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Special Issue on university technology transfer, regional specializations, and local dynamics: lessons from Italy

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1 Introduction

In the past, Italy has been characterized as having a weakly integrated national innovation system with limited university-industry relations (Malerba 1993; Malerba and Orsenigo 2013). And yet, in the last 10 years, both Italian universities and the government have become far more supportive of technology transfer. These changes have made Italy a particularly interesting nation for studying knowledge transfer from the university to industry (OECD 2019), given its potentiality and dynamics.

We deliberately use the term “knowledge transfer” because it encompasses more than the traditional “technology transfer” that relies upon patents and technology licensing offices (Agrawal 2001). Thus, the papers in this Special Issue are wide-ranging and not only cover traditional technology transfer processes, such as, academic entrepreneurship, but also the subtler knowledge-sharing that some Italian universities have developed with their regional firms.

Knowledge transfer from Italian universities is particularly interesting because Italy is home to many of the oldest universities in the world. Often, these universities are intimately involved with the cities and towns in which they are located. In fact, many were established centuries ago and funded by local ecclesiastical or business leaders to edify the local government and businesses. Knowledge transfer took place largely through teaching, but university professors already were conducting research that had economic value. For example, Galileo worked in the Universities of Pisa and Padova while developing his telescopes. The University of Padova had one of the world’s first surgical theaters for training surgeons. These were perhaps some of the earliest recorded knowledge transfer occurrences from universities to society (Biagioli 1993).

Italy has a few large cities and a rather large number of small- and medium-sized towns, industrial districts, and middle tech-based clusters, many of which have their own university and public research centers (Lazzeroni and Piccaluga 2015). Therefore, much of the research and innovation activities are taking place “in the provinces,” where most universities are located (Lazzeroni 2010). However, such provinces—as opposed to central, metropolitan areas such as Milan, Turin, and Rome—are not peripheral places, i.e., isolated,

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minor, or decentralized. Rather, many provinces are economically dynamic and have numerous public research organizations that interact with local industries.

Italy is also a particularly interesting context for understanding the operation of university knowledge transfer to regional clusters with more traditional industries (Becattini 1990; Bellandi et al. in this volume; Bigliardi et al. 2015). These various medium and high-tech industries, such as industrial automation, machine tools, packaging (Munari et al. 2012), clothing and footwear (Amighini and Rabelotti 2006; Lazzeretti and Oliva 2018), food transformation (Muscio and Nardone 2012), wine-making (Abbate et al. in this Issue), and other specialized sectors including shipbuilding, measurement systems, and energy, require state-of-the-art technology, even though they are based on physical transformations of inputs. Such industries are important not only to Italy, but also to many other European countries that make globally competitive manufactured goods and are often family-owned (Duran et al. 2016). Understanding how universities assist firms in these industries is of critical importance to the regional and national economies of many countries.

However, given that a significant part of the Italian economy is based on born-local and internationally-grown industries (Camuffo and Grandinetti 2011; Tunisini et al. 2011), there have been remarkably few studies exploring the ways in which local universities contribute to regions (Agasisti et al. 2019) outside high-technology clusters such as Silicon Valley, Boston, and Cambridge. For countries, such as Italy, it is essential to explore how universities assist traditional industries. Universities can develop technologies that assist firms in traditional industries to innovate, grow, and internationalize (e.g., Trippel 2011). The current academic fixation on cutting-edge technologies, such as, biotechnology (see, for example, Kenney 1988) and information technologies, obscured the far longer relationship that universities had with less “exciting” technological domains. This fixation, in some cases, is so overwhelming that it overlooked interactions between universities and local industries and firms-many of which are family-owned (De Massis et al. 2015).

Knowledge and technologies transferred from universities to the marketplace can generate different impacts depending on regional networks, industrial, and corporate specificities. This reinforces the idea that, within the same countries, there are different regional and industrial sector innovation systems with different trajectories and logics (Breschi and Malerba 1997). In order to understand their success, it is necessary to further explore the way local firms and universities interact in local clusters and networks (Fini et al. 2011).

The papers in this Special Issue examine universities in different regions in Italy. Each paper addresses specific mechanisms of knowledge transfer (e.g. student entrepreneurship, university-industry relations, spin-offs) and contextual specificities (Autio et al. 2014), thereby explicating how universities leverage tradition, local industry strengths, and regional resources in their relationships with local regions.

2 Italian industries and university-industry knowledge sharing

Despite the strong performance of many Italian firms in medium- and high-technology industries, it has become clear that these firms must increase the innovative content of their traditional products and services to address heightened global price pressures and the inroads of capable global competitors. This pressure is further intensified because Italian firms and clusters face the challenge of developing or reinforcing their competitive strategies by integrating new and fast-growing innovative technologies, many of which are derived, at least, in part, from university research.

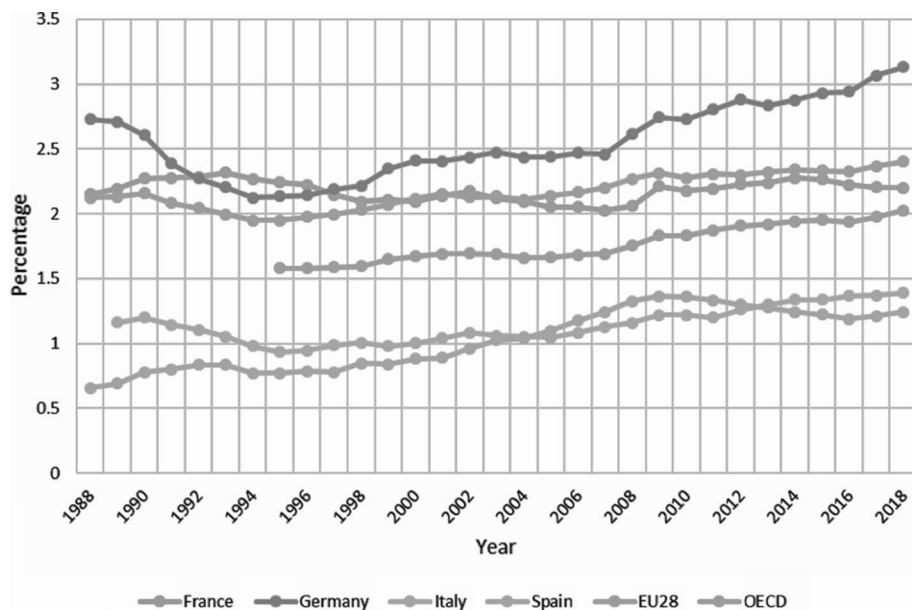


Fig. 1 Percentage of GDP Invested in R&D in the OECD, EU 28, France, Germany, Italy and Spain from 1988 to 2018 *Source* OECD 2020

Italian industries and the government have lagged behind other European nations in research and development (R&D) investment. As evidenced in Fig. 1, Italy and Spain invest roughly equal percentages of their gross domestic product (GDP) in R&D. While this conceals the relatively higher investment in Northern Italy, neither Italian industry nor the government have invested robustly in R&D. Interestingly, while other nations have increased investments, Italian investment has remained relatively static, leading to the designation of the Italian economy as practicing “innovation without R&D” (Gottardi 1996).

Italian universities have experienced continuing rounds of budget cuts during the last two decades. Despite these cuts and differences in overall research endowments in comparison with many other OECD countries, Italian universities have performed comparatively well. Unfortunately, many Italian researchers and scientists have immigrated to Northern Europe or North America due to the scarcity of available positions, lower salaries, and limited resources available for research (Carrozza and Minucci 2014). Universities, just like Italian public research in general, suffer from underinvestment, as the government has not allocated as many resources to research and education as have other OECD countries.

In recent years, largely at the behest of European policymakers, a wide variety of funding schemes have been introduced to encourage increased interactions between small- and medium-sized enterprises (SMEs), large firms, and universities. One significant reaction by Italian universities and policy-makers came at the local level, as policymakers and entrepreneurs sought to transform local traditions and industrial specificities into advantages to improve regional industrial competitiveness.¹

¹ For a more general discussion of place-product specificities, see Christensen and Kenney (2016).

102 In fact, many regional governments have identified specific territorial competences for
103 investment, based on an assessment of local industrial strengths inspired by the “Smart Spe-
104 cialization Strategy” (D’Adda et al. 2019). This strategy aimed at exploiting local specificities
105 to contribute to the growth local firms that could become dominant players at the national and
106 international level. More recently, mirroring other European countries, Italy introduced poli-
107 cies to encourage the development and diffusion of Industry 4.0 technologies, which aim to
108 partner universities and regional firms.

109 Today, in many of the most successful Italian clusters, universities are playing a significant
110 role in developing and transferring technology that contributes to upgrading competitiveness
111 (Camuffo and Grandinetti 2011; Sedita et al., in this volume). Similarly, in most industrial
112 economies, particularly in Europe and Asian nations such as Japan, high-technology indus-
113 tries, middle-technology industries such as machinery, and even food and textile industries
114 have used regional knowledge-based partnerships between firms and universities to increase
115 their competitiveness (Cooke 2001; Mueller 2006). While many nations seek to develop new
116 industrial clusters in high-technology industries—i.e. chase the Silicon Valley promise—it is
117 increasingly accepted that building upon existing industries and knowledge provides greater
118 prospects for success (Breznitz 2020). Preserving existing industries and employment is of
119 vital importance for the health several regional economies, including Italy’s (Spithoven et al.
120 2010).

121 In the last decade, increasing importance has been attached to universities’ engagement
122 with society. It has been recognized that, in addition to teaching and research, it is necessary to
123 create mechanisms supporting knowledge transfer from universities to firms. This starts with
124 the university’s Technology Transfer Offices (TTOs) (Muscio 2010; Lafuente and Berbegal-
125 Mirabent 2019). Netval, Italy’s TTO association, studied 60 organizations (universities and
126 PROs) and found that they employ an average of 5.8 people in their TTOs. This is a signifi-
127 cant increase from few years ago, but is still less than the TTOs of other advanced European
128 countries (ASTP 2019). The Netval report also shows that the number of patent applications,
129 patents granted, patents in portfolio, licenses, and licensing revenues has grown over the last
130 10 years. Italian universities have also spin-off new firms based on public research. For exam-
131 ple, over the last 10 years, Italian universities have spun-off about 110 research-based firms
132 per year, on average.

133 During the last 15 years, Italian TTOs have sought to maximize their socioeconomic impact
134 on society, particularly, upon the local region rather than maximize revenues (from licens-
135 ing and selling shares of spin-offs). TTO personnel have devoted their activities to improv-
136 ing the traditional practices of knowledge transfer and developing and promoting different
137 forms of engagement with industry, local governments, and other organizations. Moreover,
138 there has been a specific emphasis on knowledge transfer to SMEs. Recently, this emphasis
139 on broader forms of engagement has been incorporated into the Italian Ministry of Education,
140 University and Research’s university evaluation exercises, in line with the UK Research Excel-
141 lence Framework assessment exercise (Traag and Waltman 2019). The interest in knowledge
142 transfer is so great that three Italian Ministries—Education, Health, and Economic Develop-
143 ment—are collaborating to improve the process. This collaboration has led to the inclusion of
144 research hospitals in knowledge transfer activities.

145 3 The papers in this Special Issue

146 The papers in this Special Issue shed new light on the Italian knowledge transfer system.
147 They illustrate the ways in which Italian universities and their knowledge transfer prac-
148 tices are responsive to and embedded in local traditions, histories, and industrial specifi-
149 cities. It is this embeddedness that makes the papers in this Special Issue important not
150 only for Italy but also for many other countries where traditional industries are a vital
151 part of the social and economic fabric of their regions. The Italian universities provide
152 insight in how the past shapes the future and how universities contribute productively to
153 the future of regions. The first three papers all focus on large universities in important
154 Italian cities: Bologna, Firenze, and Torino. The remaining contributions look at other,
155 more peripheral campuses/universities.

156 The order of the paper reflects a growing emphasis on the regional impact of univer-
157 sities, in the form of spin-offs, industry collaborations, their interaction with SMEs, and
158 on new forms of impact. Our papers move from exploring of the internal organization
159 and practices creating the conditions for knowledge sharing to occur (first three papers)
160 in universities located in large cities. These were among the first to begin creating struc-
161 tural conditions to favor knowledge transfer. The next two paper focus more intently
162 on the regional impacts of the universities. The final three papers, while maintaining
163 a focus on regional impact, present more novel (for the Italian context) impacts from a
164 younger university, student entrepreneurship, and spin-offs from universities in the tra-
165 ditionally less entrepreneurial southern Italy.

166 In most universities, the knowledge transfer processes results from a path-depend-
167 ent evolution that includes both formal and informal, planned and emergent actions
168 involving a variety of actors. To explore this insight, Irene Sala and Maurizio Sobrero
169 conducted a historical case study of the evolution of KT policies and practices at the
170 University of Bologna from 1996 to 2016. They examine how these policies interact
171 with regional and national regulations and the simultaneous evolution of research prac-
172 tices. Specifically, they analyze how the University of Bologna leveraged for specific
173 characteristics: (a) its history and reputation within the national university community;
174 (b) its role in the evolution of Italy's knowledge transfer practices and its own research
175 and teaching efforts; (c) its multiple branches in Emilia-Romagna, which was develop-
176 ing policies encouraging university-industry collaborations; (d) and, finally, its excel-
177 lent performance in terms of student mobility, research funding, and faculty productiv-
178 ity. They demonstrate the links between internal, regional, and national policy changes
179 regarding technology transfer, and the university's research portfolio, reinforcing the
180 idea that knowledge-transfer depends on sustained actions, including those designed
181 deliberately by the university administration and those naturally emerging within
182 departments, through bottom-up processes.

183 The paper by Marco Bellandi, Annalisa Caloffi, and Sara De Masi examine the ways
184 in which individual academics and research groups at the University of Firenze organ-
185 ized their third mission activities before and after its institutionalization as university
186 policy. Their conceptual framework connects the emergence of entrepreneurial/engaged
187 strategies at the central level with changes in the way academics performed third mis-
188 sion or external engagement activities. To test their framework, they collected both
189 quantitative and qualitative data at the University of Firenze. They document a variety
190 of bottom-up initiatives to build local engagement and knowledge exchange activities
191 and found that these complemented the more traditional, top-down transfer mechanisms.

192 These bottom-up, spontaneously emerging actions were supported by the TTO and
193 brought together academics from different disciplines.

194 The paper by Alessandra Colombelli, Antonio De Marco, Emilio Paolucci, Riccardo
195 Ricci and Giuseppe Scellato explores how Politecnico di Torino has played a role in the
196 technological specialization of the Piedmont region. The authors develop a new methodol-
197 ogy for studying the ways that local universities and regional economies evolve, finding
198 that such evolutions proceed on two dimensions. The first is whether the research speciali-
199 zations of the university and local industry converge, i.e., whether their strengths became
200 more or less similar. The second dimension is whether the region “pulls” university
201 research towards its interests via funding or whether university’s technologies “push” the
202 region toward its specialization. They argue that a university’s impact on local technologi-
203 cal development and specialization depends upon three contingent factors: the specifici-
204 ties of local universities (whether they practice exploitation vs. exploration strategies), the
205 degree of innovation capabilities and absorptive capacity of local firms (high vs. low), and
206 the strength of the linkages between local firms and universities (tight vs. loose).

207 Absorptive capacity is important for industries to exploit the knowledge/technology
208 developed by universities (Grimpe and Sofka 2009). Roberta Apa, Valentina De Marchi,
209 Roberto Grandinetti, and Silvia Rita Sedita, explore the impacts of university collabora-
210 tions with small- and medium-enterprises in the Veneto region, which is well known for
211 its dynamic manufacturing sector. The firms in this region have been quite successful in
212 innovating without making large R&D investments. The authors enumerate the remarkable
213 variety of forms through which university-industry collaborations take place and distin-
214 guish between formal and informal collaborations. They then address whether the absorp-
215 tive capacity of SMEs influences the realization of benefits from U-I collaborations, espe-
216 cially in terms of innovation performance. In determining firms’ absorptive capacity, they
217 consider the presence of an internal R&D structure, a widely used proxy for absorptive
218 capacity. For these type of firms, informal collaborations with universities and especially
219 the local SMEs’ absorptive capacity are vital in rendering benefits.

220 Absorptive capacity is also central to the next paper, a contribution by Tindara Abbate,
221 Fabrizio Cesaroni, and Angelo Presenza that examines the winemaking industry. Wine is
222 a low-medium tech industry that is very important in Italy, both culturally and economi-
223 cally (Stasi et al. 2016; Morrison and Rabellotti 2009). It provides an interesting example
224 of how Italian universities interact with a traditional industry facing increased competition.
225 They assess the impacts of universities on various types of wine-industry innovations (i.e.,
226 product, process, service, and organizational). Their analysis reveals that the transfer of
227 management knowledge could assist the wine industry in developing new business models
228 to become more globally competitive. Importantly, they find that universities’ knowledge
229 of organizational and commercial innovations are more valuable than product innovation.
230 Their results suggest that the main obstacle for knowledge transfer is firms’ insufficient
231 absorptive capacity, which hinders their ability to understand, interiorize, deploy, and val-
232 orize knowledge generated by universities.

233 One challenge for universities is encouraging entrepreneurial behavior among faculty,
234 staff, and students. Elisa Villani and Christian Lechner examine the ways in which a rela-
235 tively young university initiated an internal change process, built external relationships,
236 and increased its interactions with regional actors to foster innovation in the region. They
237 began by analyzing the university’s internal initiatives to encourage entrepreneurial action
238 and its efforts to become more involved with local actors. Using a processual lens, they
239 provide insight into how key public actors such as universities can have a broad regional
240 impact. They argue that a university can be a key actor in a regional system and
contribute

to unfreezing an existing equilibrium with respect to innovation. According to the authors, internal university action can legitimate entrepreneurship, create a community of specialized and complementary actors, and form a supportive network in the local ecosystem.²

Student entrepreneurship has received much attention internationally (Wright et al. 2017). Francesco Maria Barbini, Marco Corsino, and Paola Giuri explore the ways that universities, in an attempt to maximize their success and impact, shape the configuration of student startup founding teams. Their empirical analysis is based on 154 entrepreneurial business plans presented at an annual competition in Rimini, which is home to one of the University of Bologna's campuses. More than half of the founders of entrepreneurial teams received their education and training at the University of Bologna. Interestingly, and in keeping with the region's most competitive industries, the majority of the business plans were in low- to medium-tech sectors, including agriculture, food, fashion, business services, and tourism.

The authors found that there is a robust relationship between educational level, team member specialization, and entrepreneurial projects' R&D intensity. They found that the projects proposed by university students and graduates had greater technological content than those proposed by non-graduates. For example, two thirds of teams with a PhD member presented projects in R&D-intense sectors. Founders with an engineering background proposed mainly (66%) high-tech projects, whereas 73% of founders from the humanities introduced low- to medium-tech projects. The qualitative portion of their analysis found that formal education, interactions with classmates, and knowledge that professors shared directly, were the most relevant transfer mechanisms for low-, medium-tech, and high-tech sectors.

The last contribution in this Special Issue is a paper by Mauro Sciarelli, Giovanni Landi, Lorenzo Turriziani, and Mario Tani, which explores 136 active university spin-offs in Southern Italy. Their study is particularly interesting because the region is less industrialized and has a reputation for being less supportive to entrepreneurship than the North. They explore the performance impacts of founding team composition and whether one person is both the CEO and Chairperson. They also investigate whether the presence of a woman on the board of directors impacts firm success. The authors found that firms perform better when outsiders invest in the spin-off. This suggests that firms should undertake initiatives such as match-making programs to introduce academic founders and external organizations.

4 Future avenues for research and conclusions

The articles in this Special Issue provide important insights regarding the ways in which knowledge transfer takes place in Italy. As such, there are lessons here for university administrators, government policymakers, and business managers. The papers also suggest numerous directions for further research. Importantly, several explore the less studied relationships that facilitate university-industry knowledge transfer.³ These papers can inform countries and contexts with similar features. The bulk of academic research, both globally and in Italy, has concentrated on elite universities and on "traditional"

² Kenney and Patton (2005) termed this the formation of an "entrepreneurial support network."

³ For an earlier examination of the relationship of university-industry technology transfer to local actors,

see Kenney and Mowery (2014).

282 technology transfer through spin-offs, patents, licenses, etc. (Baldini et al. 2006, 2007;
283 Lissoni et al. 2013; Balconi et al. 2004; Fini et al. 2020; Muscio et al. 2016). The knowl-
284 edge transfer processes and locations examined by our authors have received far less
285 attention in the academic literature. This lack of attention may be because these transfer
286 processes involve tacit knowledge, informal contacts, and spillover effects that are dif-
287 ficult to trace.

288 This Special Issue provides insights to university administrators and policymakers on
289 how to facilitate universities' engagement with low- and medium-technology firms and
290 industries (Santamaría et al. 2009). As Abbate et al. (in this volume) show, firms in these
291 industries have different requirements, needs, and ways of absorbing knowledge. The cog-
292 nitive distance between universities and these firms is even higher, since they are often
293 smaller and have very specific knowledge bases due to their learning-by-doing methods.
294 These firms do not conduct research and rarely consider the university as a source of tech-
295 nology, which leads to diminished absorptive capacity, making knowledge transfer particu-
296 larly difficult. The great challenge for universities is assisting small and medium compa-
297 nies, as opposed to effectively commercializing their research results via interaction with
298 large high-tech companies.

299 Our papers also address another often-overlooked aspect of knowledge transfer; namely,
300 the organizational and inter-organizational process dimensions. The articles by Sala and
301 Sobrero, Bellandi et al., and Villani et al. explore the ways universities interact with their
302 context in their efforts to articulate their third-mission strategies and integrate them into
303 their DNA. While many universities advocate knowledge transfer, creating coherent strate-
304 gies is difficult. These articles show that implementation is an organizational challenge that
305 requires initiatives at various levels in the university. The articles in this Special Issue sug-
306 gest that it is important to nurture an innovation-oriented culture, build networks of rela-
307 tionships, and encourage research that is likely to generate innovations that interest local
308 businesses. To accomplish this, universities must create the appropriate opportunity struc-
309 tures and incentive systems (Sorensen and Fassiottto 2011).

310 Our authors also question what the best practices are for knowledge transfer. They show
311 that individual universities differ in the way they contribute to regional innovation systems.
312 Active participation in the local economy differs by university and is affected by regional
313 and national policies and legislation. The papers also show that in the case of Italy and
314 probably most countries, a 'one-size-fits-all' approach to economic development, particu-
315 larly if it is solely directed toward patents, license revenue, and new business formation,
316 is unlikely to facilitate a plethora of knowledge transfer. Integrating the university with
317 regional businesses requires a more comprehensive, more differentiated view of the univer-
318 sity's role in the region. This is particularly true for a country like Italy.

319 For Italy, which has suffered slow economic growth over the past two decades, uni-
320 versities have and will continue to play a role at the regional and national level in ensur-
321 ing competitiveness. And yet, universities are trying to optimize a multitudinous set of
322 social demands and a variety of missions; each of which is of paramount importance to
323 advocates. Universities are expected to generate and publish research results to be part of
324 the global networks producing new knowledge. In these global networks, the measure of
325 success is publishing in high-visibility, globally-recognized journals that speak to global
326 issues and not those critical to the local society. The incentives are clear—publication in
327 international journals is vital—for mobility and the rewards of higher status. Contribut-
328 ing to regional growth, while important for the university, does not result in international
329 recognition. Moreover, the ever-greater emphasis on top-tier journals and citations discour-
330 ages the more mundane local projects that do not receive recognition from academic peers.

This Special Issue focuses on Italian universities and the ways they are engaging with regional industries. The experiences of Italian universities, while unique to Italy, are applicable to other nations, particularly countries that have regional specializations in low and medium technologies that are experiencing increasing competition. Italian universities and, indeed, most universities are facing increasing demands to be involved in local industries, while producing research that is valued by the global “invisible college”. Italian universities are responding to these contradictory pressures by altering their internal organization and encouraging regional linkages, while also maintaining their position in global academic networks. There is no single mode or template that fits for all universities, faculty members, or departments. Universities, ultimately, are composed of professors and students that have differing goals and sensibilities. This diversity allows universities to adapt and meet the varying and changing demands of society. Italian universities, despite being starved for funds, have made large efforts to improve knowledge transfer processes during the last two decades and is evolving to meet new demands for engagement, while continuing to fulfil its teaching and research missions.

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