its university systems through high tuition fees that students subsequently recover by means of a highly paid job after graduation. Since their expected lifetime incomes are not high enough, we believe the EU should not opt for the American model of high private (out of pocket) investments. Instead, the Union should strive for accessibility to ensure an adequate supply of well-trained technical personnel. Given the niches in which the EU competes in global markets, such a supply is crucial for its entrepreneurial society.

> Proposal 43: Invest in high-quality tertiary level technical education by attracting excellent teaching staff and students and by strengthening Europe's strong tradition of vocational training.

This general recommendation translates into different interventions depending on the member state. For example, the UK's educational system provides world-class university education, but vocational and on-the-job training falls short of the country's needs (Sanders et al. 2018c). Thus, its brilliant new start-ups struggle to hire and retain the human capital required to compete on quality in global markets. In contrast, the German university system fails to provide excellence, while the vocational training and apprentice systems support a world-class manufacturing apparatus (Sanders et al. 2018b). In Italy, curricula are challenging and people may be well educated, but traditional curricula are a poor match for dynamic market demand (Sanders et al. 2018a).

When discussing tertiary education, it is necessary to emphasize the importance of university campuses. Evidence shows that campuses can be hotbeds of entrepreneurial venturing (Audretsch 2014), and some of the Europe's campuses have already realized that potential (e.g., Chalmers in Gothenburg, Sweden: Jacob et al. 2003; Dahlstrand 2007; Lundqvist 2014). If others are to follow, policymakers need to take measures that enable several university-level links to function efficiently. Notably, for knowledge-based entrepreneurship to flourish, universities must have incentives to align subject areas with business sector demand and to facilitate knowledge transfer from academia to the entrepreneurial sector. The USA may serve as an important role model here.

That said, the US system of granting property rights for patentable research findings to universities is unlikely to be beneficial in Europe, given that

European universities are typically government owned.[3] Existing research shows that abolishing the "professor's privilege" (i.e., the university researcher's rights to acquire IPR by patenting ideas stemming from their own research) has negative effects on patenting and knowledge commercialization in countries where universities are state owned (Hvide and Jones 2018; Färnstrand Damsgaard and Thursby 2013; Goldfarb and Henrekson 2003).

The fact that Continental Europe operates just behind the global technology frontier (Acemoglu et al. 2017) suggests that its prevalence of vocational education and on-the-job-training compensates for a lack of innovative, entrepreneurial campuses. In addition, semi-public knowledge institutes (such as the Fraunhofer Institut and Max Planck Society in Germany, the CNRS in France, and TNO and ECN in the Netherlands) complement the European university system, diffusing scientific knowledge into commercial activity and society at large (Agrawal 2001; Bergman 2010; Perkmann et al. 2013).[4] To be sure, incumbent firms are often the partners of choice in this more institutionalized European system of knowledge diffusion. By also supporting students and researchers striving to creating new and competing ventures, European universities could aid in the transition to an entrepreneurial society.

However, most European systems of higher education are currently ill equipped to take on such a role. For one thing, they are too centralized; European universities tend to be government owned and tax financed, with the entry of private universities being disallowed or highly restricted (Aghion et al. 2007, 2008; Jongbloed 2010). The Union's universities should be given more flexibility to respond to the needs of regional collaborative innovation blocs, where demanding customers serve as crucial sources of information regarding consumer needs and preferences (von Hippel et al. 2011). Here, academic entrepreneurs can show how to commercialize new knowledge and research. Furthermore, it is important to actively engage with societal partners outside of academia, such as corporations, governments, NGOs, and civil society organizations. Reaching out more to such external stakeholders would expose students and staff to more opportunities for useful application of new knowledge in social or commercial ventures.

[3] Much research examines the effects of the Bayh-Dole Act that established this incentive in the USA (Popp Berman 2008; Leydesdorff and Meyer 2010). The EU's and many European countries' efforts to emulate its success have met mixed results (Siepmann 2004; Mowery and Sampat 2004), likely because the same institutional reform works out very differently in different national contexts.

[4] *Wikipedia* lists 106 such institutes in France, 173 in Germany, and 64 in the Netherlands. The US total is 405, suggesting that they are far more prevalent in Europe.

Proposal 44: The link between universities and external stakeholders should be strengthened by encouraging universities to stimulate entrepreneurial initiatives and university spinoffs.

There are already successful examples of such collaborations, bringing business to science and science to business (Jacob et al. 2003; Hommen et al. 2006; Castillo and Meyer 2018). Successful incubators managed by European universities ranking in the global top 20 include Bath in the UK, Politechnico di Milano in Italy, Chalmers ventures in Gothenburg, Sweden, and London's South Bank University. More European incubators are affiliated with and collaborating with universities (Castillo and Meyer 2018). Such joint efforts may be especially crucial in high-technology fields; for example, universities and their faculties have encouraged local economic development by improving the ability of new and incumbent firms to use biotech research (Zucker et al. 1998; McKelvey et al. 2003; Okubo and Sjöberg 2000; Link and Swann 2016; Amoroso et al. 2018). If they learn from such examples, European policymakers will be better placed to stimulate academic entrepreneurship and accelerate the commercialization of university-developed inventions of great potential value (Goldfarb and Henrekson 2003; Kauffman Foundation 2007; Link and Swann 2016; Amoroso et al. 2018).

A shift towards excellence is also required if academic entrepreneurship is to flourish. European universities already pay lip service to excellence (Vogel 2006; Corradi 2009; Hallonsten and Silander 2012; Wolfensberger 2015), but the reality is that few of them rank among the top universities globally.[5] Europe's strategy of providing a high-quality university education to the average student worked very well in the age of "the managed society" (Audretsch and Thurik 2000) when the rapid adoption of new knowledge in multinational industrial firms was sufficient to maintain a viable competitive position (Acemoglu et al. 2006; Audretsch et al. 2017). Following the rise of Asia, this strategy must now be complemented with policies allowing Europe's best and brightest to excel.

The challenge is to turn (some of) the EU's universities into world-class institutions while safeguarding the distinct inclusive character of university education (Aghion et al. 2008). A sensible way to reach higher is to broaden the base. Europe's university research and education systems are still nationally organized and fragmented. Differences are often deeply rooted, which

[5] Whereas seven UK universities can be found among the 50 highest ranked universities, only five universities from the rest of the EU appear (three from Germany, one from Belgium, and one from Sweden) (Times Higher Education 2018).

complicates efforts to create an integrated European Research Area (European Commission 2012). Indeed, the Union respects member states' prerogatives in this area. For example, EU leadership acknowledges the existence of 28 national research systems funded from national tax revenues and states that these member state-specific systems "will remain distinct in so far as this benefits the EU and individual Member States, allowing Europe to capitalize on its scientific, cultural and geographical diversity" (European Commission 2012, p. 3). This obliging attitude sometimes hampers the exchange and mobility of both students and academic staff and may be a chief reason why so little actual progress has been made. Most students still study in their country of birth, and only the most productive and innovative researchers are truly mobile (Karamanis and Economidou 2018).

A push for more openness in the national science foundations could strengthen the integration of the EU's knowledge base. National borders and nationality should, after all, be irrelevant in regard to basic research. Therefore, it is worth pondering whether all EU researchers should be eligible for funding by all member states' national research funding agencies. Such a change would be relatively easy to implement, but it entails a non-negligible risk that the already strong universities and knowledge centers will be the big winners, further concentrating world-class research in leading countries at the expense of laggards.

Of course, the top-ranked universities in the USA and elsewhere maintain their position precisely by attracting the best and brightest from a large population of students. Today, these institutions compete for the best and brightest from all over the world. Perhaps geographical concentration is simply the price we have to pay for academic excellence, and as long as all Europeans have equal access, the problem may be tolerable. Before considering a reform in this direction, however, policymakers should strive to ensure that all countries develop an intellectual environment capable of identifying and honing citizens' talents, absorbing research findings and applying them commercially. To level the playing field before introducing healthy competition, there is a need to nurture a sound academic environment in all member states, thereby paving the way for a much needed top-level European research environment (Aghion et al. 2008).

> Proposal 45: Both the EU and its member states should create healthy, well-funded, academic institutions that allow Europe's most talented academics to pursue their research interests.

The specifics matter for the implementation of such a proposal, and they differ across countries. In Germany, for example, this proposal may be

interpreted as a call for increased public funding for universities, which despite their strong educational focus have seen a steep decline in their spending per student (Füller 2017; Sanders et al. 2018b). By contrast, Italy should first take measures to open up academic institutions characterized by deeply entrenched vested interests and gilded contracts; before such structural issues are addressed, it makes little sense to spend much money (Sanders et al. 2018a).

Competition on excellence among universities will inevitably create regional knowledge concentration, especially given the importance of networks in academic research and economies of agglomeration. This concentration should be considered as normal and acceptable between member states as it is between regions within countries. Likewise, successful entrepreneurial ecosystems and industrial clusters follow an economic logic that is not necessarily politically convenient. There is little doubt that geographic proximity facilitates knowledge spillover and knowledge transfer among networks and collaborations (Jaffe et al. 1993; Sorenson and Stuart 2001; Ponds et al. 2007; Arzaghi and Henderson 2008; Rosenthal and Strange 2008).

These findings hint at a potential role for governments, national and local, in promoting urbanization, local networks, and clusters (Andersson and Henrekson 2015). Today, clusters are considerably more common in Western European countries, but they could help facilitate entrepreneurship in Eastern and Mediterranean Europe as well if policymakers enable a greater transfer of knowledge between businesses and knowledge-creating organizations (Moretti 2012; Moretti and Thulin 2013). Strong, dynamic clusters are bottom-up phenomena that can emerge anywhere (Klepper 2016) and should be allowed to form endogenously. However, policy and institutional reforms can improve initial conditions. For one thing, they can reform real estate markets so that housing prices reflect scarcity and preferences; where appropriate, they should also liberalize zoning laws and remove any red tape that could curb cluster development (Glaeser 2008, 2011). Local policymakers should also provide an infrastructure that allows smooth transportation and commuting.

> Proposal 46: Liberalize, where possible, spatial planning regulations to allow the endogenous clustering of business activity rather than trying to plan clusters from the top down.

Furthermore, policymakers should keep in mind the late Steven Klepper's (2016) persuasive findings that industry clusters can gain momentum through entrepreneurial spinoffs from existing firms. In the USA, it seems that many spinoffs and spinouts result from conflict and strategic disagreement between R&D workers and their managers (e.g., Klepper 2002, 2009; Klepper and

Thompson 2010). In the more consensual European context, a system of collaborative, open innovation characterized by intrapreneurship and consensual spinouts may well serve a similar function; at least in the UK, spin-off ventures are on average more innovative and successful than those started without industry experience (Sanders et al. 2018c; Wennberg et al. 2011). The same is probably the case elsewhere in the Union. Currently, however, incumbent firms likely shelve many potentially valuable R&D projects because they do not fit these firms' strategies and interests.

It may be worthwhile to encourage entrepreneurial R&D workers to spin off and develop such projects as independent ventures. Another option would be to promote intrapreneurship—entrepreneurship by employees. Judging by the evidence to date, intrapreneurship seems well aligned with the Nordic welfare state and the Rhineland consensus model (Henrekson and Roine 2007; Bosma et al. 2010), perhaps because intrapreneurship depends crucially on management practices and employee autonomy in the workplace, phenomena that, in turn, stem from a high level of generalized trust (Elert et al. 2019; Ljunge and Stenkula 2018). While trust is not easily stimulated through institutional reforms, policymakers should permit the many European firms that already experiment with intrapreneurship (Bosma et al. 2013, 2014) to keep doing so. Hopefully, careful study of intrapreneurship can teach us how to develop more targeted interventions in the future.

Returning to the role that knowledge plays in an entrepreneurial society, we should note that scientific knowledge is a pure public good (Nelson 1959; Romer 1990; Salter and Martin 2001; Pavitt 1991)—channeling more money to basic research that provides positive knowledge spillovers throughout the Union would therefore seem like a no-regrets policy. Furthermore, R&D spending is positively associated with a greater patenting rate (Elert et al. 2017). However, it does not follow from these facts that a policy of increased government R&D spending or subsidies will result in more economically valuable knowledge.[6] Public R&D can crowd out private R&D: the share of R&D in the business sector that is directly or indirectly funded by the government tends to be lower in countries with high R&D spending by business enterprises and higher in countries with low R&D spending by businesses (Table A.7 in the Appendix). Furthermore, patenting and R&D are inputs in the production process; the desired output—higher value creation—depends on many more steps along the way.

[6] Da Rin et al. (2006) examined 14 European countries between 1988 and 2001, without finding any positive relationship between public R&D spending and the rate of innovation (defined as the share of high-tech and early-stage venture capital investments).

For these reasons, it is probably better to promote R&D—and ultimately, scientific knowledge—through the pull of demand rather than through the push of supply. A broad policy program conducive to innovative entrepreneurial venturing will likely spontaneously increase R&D spending and allocate it efficiently as a side effect. Conversely, if a well-functioning entrepreneurial ecosystem is not already in place, a government push to increase R&D becomes a waste of resources, directing focus and resources towards factors that would have found better use elsewhere in the European economy. Spontaneous, demand-driven increases in R&D expenditures should be preferred over any top-down designed alternatives, as it is next to impossible for a bureaucracy to "pick the winners." Instead, policies and reforms should aim to mobilize and incentivize the available resources to flow to their most productive use, including R&D.

People always create knowledge; policymakers should, therefore, begin by increasing the pool of talented and highly motivated individuals able to dedicate time to research. As such, educational reforms must aim to increase the stock and quality of home-grown human capital. The aging European economy would also do well not to ignore the pool of talent available abroad. In this respect, the European Commission's Blue Card Directive, while laudable, is problematic because it remains reserved exclusively for highly qualified *employees* (Eisele 2013). The Directive explicitly refers to this group as "managers and specialists" who are required to have (and hold) a formal labor contract with a minimum salary that may differ per member state but that is invariably high. In its current guise, therefore, the Blue Card system has little to offer entrepreneurial start-ups in Europe. It certainly does not promote the immigration of entrepreneurs, who are typically not specialists with high salaries but "jacks-of-all-trades" possessing a broad and balanced skill mix (Lazear 2005). A college drop-out with a wild idea (like Bill Gates when he founded Microsoft) would currently not qualify for a Blue Card. In line with our principle of neutrality, we therefore propose to reform the Blue Card system in a direction that makes it more conducive to an entrepreneurial society.

> Proposal 47: Reform the European Blue Card system to also include nonemployees and people lacking high formal educational credentials provided they have a plan to support themselves and the requisite equity to start a viable business.

Furthermore, entrepreneurship should not be promoted by picking winners but by creating an environment in which winners thrive. To that end, policy initiatives should support firms that experiment with a clear market

focus in mind, much like the US Small Business and Innovation Research Program (SBIR), a highly competitive program encouraging domestic small businesses to engage in federal research and development with the potential for commercialization. However, whereas SBIR by and large has been successful in stimulating innovation (Lerner 1999; Wessner 2008), similar initiatives by EU member states have thus far had mixed and limited success (Camerer and van Eijl 2011; Apostol 2017).

Hopefully, that track record can improve: according to Apostol (2017), a key success factor for such programs is that they predominantly tender high-risk R&D projects to small and young firms, and public program managers play a critical role by carefully selecting these projects based on a sound understanding of market and technological trends. Moreover, a tolerance for failure is essential, and an EU equivalent to the US SBIR program should not be a backdoor to protecting local and domestic firms from foreign competition. It seems, therefore, that SBIR-type programs are best suited for countries with high-quality public sectors, low risk of corruption, and a strong tradition of small industrial firm R&D. Strict enforcement of nondiscrimination clauses is also essential. Thus, in line with the principle of contestability, we propose:

> Proposal 48: Develop highly competitive programs encouraging small businesses to engage in research and development with the potential for commercialization.

Of course, IPR are essential to ensure strong incentives for knowledge creation and diffusion. In Chap. 2, we made several proposals to improve the balance between just rewards and positive externalities in the IPR system. These reforms are relevant here as well. As we noted in Chap. 2, a core issue is to weigh the interests of inventors against the positive spillover effects of knowledge diffusion. We would add that although bureaucrats should not try to pick winners, policymakers may have a legitimate role to play in formulating challenges for entrepreneurs (Montalvo and Leijten 2015; Mazzucato 2018). SBIR-like programs would be one way for political bodies to support and direct the activities of entrepreneurs. By challenging entrepreneurs to develop innovative solutions to well-defined social challenges, such programs provide clear market signals, even if the customer is the taxpayer. Such targeted support can also be justified if one expects strong positive externalities; in the European setting, this would be the case for international partnerships for innovation, in which public and private parties cooperate to address specific innovation challenges.

Proposal 49: Support international partnerships for innovation through specific innovation challenges.

The European Commission's Horizon 2020 program already has this structure. For the most part, it sets clear innovation challenges and invites international consortia to enter an open competition for the funds. The solution to the problem articulated in a call is rarely the only positive outcome of such grants, as lasting collaborations across the Continent are established in the process. In an interim evaluation, the European Commission (2017c) reported that some 75% of Horizon 2020 funding benefited international collaborations, which, in nine cases out of ten, benefited EU-28 research institutes and researchers. It is too early to tell if the connections forged in European projects will have lasting impact and sustain a more integrated European Research Area, but we believe that incentivizing researchers to collaborate across borders is an effective way to make progress in this area.

Horizon 2020 and similar public R&D programs typically select a few proposals on a predefined call before commissioning the research. By contrast, in the eighteenth and nineteenth centuries, the use of innovation challenges often took the specific form of prizes. Such challenge-based prizes yielded substantial progress in such varied fields as navigation, air voyage, and food preservation (Abramowicz 2003; Shavell and van Ypersele 2001). The competitions are specific, in the sense that they stipulate a clear goal to be achieved—say, the development of a climate-neutral technology for transportation—but can be formulated in an open-ended way in regard to matters of technology. Furthermore, technology inducement prizes are exempt from the welfare loss that comes from the monopoly rents associated with patents (Adler 2011) and do not require an extensive bureaucracy that assesses and evaluates proposals and credentials *ex ante*.[7] While a social loss due to duplication of effort is likely to occur, a prize does imply that the public pays a clear and pre-set amount only when the problem gets solved.

The prize philosophy currently guides the XPRIZE Foundation, a nonprofit organization that designs and manages public competitions intended to encourage technological development that could benefit humanity. The same is the case for Sir Richard Branson's Virgin Earth Challenge, awarding 25 million dollars to "a commercially viable design which results in the removal of anthropogenic, atmospheric greenhouse gases so as to contribute materially

[7] An evaluation of the web page *Innocentive*, where firms and organizations announce rewards to problem-solvers, reveals that the best solutions often originate with outsiders who are neither researchers nor work in the relevant field (Lakhani et al. 2007).

to the stability of Earth's climate." Though huge, that prize sum is small in comparison to what governments throughout the world spend annually on energy- and climate-related research, as well as in comparison to the projected costs should humanity fail to stop climate change. European countries could easily emulate the same philosophy, combining a minimal risk to taxpayers with innovation encouragement that does not commit to specific firms or a particular technology. Moreover, a prize can be made transparent, neutral, and contestable by design. We therefore propose the following:

> Proposal 50: Institute technology inducement prizes to further the development of commercially applicable knowledge in socially important areas, such as climate change, health care, and education.

Obviously, it is always possible that collaborations emanating from publicly funded knowledge creation have spillover effects that benefit third-party countries or private parties and might be perceived as free riding on European funds (e.g., Mazzucato 2015). From the point of view of an entrepreneurial society, however, it would be wise to allow private firms, even from third-party countries, to use publicly generated knowledge at zero marginal cost.

The problem is not that they use "our" knowledge but that the knowledge in question is sometimes used to secure socially inefficient rents for the benefit of the few. Ultimately, it is a good thing that a firm like Apple uses vast amounts of knowledge—even if some of that knowledge was initially developed with public funds in European university labs. The act of taking the risk and putting all that knowledge together in a well-designed and functional smartphone entitles the firm to a handsome reward. This emphatically does not mean that Apple should be allowed to patent some design features and use those patents to prevent competitors from entering the same market.[8] Unfortunately, such practices do occur, but they do not justify a stop on promoting publicly funded research *ex ante*, nor should policymakers seek to recover such public funds *ex post* through taxation or the exclusion of foreign partners. Instead, the goal should be to maximize the social benefits and consumer surplus by enforcing full disclosure and contestability, in IPR as well.

[8] See https://en.wikipedia.org/wiki/Apple_Inc._v._Samsung_Electronics_Co. for an entertaining description of the Smartphone War in which Samsung and Apple have been engaged since 2011. Burnick (2017) offers a more academic account of the Supreme Court Ruling.

7.3 Summary

The European entrepreneurial society will bring inclusive and innovative growth only if its citizens are educated and able to act on the opportunities that arise. Educational reform tailored to national preconditions is essential in equipping Europeans for a productive and fulfilling future in that society. Knowledge and innovation clustering will inevitably result in regional disparities but should not be considered a problem as long as Europeans can participate and benefit from such clustering regardless of their place of birth. The principles of neutrality and contestability ensure that the entrepreneurial society will be inclusive at all levels, whereas a clear focus on excellence and societal challenges through public procurement, prizes, and public research programs can ensure the innovativeness and sustainability of growth.

In Table 7.2, we list the proposals made in this chapter. As seen, the appropriate level of policymaking differs quite a bit: For the reforms in the educational system, member states or even regional and local authorities possess the necessary legal competencies, but the EU can and should support their actions. Likewise, the policies and institutions supporting local and regional knowledge and entrepreneurship clusters will typically take shape in the interaction between universities and local authorities. In contrast, the European Commission should be able to address innovation policy, as the Lisbon Treaty gave it the budget and legal competencies necessary to do so.

Table 7.2 Summary of proposals regarding mobilizing human capital for entrepreneurship, specifying the level in the governance hierarchy where the necessary decisions should be made

No.	Principle(s)	Policy area	Proposal	Policy level[a]
41	Neutrality and contestability	Education system	Reforms in primary and secondary education should provide pupils with a solid and coherent knowledge base and promote initiative, creativity and a willingness to experiment.	MS, REG, LOC
42	Neutrality and contestability	Education system	Promote STEM education and English as a (mandatory) second language early on and then throughout educational career.	EU, MS
43	Justifiability and neutrality	Education system	Invest in high-quality tertiary level technical education by attracting excellent teaching staff and students and by strengthening Europe's strong tradition of vocational training.	MS

(continued)

Table 7.2 (continued)

No.	Principle(s)	Policy area	Proposal	Policy level[a]
44	Justifiability and contestability	Universities/ entrepreneurial clusters	The link between universities and external stakeholders should be strengthened by encouraging universities to stimulate entrepreneurial initiatives and university spinoffs.	MS, LOC
45	Justifiability and contestability	Universities/ entrepreneurial clusters	Both the EU and its member states should create healthy, well-funded, academic institutions that allow Europe's most talented academics to pursue their research interests.	EU, MS
46	Justifiability and contestability	Entrepreneurial clusters	Liberalize, where possible, spatial planning regulations to allow the endogenous clustering of business activity rather than trying to plan clusters from the top down.	MS, REG, LOC
47	Neutrality and contestability	Immigration	Reform the European Blue Card system to also include nonemployees and people lacking high formal educational credentials provided they have a plan to support themselves and the requisite equity to start a viable business.	EU
48	Justifiability and contestability	Innovation policy	Develop highly competitive programs encouraging small businesses to engage research and development with the potential for commercialization.	EU, MS
49	Justifiability and contestability	Innovation policy	Support international partnerships for innovation through specific innovation challenges.	EU
50	Justifiability and contestability	Innovation policy	Institute technology inducement prizes to further the development of commercially applicable knowledge in especially important areas, such as climate change.	EU

[a]*EU* federal level, *MS* member state level, *REG* regional government level, *LOC* local/ municipal level