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The Belt and Road Initiative and the Internationalisation of China's Scientific Power: The Case of Italy

by Lorenzo Mariani

ABSTRACT

What are the elements and the impact of the inclusion of scientific cooperation within the 2019 Memorandum of Understanding (MoU) in support of the Belt and Road Initiative between Italy and China? Like many other developed countries, Italy has played a role in contributing to China's growth as a science and technology (S&T) power. Most S&T bilateral collaborations are decade-long and predate the MoU, suggesting that the importance of the latter is largely symbolic. Nonetheless, the MoU of March 2019 has reinforced the process of centralisation of S&T collaborations as well as a public debate that has grown to include matters regarding 5G technology and public procurement involving Chinese technology.

keywords

China | Italy | Science | Technology | R&D

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by Lorenzo Mariani*

Introduction

In May 2016, during the national congress of the China Association for Science and Technology, President Xi Jinping outlined his country's roadmap for becoming a global power in science and technology (S&T). China, President Xi pledged, would be among the world's most innovative countries by 2020, becoming a leading innovator by 2030 and a global scientific power by 2049 – the 100th anniversary of the founding of the People's Republic of China (PRC).[1]

Today, having reached the first of these milestones, China is on track to fulfil its leader's dreams. The People's Republic is the second-largest S&T powerhouse after the United States (US), and its companies are global champions in key sectors such as quantum computing, robotics, artificial intelligence, augmented/virtual reality, telecommunications, fintech products, e-commerce, renewable energies and electric vehicles.[2]

China's scientific rise has relied heavily on the contamination and absorption of foreign know-how, and has benefitted greatly from the openness of science professed and promoted by other advanced economies by attracting foreign talent, establishing outbound research facilities and pushing its companies to establish research and development (R&D) centres abroad. Now that its innovation system – i.e. the network of institutions in the public and private sectors whose activities

[1] Xinhua, "Xi Sets Targets for China's Science, Technology Progress", in *China Daily*, 30 March 2016, https://www.chinadaily.com.cn/china/2016-05/30/content_25540484.htm.

[2] Reinhilde Veugelers, "The Challenge of China's Rise as a Science and Technology Powerhouse", in *Bruegel Policy Contributions*, No. 19 (July 2017), https://www.bruegel.org/?p=21154.

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and interactions initiate, import, modify and diffuse technologies - is mature, the PRC is using its technological capabilities as a major component of its foreign-policy strategy. Technological advancement in key sectors is used not only to gain a strategic advantage from an economic and military point of view but also as a soft power lever.

Scientific cooperation has consequently become a pillar of the Belt and Road Initiative (BRI), China's connectivity project whose ostensible goal is to foster land and maritime trade routes between East Asia and Europe. Science and technology are therefore an important item on China's agenda of cooperation with the countries that have pledged their support to the BRI, the most important of which is Italy, being the first and only G7 country to have formally endorsed the Chinese project.

Cooperation between Italy and China in S&T – for decades, a minor element in bilateral relations between the two countries – gained momentum in the aftermath of the 2008 global financial crisis. At that point, the PRC's push for a more vigorous internationalisation of its innovation system and the simultaneous explosion of Chinese outbound investments coincided with the prolonged stagnation of the Italian economy.

The Italian national innovation system was already in a precarious state before the financial crisis, and the austerity policies introduced in 2011 in the wake of the Eurozone crisis made things worse. The progressive loss of production severely affected the capabilities of the country's private industries in terms of innovation. As the Italian Government started to look for new sources of investment to revive its economy and give fresh impetus to its R&D activities, it turned its attention to China. A section on S&T was therefore included in the Memorandum of Understanding in support of the BRI that Italy and China signed in March 2019. Italy has since emerged as an exemplary case study of China's strategy to internationalise its scientific power, as it is a case in which all the major components of this phenomenon – i.e. private and public cooperative schemes – can be observed.

1. China's rise as a global scientific powerhouse

China's quest for scientific primacy dates back well before the Xi presidency.[3] At the turn of the century, as its economy became more mature, Beijing started implementing a series of industrial, educational and fiscal policies that prioritised scientific and technological development. The goal was to stimulate and sustain a transition from a labour-intensive economy towards an innovation-based and capital-intensive one.

[3] Evan A. Feigenbaum, *China's Techno-Warriors. National Security and Strategic Competition from the Nuclear to the Information Age*, Stanford, Stanford University Press, 2003.

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This top-down approach to scientific development has – together with a mixture of protectionist practices, economies of scale and the forced transfer of foreign know-how and technology through acquisitions and joint ventures – allowed China to develop a competitive National Innovation System (NIS) of its own. The PRC aims to use its competitive advantage to advance its companies' market share and profits in emerging markets and developed economies, thus escaping the middle-income trap and securing its long-term growth.[4]

General indicators related to scientific and technological development seem to confirm the success of Beijing's development strategy.[5] In 2019, China was the biggest source of applications for international patents, with more than 58,000 applications filed to the World Intellectual Property Organisation (WIPO) – accounting for more than 40 per cent of the global total. The number of patents filed to domestic authorities is also impressive, with almost 3.6 million licences approved by the China National Intellectual Property Administration (CNIPA) in 2020.[6] The country recently outstripped the US in the number of research papers produced, with 19.9 per cent of global peer-reviewed studies published in scientific journals.

This vast research output does not translate automatically into a sharp advancement in terms of academic impact or commercial value. The impact of Chinese researches in terms of technical inventiveness is still considered relatively poor, with a quality standard lower than the one of major developed economies such as Germany, France, Japan and South Korea.[7] Chinese patents score poorly also with regard to their commercial value. While in the United States university patents have a commercialisation rate between 40 and 50 per cent, those in China have an industrialisation rate of only 18.3 per cent.[8]

While patents and peer-reviewed research ought to be "weighed rather than counted", in recent years China's research output has also started to grow in terms of quality and commercial relevance. In 2017, Chinese researchers were responsible for 22 per cent (while the US accounted for 24.7 per cent) of the most-cited natural-science papers.[9]

[4] Andrew Kennedy, "China's Rise as a Science Power: Rapid Progress, Emerging Reforms, and the Challenge of Illiberal Innovation", in *Asian Survey*, Vol. 59, No. 6 (November/December 2019), p. 1022-1043.

[5] Ibid.

[6] China's National Bureau of Statistics, *Statistical Communiqué of the People's Republic of China on the 2020 National Economic and Social Development*, 28 February 2021, http://www.stats.gov.cn/english/PressRelease/202102/t20210228_1814177.html.

[7] Alex He, "What Do China's High Patent Numbers Really Mean?", in *CIGI Articles*, 20 April 2021, https://www.cigionline.org/articles/what-do-chinas-high-patent-numbers-really-mean.

[8] Ibid.

[9] Noriaki Koshikawa, "China Passes US as World's Top Researcher, Showing Its R&D Might", in *Nikkei Asia*, 8 August 2020, https://asia.nikkei.com/Business/Science/China-passes-US-as-world-s-top-

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The backbone of China's innovation system is an enormous capacity in terms of budget allocation for research and development activities, in both the private and public sectors. Between 2001 and 2013, the government doubled R&D public spending – from 1 to 2 per cent of its gross domestic product (GDP) – and by 2019 the country had reached the self-imposed target of 2.4 per cent, established by the 2006 strategic plan.[10]

As China moved up the added-value chain, the share of R&D contribution to the country's annual GDP growth increased significantly, from 46 per cent in 2007 to 57.5 per cent in 2017, becoming a more relevant factor for economic growth than labour and capital.[11] According to the latest projections, in 2020 the country invested 378 billion US dollars in research and development activities – roughly 23 per cent of global annual R&D spending. Although the central government plays a decisive role in shaping the research environment, the innovation effort is primarily sustained by the contribution of the county's corporate sector, which at the time of writing accounts for almost three-quarters of total expenditure.[12]

The transition towards a knowledge-based and services-centred economy has also encompassed considerable investment in human capital, which has led to the development of a massive talent pool. The number of new students enrolled in master's and doctorate degree programmes doubled in less than ten years (2009–19), with more than 1.6 million new undergraduates enrolling in scientific faculties each year.[13] The subsequent spillover into national scientific manpower has been significant. In 2018, 4.19 million people in China were engaged in S&T activities – almost 25 per cent of the world's R&D workforce.[14]

1.1 The international component of China's innovation system

China's scientific rise has relied heavily on interaction with and absorption of foreign know-how. This has been achieved through four patterns:

- *forced technology transfer* from foreign companies as a bargaining chip in exchange for domestic market access;

researcher-showing-its-R-D-might.

[10] Philipp Boeing, Elisabeth Mueller and Philipp Sandner, "China's R&D Explosion—Analyzing Productivity Effects Across Ownership Types and Over Time", in *Research Policy*, Vol. 45, No. 1 (February 2016), p. 159-176.

[11] Jiandang Liu et al., "The Effect of Governance Quality on Economic Growth: Based on China's Provincial Panel Data", in *Economies*, Vol. 6, No. 4 (December 2018), Article 56, https://doi.org/10.3390/economies6040056.

[12] World Bank and Development Research Center of the State Council (DRC), *Innovative China. New Drivers of Growth*, Washington, World Bank, 2019, http://hdl.handle.net/10986/32351.

[13] See Statista, *Number of Master's and Doctor's Degree Students Enrolled at Public Universities in China from 2009 to 2019*, October 2020, https://www.statista.com/statistics/1101469.

[14] Janni Ekrem, "China's Historic Rise in Science and Tech Stirs Criticism", in *Science|Business*, 6 April 2020, https://sciencebusiness.net/international-news/chinas-historic-rise-science-and-tech-stirs-criticism.

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• *technological spillover/drain* generated by foreign industries that have established R&D facilities in China, a practice that usually carries along other forms of investment such as education and training programmes, licensing agreements and equipment donations;[15]
• technology transfer through the *acquisition of foreign companies or participation in venture deals* financing early-stage companies abroad; and
• international collaborations, scientific mobility and the attraction of foreign talent.

The Chinese Government has never concealed the pivotal role of foreign expertise and technology in reducing the country's technological gap. To mention just one example, one of the programmatic documents that guided China's scientific research between 2006 and 2020 – the "Medium- and Long-term Plan for Science and Technology Development" – stated that the development of "original innovation" was to be obtained by the "assimilation and absorption of imported technology".[16]

The main effect of these strategies has been an impressive flow of Chinese investment into Western innovation companies: between 2005 and 2020, the PRC's outbound investments in the United States and the European Union reached 550 billion US dollars, most of which was brownfield investment that boosted China's competitiveness.[17] The expansion of Chinese investments and acquisitions has also been facilitated by the impact of the 2008 global financial crisis on the industrial sector in the US and in Europe. Despite the declining flow of Chinese capital in more recent years – and increased scrutiny from European governments – in 2019, a significant proportion of Chinese foreign direct investment (FDI) in the EU was still targeted at high-tech companies.[18]

Over the years, the PRC has also managed to create a more friendly environment for foreign companies interested in conducting R&D in China – primarily, computer and telecommunication multinationals.[19] Despite the many risks associated with China's predatory approach to intellectual property rights, in 2013 there were more than 1,300 R&D facilities run by foreign companies in the country.[20] More recently, Chinese corporations have started establishing R&D

[15] Kathleen Walsh, *Foreign High-Tech R&D in China. Risks, Rewards, and Implications for U.S.-China Relations*, Washington, The Henry L. Stimson Center, 2003, https://www.stimson.org/?p=5079.

[16] China's State Council, *The National Medium-and Long-Term Program for Science and Technology Development (2006-2020). An Outline*, 2006, https://www.itu.int/en/ITU-D/Cybersecurity/Documents/National_Strategies_Repository/China_2006.pdf.

[17] See American Enterprise Institute's website: *China Global Investment Tracker*, https://www.aei.org/?p=830737.

[18] Agatha Kratz et al., "Chinese FDI in Europe: 2019 Update", in *MERICS Papers on China*, 8 April 2020, https://merics.org/en/node/126.

[19] Kathleen Walsh, *Foreign High-Tech R&D in China*, cit.

[20] Nick Marro, "Foreign Company R&D: In China, for China", in *China Business Review*, 1 June 2015, https://www.chinabusinessreview.com/?p=4812.

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centres in developed countries.[21] This is common practice for large corporations, especially in technologically intensive industries, and it follows the global trend of decentralisation and the globalisation of private R&D facilities.[22] Nevertheless, besides serving the usual purposes, such as product adaptation for foreign markets, the opening of research facilities in developed countries has also aimed at taking advantage of locally recruited high-skilled talents and acquiring know-how.

With China expanding its reach, greater emphasis has been placed on the internationalisation of its innovation system and scientific diplomacy. During the past few decades, the government has aimed at attracting and retaining overseas Chinese talent as well as recruiting foreign experts through designated programmes such as the Thousand Talents Plan. In 2018, China ranked third in the list of host destinations for international students, and while 60 per cent of these came from Asian countries the second continent of origin was Europe, which accounted for almost 17 per cent of the total.[23] The PRC has developed numerous incentives for foreign researchers such as fast-track visas, better working conditions, high salaries and benefits like support for family arrangements.[24] With 522 key laboratories, 350 national engineering research centres and 1,173 incubators for high-tech companies, China has also increased its attractiveness thanks to the growing quantity and quality of its scientific infrastructures.[25]

1.2 Scientific cooperation along the Belt and Road

Given the above premises, it should come as no surprise that S&T cooperation represents a pillar of the Belt and Road Initiative. Since the initiative was unveiled in 2013, Beijing has signed 46 new agreements on S&T cooperation with BRI countries, inaugurated two S&T partnership programmes with Southeast Asian countries and built five regional platforms for technological transfer.[26] In November 2016, the Chinese Academy of Science (CAS) organised the "First International Science Forum of National Scientific Organizations on the Belt and Road Initiative", at the

[21] Alberto Di Minin, Xiaohong Iris Quan and Jieyin Zhang, "A Comparison of International R&D Strategies of Chinese Companies in Europe and the U.S.", in *International Journal of Technology Management*, Vol. 74, No 1-4 (2017), p. 185-213.

[22] Alberto Di Minin, Jieyin Zhang and Peter Gammeltoft, "Chinese Foreign Direct Investment in R&D in Europe: A New Model of R&D Internationalization?", in *European Management Journal*, Vol. 30, No. 3 (June 2012), p. 189-203.

[23] Zhou Yang and Hans de Wit, "International Students in China: Facts, Paths, and Challenges", in *International Higher Education*, No. 97 (Spring 2019), p. 18-20, https://doi.org/10.6017/ihe.2019.97.10945.

[24] Pierre Courtioux, François Métivier and Antoine Reberioux, "Scientific Competition between Countries: Did China Get What It Paid for?", in *CES Working Papers*, No. 2019.13 (5 September 2019), https://halshs.archives-ouvertes.fr/halshs-02307534.

[25] China's National Bureau of Statistics, *Statistical Communiqué of the People's Republic of China on the 2020 National Economic and Social Development*, cit.

[26] Leading Group for Promoting the Belt and Road Initiative, *The Belt and Road Initiative: Progress, Contributions and Prospects*, Beijing, Foreign Languages Press, 22 April 2019, http://wb.beijing.gov.cn/en/policy_release/belt_road/202007/P020200727556630061915.pdf.

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end of which the representatives of twenty BRI countries issued a joint statement calling for strengthened cooperation in science.[27] According to the former president of CAS, Bai Chunli, by 2019 the CAS had invested almost 286 million US dollars in S&T activities in the framework of the BRI, providing funds for research projects that range from safe drinking water investigation in Sri-Lanka to rice agriculture studies in Pakistan.[28] Although China promotes such cooperation as a win-win partnership between equals, the unidirectional flow of investments reveals the patronising approach in-built in its strategy. While providing funds for research activities surely benefits recipient countries, the unbalanced nature of this cooperation model risk increasing the dependency of low-income countries on Beijing.

One of the first BRI-related scientific institutions was the Digital Belt and Road Program (DBAR). Created in 2016, this platform brings together scientists from BRI countries to cooperate on space-based Earth observations in order to "identify and manage natural resources, protect the environment, and prepare for and respond to disasters" along the BRI.[29] Moreover, in 2018 CAS and 36 other international institutions from BRI signatory countries created the Alliance of International Science Organizations (ANSO), a multilateral institution aimed at implementing innovative international science initiative for identifying and addressing common issues in the Belt and Road region. ANSO organises collaborative research projects and training programmes, and, through its "Scholarship for Young Talents", provides funds for 200 master's and 300 doctoral international students.[30]

As the promise of investment in new research facilities and access to Chinese expertise in new technologies appeals to many developing nations, S&T cooperation under the BRI umbrella has been used by the People's Republic to strengthen ties with scientific communities in such countries along the Belt and Road – especially those in Central Asia. In order to meet this growing demand, Beijing has increasingly tried to place S&T cooperation in the wider framework of the BRI – including in its interactions with developed economies such as those of Europe.[31] The most prominent example of this phenomenon is the inclusion of S&T cooperation agreements in the MoU in support of the initiative that was signed by Italy and China in March 2019.

[27] "Beijing Declaration, Issued at the First International Science Forum of National Scientific Organizations on the Belt and Road Initiative (Nov. 7–8, 2016)", in *Bulletin of the Chinese Academy of Sciences*, Vol. 30, No. 4 (2016), p. 220-221, http://english.cas.cn/bcas/2016_4/201703/P020170310587505348444.pdf.

[28] Ehsan Masood, "All Roads Lead to China", in *Nature*, Vol. 569, No. 7754 (2 May 2019), p. 20-23, https://doi.org/10.1038/d41586-019-01124-7.

[29] Dennis Normile, "China's Belt and Road Infrastructure Plan Also Includes Science", in *Science*, 16 May 2017, https://doi.org/10.1126/science.aal1198.

[30] See ANSO website: *The ANSO Scholarship for Young Talents. 2021 Call for Applications*, http://www.anso.org.cn/programmes/talent/scholarship/201904/t20190429_485616.html.

[31] Antoaneta Roussi, "China Charts a Path into European Science", in *Nature*, Vol. 569, No. 7755 (8 May 2019), p. 174-176, https://doi.org/10.1038/d41586-019-01126-5.

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2. Scientific cooperation between Italy and China

Until the end of the 2000s, scientific cooperation between Italy and China was mostly confined to academia and relied on informal ties between scientists, with little spillover effect into corporate relations. Joint research undertakings were mostly project-oriented and carried out in niche sectors. Industrial contamination was fairly one-sided, with China being the party benefitting the most from cooperation. From the Italian perspective, the scientific relationship with the PRC was a means to strengthen mutual understanding rather than part of an economic partnership – and thus, for decades, it remained framed as developmental assistance.[32] Attempts to build a model mechanism for cooperation were made, especially through bottom-up initiatives. Nonetheless, Italian political institutions missed the chance to leverage these initiatives in their formal relationship with Beijing, which reflects their failure to develop a comprehensive strategy towards China.

During the last two decades, linkages with the Chinese innovative system have grown significantly in all major networks for scientific cooperation: academia, the private sector and public institutions. The number of cooperative schemes signed between Italian and Chinese institutions reveals the importance that Rome has attached to this partnership. In Italy the main instrument for bilateral cooperation in S&T is the Executive Programme for Scientific and Technological Cooperation: out of sixteen programmes currently in place three have been signed with Chinese institutions.[33]

As is the case for other countries, this trend might be credited primarily to China's growing international relevance. However, the frail state of the Italian economy and of its innovative "ecosystem" has also played a decisive role. The Italian national innovation system is severely impaired by historical and structural deficiencies such as low R&D investments in both the private and public sector, the meagre presence of large-sized industries, low levels of public investment in research and education, a modest percentage of highly skilled workers and profound territorial disparities.[34] Italy is considered to be a "moderate innovator" in the EU, ranked 18th out of the Union's 27 countries on the European Innovation Scoreboard (EIS).[35]

Despite this situation, the quality of its scientific output is rather competitive and Italian academia can boast prominent centres of excellence in critical sectors such as mechanical engineering, physics, materials science, clinical medicine,

[32] Interview with former member of the Italian National Research Council.

[33] See the website of the Italian Ministry of Foreign Affairs and International Cooperation: *Elenco dei protocolli esecutivi scientifici e tecnologici bilaterali*, https://www.esteri.it/mae/tiny/362.

[34] Leopoldo Nascia, Mario Pianta and Giovanni La Placa, "RIO Country Report 2017. Italy", in *JRC Science for Policy Reports*, 2018, https://op.europa.eu/s/rSyY.

[35] Mattia Ceracchi, "Innovation Scoreboard, Italy Lags Behind in Europe (But There Is Some Good News)", in *I-Com Blog*, 25 June 2020, https://www.i-com.it/?p=21772.

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pharmacology, biology and biochemistry. Despite the country's low number of large multinational groups, Italy is home to a galaxy of small and medium-sized enterprises that hold patents for niche, emerging and disruptive technologies. The Italian scientific community is also deeply involved in international mega-projects – granting access to its partners' technologies – and has critical research facilities, among which are two Antarctic base camps and the Gran Sasso physics lab, the world's largest underground research centre for the study of particle physics.

Building on these foundations, it is evident that for both Rome and Beijing cooperation in science and technology represents – on paper – a win–win partnership. From the Italian perspective, cooperation with China offers access to advanced laboratories and new research funds, exposure to the Chinese market culture in order to develop long-term commercial-entry strategies, strengthening the country's response capacity to global challenges and an opportunity to safeguard some Italian competitive advantages in products exported to the PRC. On China's side, cooperation with Italy is instrumental for gaining access to a mature academic ecosystem as well as the prospect of Chinese companies gaining technology, expertise, managerial and marketing skills, recognised brand names, distribution networks and reputational gains through the acquisition of renowned companies.[36]

However, there are also several downsides that should be taken into account. Although China has made numerous steps forward in terms of transparency, quality and openness to international collaboration, in academia there are still numerous problems of reciprocity in the treatment of researchers. Moreover, when scientific cooperation among private entities is concerned, issues related to patent and know-how protection during technology transfer still represent a strong disincentive for Italian companies to partnering with Chinese firms.[37]

2.1 The reach of the Chinese innovation system into Italy

Academia is the segment in which the intensity of Italian–Chinese cooperation on innovation is most keenly felt. The number of bilateral agreements between the two countries' universities has grown from 41 in 2007 to 932 in 2021, with a significant increase in the number of partnerships involving science departments.[38] During the same period, the number of Chinese students in Italy has grown fourfold, with Chinese scholars representing to date the third-largest community of foreign

[36] Carlo Pietrobelli, Roberta Rabellotti and Marco Sanfilippo, "What Drives Chinese Multinationals to Italy?", in Riccardo Crescenzi and Marco Percoco (eds), *Geography, Institutions and Regional Economic Performance*, New York/Heidelberg, Springer, 2013, p. 397-414.

[37] Italian Ministry of Foreign Affairs and International Cooperation, *Italia-Cina, collaborazione scientifico tecnologica. Piano d'azione verso il 2025*, March 2020, https://www.esteri.it/mae/tiny/38974.

[38] Ties Dams, Xiaoxue Martin and Vera Kranenburg (eds), *China's Soft Power in Europe. Falling on Hard Times*, A Report by the European Think-tank Network on China (ETNC), The Hague, Clingendael, April 2021, https://www.clingendael.org/node/12620.

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students in the country.[39] In parallel, the PRC has become more attractive for Italian students. In 2017, China became the top destination for Italian exchange programmes outside of the EU – surpassing even the US.[40]

Academic cooperation has become more robust, and so far has produced more than 2,500 joint publications in high-impact scientific journals.[41] Public research initiatives have led to the establishment of joint facilities such as the Sino-Italian Laboratory on Genomics, Translational Medicine and Clinical Research on Lung Tumors (2014) and the Sino-Italian Joint Laboratory on Geological and Hydrological Hazard (2017), as well as the creation of bridging institutions for university–industry technology transfer such as the China-Italy Joint Laboratory on Advanced Manufacturing (CI-LAM) and the Sino-Italian Innovation Base Camp (SIIB-C), both founded in 2017.

Chinese companies have found in Italy a suitable place from which to expand their interests, acquiring innovative companies in core sectors such as automotive, pharmaceuticals and machinery. The incoming stream of Chinese capital started in the late 2000s and peaked in 2014–15 with major strategic acquisitions such as that of Pirelli by ChemChina and Ansaldo Energia by Shanghai Electric.

Despite the relatively recent debate, in Italy and Europe, regarding the opportunity for (under)selling critical firms that own high-value patents or that conduct R&D activities in strategic sectors, acquisitions and buyouts by Chinese companies have continued, following the same investment pattern. Among the most recent ones it is worth mentioning the acquisition of companies such as Olivotto systems (machines and plants for the production of hollow glass) by China Glass Technology, Laudner Ambiente (solid-waste treatment and the production of renewable energies) by Zoomlion Heavy Industry S&T, Adaptica (visual technologies) by the Chinese Ophthalmological Group and Meta System (electronic products for the automotive sector) by Shenzhen Deren Electronic.[42] All of these operations were carried out in 2018.

Chinese private-equity and venture-capital firms have also remained active. In 2017, ZZ Capital International Limited and Zhongzhi Capital acquired 7 per cent of Building Energy, specialising in renewable energies. In 2018, a consortium of investors composed of Youfeng Capital, Shanghai FTZ Fund, Tianyi, Yuye and Kanda purchased 100 per cent of Esaote medical diagnostics. In that same year, Nerviano Medical Science, a group of companies focused on clinical and preclinical

[39] See Statista, *Leading Countries of Origins of Foreign Students Enrolled at University in Italy in the Academic Year 2018/2019*, November 2020, https://www.statista.com/statistics/572639.

[40] Elisabetta Tola, "Tutti i numeri sugli italiani all'estero", in *AGI*, 4 November 2018, https://www.agi.it/data-journalism/italiani_estero_quanti_sono-4564494/news/2018-11-04.

[41] See Città della Scienza, *China-Italy A Successfull Innovation Week in Beijing and Jinan, November 25th – 29th, 2019*, 2 December 2019, http://www.cittadellascienza.it/?p=61218.

[42] BeBeez, *All the Chinese Investments in Italy*, Milan, EdiBeez, June 2019, https://bebeez.it/files/2019/06/Cina-Report-giu-2019-def-EN.pdf.

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research, was acquired by Hefei SARI V-Capital Management. Lastly, in 2019, Zouk Capital bought 51 per cent of Be Power, a company specialising in electric mobility.

The internationalisation of the Chinese innovation system in Italy has also encompassed the establishment of R&D centres as well as other forms of research partnership with Italian firms, universities and innovative labs. As explained in the first section, this has served genuine purposes such as product adaptation and technology exploration, yet it has also resulted in Chinese companies exploiting know-how from their Italian partners or affiliates.

A model example of this phenomenon is the penetration of Italy's National Innovation System by Huawei, China's telecom giant. Since it opened its commercial office in Italy in 2004, Huawei has greatly expanded its R&D activities with both public and private entities. It has partnered with all the major telecom companies operating in Italy – in particular, by opening several joint research centres: four with Telecom Italia and one with Vodafone Italia.[43]

Huawei's R&D activities have also stretched as far as Italian academia, as the company has financed scholarships and talent programmes and partnered with several universities, including the Polytechnic of Milan and the universities of Trento, Bologna, Pavia and Cagliari.[44] Moreover, in 2011, Huawei opened its own research facility – devoted to the study of microwaves – in Segrate (near Milan).

Thanks to such rooted connections – and also to its relatively low-priced services – the company has managed to participate in eminent commercial projects such as the roll-out of the LTE network in southern Italy (with Telecom Italia); the deployment of ICT smart solutions and services for the Municipality of Cagliari; and, last but not least, the partnership for the development of the 5G network in Milan (with Vodafone Italia), Bari and Matera (with Telecom Italia and Fastweb).[45]

2.2 The BRI and the 2019 S&T agreements: A breakthrough or natural evolution?

Until 2019, the scientific component of the BRI had only indirect connections with the Italian innovation ecosystem and was limited to cooperation through international institutes. Italy is home to The World Academy of Sciences (TWAS), an academy for the promotion of scientific studies in developing countries administered by the United Nations Educational, Scientific and Cultural

[43] Edward Chan, *Building a Better Connected World*, presentation at the conference "Investire in Italia: quadro normativo ed istituzionale per gli investimenti esteri", organised in Rome on 13 June 2017 by the Italian Ministry of Foreign Affairs and International Cooperation, https://www.esteri.it/MAE/resource/doc/2017/06/huawei_-_chan_-_sito.pdf.

[44] Ibid.

[45] Francesco Silvestri and Virginia Mariano, "L'Italia e le società di telecomunicazioni cinesi tra congiuntura politica globale e incertezze interne", in *OrizzonteCina*, Vol. 11, No. 2 (2020), p. 58-73, https://doi.org/10.13135/2280-8035/5412.

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Organization (UNESCO). TWAS has a strong partnership with the Chinese Academy of Science. The two institutions provide around 200 scholarships and have set up five joint centres of excellence in Beijing.[46] TWAS is also member of the ANSO.

This situation changed with the signing in March 2019 of the Memorandum of Understanding on the Belt and Road Initiative between Italy and China. Italy's decision to endorse the Chinese project prompted wide-ranging criticism from partners and allies, and generated a wave of speculation – ranging from the possibility that Italy was jeopardising its own and European security interests by allowing greater Chinese presence in sensitive sectors to the eventual disentanglement of Italy from its traditional alliances.

Although some of these assumptions stemmed from understandable concerns, Italy's decision to seek a stronger relationship with China is not the result of a sudden change in its strategic direction but represents the continuation of a long-standing strategy. This is particularly evident as regards the MoUs concerning S&T cooperation.

Among the agreements signed in 2019, three institutional memoranda and one commercial protocol can be framed in the broad context of S&T cooperation. They are:

1) *The Memorandum of Understanding between the Italian Ministry of Economic Development (MISE) and the Ministry of Science and Technology of the People's Republic of China (MOST) for the promotion of Innovative Startups*. The MoU between MISE and MOST is the one that carries most political weight, as it was signed by then Minister of Economic Development (and currently Foreign Minister) Luigi Di Maio, former leader of the Five Star Movement (M5S) and a major supporter of the BRI MoU. The intention of the memorandum is to promote closer cooperation in the field of technological innovation between start-up companies through the organisation of promotional events and exchange visits. The document explicitly refers to the promotion of two activities already in place: the China-Italy Innovation Week and the Italy-China Best Startup Showcase. To monitor this agreement, a working group composed of members of the Italian Trade Agency (ITA) and the MOST department for international collaboration is envisaged.

2) *The Memorandum of Understanding between the Italian Ministry of Education, University and Research (MIUR) and the Ministry of Science and Technology of the People's Republic of China (MOST) on strengthening cooperation on science, technology and innovation*. The content of this document is rather meagre, with the two entities pledging to finance joint research projects and support cooperation initiatives promoted by the universities of both countries. The sole innovative element is represented by the creation of a new exchange programme

[46] See TWAS website: *CAS-TWAS Centres of Excellence*, https://twas.org/node/8652.

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named "China-Italy Talent Exchange Program", for which, however, no details are provided. At the time of writing, the exchange programme has not been launched yet but the possibility should not be ruled out that activities of this kind – included also in other agreements – might have been put on hold due to the effect of the covid-19 pandemic.

3) *The Memorandum of Understanding between the Italian Space Agency and the China National Space Administration on cooperation relating to the mission China Seismo-Electromagnetic Satellite 02 (CSES-02)*. This memorandum commits the partners to the CSES-02 scientific mission, which studies and monitors the Earth's seismic activities from space. Italian cooperation in the CSES China Seismo-Electromagnetic Satellite mission has been in place since 2012 through the LIMADOU project, co-financed by MIUR.[47] According to the document, the Italian contribution includes the supply of instruments and components; collaboration on ground calibration and assistance to its Chinese counterpart in completing the general assembly, integration and testing of the Italian instruments; and the provision of the necessary technical support during system-level satellite tests. The value of the entire mission is about 13 million euro for a period of three years.

4) *The Protocol between Ansaldo Energia S.p.a. and China United Gas Turbine Company (UGTC) for technology collaboration in the field of heavy-duty gas turbines*. Ansaldo Energia pledges to support UGTC's heavy-duty gas-turbine programme with its technical expertise in design, engineering and testing. This follows the Memorandum of Understanding with the State Power Investment Corporation (SPIC), the majority shareholder of UGTC, which was signed by Ansaldo in July 2018. These commitments do not represent a major breakthrough for the company as its position in the Chinese market was granted in 2014 when 40 per cent of the company was acquired by Shanghai Electric.

Overall, these four arrangements represent the continuation of previous commitments or the renewal of existing projects. The M5S's push to include them in the MoU in support of the BRI was probably motivated by a desire to demonstrate the wide extent of Italy–China relations. It was an instrumental decision aimed at extending the attractiveness of the BRI label – primarily linked to infrastructural projects – to other sectors such as finance; philanthropy; and, last but not least, S&T cooperation.

The M5S's decision to include a scientific component in the BRI agreements was, however, regrettable because – given the symbolic nature of the BRI Memorandum of Understanding – it did not involve any practical return for the Italian scientific community and innovative system in terms of either new partnerships or funding opportunities. As a result, it was China that benefitted the most from this decision

[47] Italian Space Agency (ASI) and National Institute for Nuclear Physics (INFN), *Stipula dell'Accordo ASI – INFN "LIMADOU-2 fase B2/C/D/E1*, 24 October 2019, https://trasparenza.strategicpa.it/asi/archivio/25891-programma-limadou-2-attivita-di-fase-b2-c-d-e1-accordo-asi-infn/doc/1925.

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since it added yet another string to Beijing's bow in promoting the scale and prestige of its flagship foreign-policy initiative.

Besides the unbalanced nature of the deal, from an Italian perspective the decision to include S&T among the fields of cooperation with Beijing was, overall, coherent not only with the M5S's plan to scale up the relationship with China but also with the country's decade-long strategy of strengthening its scientific relations with the PCR.

In 2010, the Italian Government signed a China–Italy Three-Year Action Plan on Strengthening Economic Cooperation. A few months later, the Chinese MOST and the Italian Government launched the China-Italy Innovation Forum (CIIF) and set up three joint research centres.[48] The following year, a memorandum was signed for the realisation of the China-Italy Technology Transfer Center (CITTC), a platform aimed at promoting internationalisation activities in the research-industry system. On the initiative of the MIUR, in 2013 a national platform for S&T cooperation with China was created with the support of Fondazione IDIS – Città della Scienza (an institution meant to promote and disseminate scientific progress), the Ministry of Foreign Affairs and International Cooperation (MAECI), the MISE, the ITA and the Agency for Digital Italy (AGID).[49] Città della Scienza was charged with the organisation of the China-Italy Science, Technology & Innovation Week, a yearly event that combined the CIIF and the Sino-Italian Exchange Event (SIEE) and was supported by the Italian National Research Council, the Chinese Ministry of Science and Technology, the Beijing Municipal Science & Technology Commission and the Beijing Association for Science & Technology.[50]

In 2014, the MAECI established the Technical Committee on S&T Cooperation with China, a working group consisting of representatives from more than 30 stakeholders and tasked with elaborating a set of guidelines for the use of Italian academic institutions and research centres in their relationship with Chinese partners. The following year, the working group released an "Italian strategy in China", whose primary goal was to map major opportunities for cooperation pairing the objectives of the Chinese 13th Five-Year Plan and the Italian National Research Programme 2015–2020. The document also contained a brief summary of legal recommendations regarding the signature of agreements and the protection of intellectual property rights and patents.[51]

[48] China-Italy Technology Transfer Center (CITTC), *China and Italy Work Together. Win-win Cooperation and Innovation*, 2015, http://www.laziointernational.it/files/150805/china_italy_technology_transfer_center_brochure_en.pdf.

[49] See Città della Scienza website: *China-Italy Science, Technology and Innovation Program*, http://www.cittadellascienza.it/cina/en/?p=5665.

[50] Pietro Greco, "China-Italy Innovation Forum", in *La rivista del Centro Studi Città della Scienza*, 22 March 2016, http://www.cittadellascienza.it/centrostudi/?p=1237.

[51] Italian Ministry of Foreign Affairs and International Cooperation, *Scienza & Tecnologia: Per una strategia italiana in Cina*, May 2015, https://www.esteri.it/mae/resource/doc/2015/06/Studiocina.pdf.

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In 2016, the MIUR inaugurated the first edition of the Italy-China Best Startup Showcase, a matching initiative for innovative start-ups and young talent in order to attract investments from Italian and Chinese incubators and funds.[52] A few months later, Italy's then Prime Minister, Paolo Gentiloni, attended the first Belt and Road Forum in Beijing – the only leader of a G7 country to do so. During his visit, he signed the China-Italy Action Plan for Strengthening Economic, Commercial, Cultural and Scientific Cooperation 2017–2020.[53]

2.3 The consequences of the 2019 agreements and the controversies of Chinese technologies in Italy

The expansion and strengthening of scientific and technological cooperation between Italy and China was a trend that began before the MoU in support of the BRI. Therefore, it is not surprising that the process of institutionalisation and centralisation of technological and scientific cooperation with China has continued even under the ruling coalition – first (summer 2020–February 2021) the one between the M5S and the centre-left Democratic Party (PD) and then (since early 2021) the "grand coalition" supporting Mario Draghi's government, which replaced the government that was in power in March 2019.

In March 2020, the foreign ministry published the new Italian strategy for bilateral collaboration with China. The document, entitled "Action Plan towards 2025", is divided into eight areas of mutual interest identified by comparing the different research and development plans of Italy and China.[54] To grasp the significance of this document, it must be noted that the PRC is the only country towards which Italy has so far developed a detailed and structural strategy for S&T cooperation. This programmatic document is a demonstration of Italy's lingering ambition to strengthen links with the Chinese innovative ecosystem – and it is certainly not the only country trying to do so. This trend – at least, at the institutional level – can be observed in other European countries such as France and the Netherlands, and it is also consistent with the EU's plan for S&T cooperation with China.[55]

[52] Città della Scienza, *Italy-China Science Technology and Innovation Program Activity Report 2016*, February 2017, http://www.cittadellascienza.it/cina/wp-content/uploads/2017/02/report-China-ENG_web1.pdf.

[53] Nicola Casarini, "Rome-Beijing: Changing the Game. Italy's Embrace of China's Connectivity Project, Implications for the EU and the US", in *IAI Papers*, No. 19|05 (March 2019), https://www.iai.it/en/node/10105.

[54] Namely the Italian National Smart Specialisation Strategy, the Italian National Programme for Research (PNR) and the programme contained in the XIII Chinese five year plan.

[55] European Union Delegation to China and Mongolia, *Research, Innovation and Science: Cooperation between EU Member States, Associated Countries, the European Union and China*, April 2014, https://eeas.europa.eu/archives/delegations/china/documents/eu_china/research_innovation/6_eumembers_states/140714_eu_ms_and_china_cooperation_brochure_final.pdf; European Union Delegation to China, *Research, Innovation and Science: cooperation between EU Member States, H2020 Associated Countries, the EU and China*, March 2021, https://eeas.europa.eu/sites/default/files/brochure_st_mar_2021_final_0.pdf.

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Despite the unwavering efforts of Italy's institutions, two years after the 2019 agreements it is possible to state that the inclusion of scientific agreements in the framework of the BRI has been largely inconsequential – both in terms of economic benefits and improvements in public or private R&D activities. As explained in previous sections, the main reason behind this lies in the very nature of such agreements, since all of them were mere renewals of previous commitments. This does not imply, however, that the researches included in the agreements were not scientifically relevant or that research institutions involved did not benefitted from partnering. Moreover, failure in the implementation of people-to-people activities – i.e. student exchanges or talent programmes – could be attributed to the effects of the covid-19 pandemic.

The only significant development in terms of advancing the institutional scheme of cooperation between the two countries that can be framed as a direct consequence of the BRI's agreements has been the opening of the first international centre of excellence of the Digital Belt and Road Programme (DBAR ICoE) in Italy. The centre – one of eight overseas facilities approved by DBAR – was inaugurated in May 2019 and will be devoted to space-archaeology investigations.[56]

The lack of any significant impact for the Italian innovative system does not imply that the MoU has produced no effect at all. In fact, a domestic debate that arose from Italy's endorsement of the BRI has set in motion – for the first time – a momentous discussion within Italian institutions and the public at large regarding the nature of Italy's relationship with China, especially concerning Chinese-made technologies.

Italy had already started adopting measures to protect its technological assets domestically, and was among the countries that pushed for strict regulations in this domain at the European level.[57] Yet, these norms were rarely implemented and public debate about the issue was minimal. Starting from 2019, greater attention has been paid to the issue of including Chinese companies in the realisation of the national 5G network. The Italian Government has made further progress in protecting its telecommunications assets. Critically, it has strengthened its so-called Golden Power, which allows it to block acquisitions of companies in sectors deemed strategic. Prime Minister Draghi recently exercised this prerogative and halted the acquisition of an Italian semiconductor company by Shenzhen Investment.[58] Secondly, it has increased scrutiny of the roll-out of the new telco

[56] Digital Belt and Road, *The DBAR ICoE-Potenza Established and Launched Space Archaeology Sino-Italian Joint Investigation*, 28 May 2019, http://www.dbeltroad.org/index.php?a=show&catid=85&id=648.

[57] See Italian Chamber of Deputies website: *La disciplina del golden power: quadro normativo*, https://temi.camera.it/leg17/post/la_disciplina_del_golden_power__quadro_normativo.html.

[58] Miles Johnson, Davide Ghiglione and Silvia Sciorilli Borrelli, "Mario Draghi Sets Tone in Cooling EU-China Relations", in *Financial Times*, 6 June 2021, https://www.ft.com/content/4d7bf8ad-f585-44b2-9250-790ec430de4b.

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(telecommunications-company) infrastructure.[59] The Italian Government has not openly excluded Chinese companies from the development of the 5G networks; however, it has quietly encouraged private companies to take that decision on their own, which has led to a de facto phasing out of Huawei and the partially state-owned technology company ZTE from the Italian 5G market.

More recently, the public debate has moved from telecommunication to other critical sectors in which Chinese technologies have been deployed in the past few years. In May 2021, following a media investigation, a parliamentary inquiry questioned the lawfulness of the purchase – between 2017 and 2019 – of surveillance cameras from the Chinese multinationals Hikvision and Dahua for use in 134 public attorney's offices; the airports of Rome and Milan; and the offices of RAI, the national public broadcasting company.[60] Concerns have also been raised with regard to the procurement – during the first wave of the COVID-19 pandemic – of 19 thermoscanners with facial-recognition technology from Dahua to monitor Chigi Palace, the office of the Council of Ministers and residence of the Prime Minister.[61] The use of technologies from Hikvision and Dahua is controversial for several reasons. Both companies have been accused of supplying surveillance equipment to Chinese facilities linked to the oppression of Uyghurs in Xinjiang.[62] Moreover, it has been proved that their devices have secondary memories that can communicate with and send information back to Chinese servers – technological specifications that were not disclosed to recipients and customers.[63]

The increased awareness in both public opinion and institutions can be regarded as a positive outcome. However, the debate on the integration of Chinese technologies is only the tip of the iceberg. In Italy to date, little attention has been paid to the consequences that academic and industrial S&T cooperation with Chinese entities can have in terms of either national security or the loss of economic competitiveness through technological spillover.

Italy thus lags behind other countries, where the debate regarding scientific cooperation with Beijing has already moved into academia and the scientific marketplace. In October 2020, Britain's Centre for the Protection of National Infrastructure published a set of guidelines to help researchers, universities and industries protect their assets against hostile interference and promote academic

[59] Francesca Ghiretti, "Europe's Manoeuvring on 5G Technology: The Case of Italy", in *IAI Commentaries*, No. 20|67 (September 2020), https://www.iai.it/en/node/12149.

[60] Italian Senate, *Legislatura 18 Atto di Sindacato Ispettivo n° 4-05469*, 18 May 2021, http://www.senato.it/japp/bgt/showdoc/18/Sindisp/0/1297968.

[61] Giulia Pompili, "Conte e la videosorveglianza cinese a Palazzo Chigi", in *Il Foglio*, 9 April 2021, https://www.ilfoglio.it/esteri/2021/04/09/news/conte-e-la-videosorveglianza-cinese-a-palazzo-chigi-2173612.

[62] James Franey, "EU Taps Chinese Technology Linked to Muslim Internment Camps in Xinjiang", in *Deutsche Welle*, 26 October 2020, https://p.dw.com/p/3kIDV.

[63] Raffaele Angius and Luca Zorloni, "Come sono finite mille telecamere della cinese Hikvision nella procura di tutta Italia", in *Wired*, 7 April 2021, https://www.wired.it/?p=302976.

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freedom.[64] On the other side of the Atlantic, former US president, Donald Trump, in one of his final acts, published a memorandum aimed at strengthening the protection of intellectual capital and discouraging research misappropriation from state-supported R&D facilities.[65] The issue has also been raised within EU institutions, and research ministers recently agreed to update Article 18 of the Horizon Europe text in order to limit foreign participation in its framework programmes, a decision primarily aimed at targeting Chinese tech giants.[66]

With major Western powers questioning their connections with the Chinese National Innovation System, Italy's long-term strategy for a greater scientific relationship with Beijing will soon prove problematic. Indeed, besides the domestic controversies that this relationship generates – in terms of intellectual and industrial pitfalls – the country risks becoming caught in the middle of an international push for disentangling from the Chinese scientific community and, most specifically, its technologies.

Conclusion

China has achieved the status of global science and technology (S&T) powerhouse. Its companies are global champions in sectors that will be pivotal for the next industrial revolution, and its public research facilities are amongst the most prominent hubs for the study and development of basic and advanced sciences. The magnitude of the Chinese National Innovation System is so great that it is becoming increasingly difficult for foreign researchers and companies to resist its lure. Leveraging this fact, the Chinese Government has transformed scientific cooperation into a tool for advancing its foreign-policy interests.

Over the last decade, Italy has invested significant political capital in its engagement with the Chinese innovation community. It has systematised public and private initiatives to expand and maximise the economic and technological benefits that this relationship has to offer, a strategy shared by many in Europe. As is the case in other countries, Italy's decision to seek greater engagement in the Chinese innovative system is also a natural consequence of Beijing's growing role as an innovative power and a direct consequence of the proactive expansion of Chinese entities – private and public – in Italy's Innovation System.

[64] See Centre for the Protection of National Infrastructure (CPNI)'s website: *Trusted Research Guidance for Academia*, last updated on 29 May 2020, https://www.cpni.gov.uk/trusted-research-guidance-academia.

[65] White House, *Presidential Memorandum on United States Government-Supported Research and Development National Security Policy*, 14 January 2021, https://trumpwhitehouse.archives.gov/presidential-actions/presidential-memorandum-united-states-government-supported-research-development-national-security-policy.

[66] Éanna Kelly, "EU Expands Powers to Block Chinese and US Companies from Horizon Europe", in *Science|Business*, 1 October 2020, https://sciencebusiness.net/framework-programmes/news/eu-expands-powers-block-chinese-and-us-companies-horizon-europe.

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The inclusion of an S&T chapter in the March 2019 Memorandum of Understanding in support of the Belt and Road Initiative (BRI) should thus be seen as the continuation of an institution-driven strategy rather than a political decision made by the coalition government that promoted the signature of the memorandum. This does not mean that the choice to include scientific cooperation in the framework of the BRI was wise, since it primarily served China's interest – providing Beijing with a powerful rhetorical tool to further promote its most prominent foreign-policy initiative. In addition, and most critically for Italy, linking scientific cooperation with the BRI has been largely inconsequential in terms of both economic benefits and improving public or private scientific and innovation-oriented activities.

That said, Italy's endorsement of the BRI has stimulated a public debate over the equivocal nature of partnering with China – especially for the development and deployment of new technologies. Besides the evident role played by political pressure exerted from Brussels and Washington, the "awakening of consciousness" generated by this domestic debate has probably played a role in persuading the Italian Government to reinforce its scrutiny of the presence, reach and use of Chinese technologies within the country.

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