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China-Saudi Technology Transfer: The Purposeful Bipartite Technology Movement

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Abstract

The significance of technology transfer (TT) for economic development cannot be overemphasized where it lies at the heart of international business (IB) activities. The literature on technology transfer has focused on North-South transfer and has analyzed transfer as a largely technical process. This is despite the increasing influence of rising powers in technology transfer, specifically in tech industry, China is an important player in this field. This article has two aims: firstly, it adds to the small but emerging literature on South-South technology transfer by exploring the role of Chinese actors, using Saudi Arabia's data and tech spheres as a case study. Secondly, the article develops an expanded notion of technology transfer by arguing that technology transfer is not only a technical process, but it is inherently political as it includes crucial issues on decision-making regarding the type of technology that is transferred. Many of these issues become less unwieldy and get attenuated if technology is transferred from same environment as the recipient (e.g., South-to-South) rather than from north (developed countries) to south countries. This paper discusses various market mechanisms and models of technology transfer that could be applied between China and Saudi Arabia via South-South mode of technology cooperation and transfer.

Keywords: south-south technology transfer (SSTT), foreign investment, technology exchange, investment treaties, market entry.

ملخص الدراسة

لا مبالغة في التأكيد على أهمية نقل التكنولوجيا للتنمية الاقتصادية حيث يقع ذلك في قلب أنشطة الأعمال التجارية الدولية .
ركزت الأبحاث المتعلقة بنقل التكنولوجيا على مفهوم النقل بين الشمال والجنوب وحللت النقل التكنولوجي باعتباره عملية فنية إلى حد كبير. هذا على الرغم من التأثير المتزايد للقوى الصاعدة في نقل التكنولوجيا ، وتحديداً في قطاع التقنية تبقى الصين لاعب مهم في هذا المجال. تحتوي هذه المقالة على هدفين: أولاً ، تضيف إلى الدراسات القليلة ولكن الناشئة حول نقل التكنولوجيا من الجنوب عبر استكشاف دور الجهات الفاعلة الصينية ، باستخدام بيانات المملكة العربية السعودية ومجالات التكنولوجيا فيها كدراسة حالة. ثانيًا ، يطور المقال مفهومًا موسعًا لنقل التكنولوجيا من خلال القول بأن نقل التكنولوجيا ليس فقط عملية تقنية ، ولكنه سياسي بطبيعته لأنه يتضمن قضايا حاسمة بشأن صنع القرار فيما يتعلق بنوع التكنولوجيا التي يتم نقلها. العديد من هذه القضايا تصبح أقل صعوبة وتضعف إذا تم نقل التكنولوجيا من نفس البيئة مثل المتلقي (على سبيل المثال ، من الجنوب إلى الجنوب) بدلاً من الشمال (البلدان المتقدمة) إلى بلدان الجنوب. تناقش هذه الورقة مختلف آليات السوق ونماذج نقل التكنولوجيا التي يمكن تطبيقها بين الصين والمملكة العربية السعودية من خلال نمط التعاون ونقل التكنولوجيا من الجنوب.

الكلمات المفتاحية: نقل التكنولوجيا بين الجنوب والجنوب ، الاستثمار الأجنبي ، التبادل التكنولوجي ، معاهدات الاستثمار ، دخول السوق.

Introduction

Countries across the globe have often gone to great lengths to develop unique technologies that would facilitate people's lives or boost their financial wellbeing, with some nations like China surpassing others in their technological development pace, such as the Kingdom of Saudi Arabia, which may prompt states less apt at research and development to seek technology transfer, whether it be through market channels or otherwise. According to Hensengerth (2018), suggesting that the respective literature had prioritized the North-South direction. What scientific studies have also done is examined the transfer from a largely technical process (Hensengerth, 2018). Research needs diversifying in terms of focus, where such an aspect as the causal factor behind the technology transfer seems often overlooked despite it being specific reasons that cause the two nations to seek the exchange of knowledge, that is, if not for a special purpose-driven interest in the exchange, China and Saudi Arabia would not be cooperating on the technology front in many sectors. Studying these factors can help draw the attention of countries like the US to a potentially dangerous case of technology exchange that could render the geopolitical status quo unstable if it leads to the endemic armament level being increased; hence, such countries wielding much weight

internationally can work towards raising the security confidence of regional partners to prevent the buildup of a combustible situation.

Overall, the paper pursues to achieve the following **objectives**:

Understanding the nature of South-South China-Saudi technology transfer; recognizing Why is China that eager on technological exchanges; and investigate if the kingdom is just a technology recipient as China seeks to achieve specific economic, reputational, and geopolitical objectives.

Literature Review

Several transfer procedures, which include foreign trade, direct investment and joint enterprises have been examined by the literature on the topic of technology transfer. Other mechanisms examined by this literature are distribution of technologies, including reaching the population in the host nation. These also involve obstacles to transfer which include cultural variations, infrastructure, and investment policies, as well as technology transfer quality (Hensengerth, 2018). It is basically accepted by literature that both hard and soft elements are involved in technology transfer, as Lema and Lema (2013) mention both a wide and narrow viewpoint of transfer. The following physical factors encompass the narrow viewpoint: transaction agreements, cross-border movements, and the technology itself. Contrastingly, the wide viewpoint involves generating aptitude and domestic abilities to innovate the motivation for technological transformation. The wide viewpoint, which could be the eventual target of technology transfer, is critical, meaning that it is possible to judge technology transfer according to which hard or physical elements fulfil the realization of soft facets. Although south-south coordination has been dominant, the technology transfer literature has concentrated on north-south technology transfer. In 1978, the Buenos Aires Plan of Action for Promoting and Implementing Technical Cooperation among Developing Countries was initiated, and from that time onwards, recognition was given to the importance of south-south technology transfer (SSTT), whereby coordination between southern nations has been occurring. This has been more apparent in recent times as a reaction to new requirements which have emerged from the change of consumption and production patterns (Saxena, 2014). It is apparent that recent experiential evidence of developmental assistance

has been utilized as a substitute among southern partners in that TT has, up to the present time, been in soft infrastructure as capacity building projects. Furthermore, the emergence of greater enterprises having greater pay-off potential; for example, coordination in the field of science and technology, is now apparent (Dhar & Joseph 2012). From another perspective, the Technology, and Innovation Report (2012) from UNCTAD, states that 55 percent of global trade in 2010, in comparison with 41 percent in 1995, was attributed to exchanges between developing nations. This report is appropriately known as 'Innovation, Technology and South-South Collaboration'. The discussion on the inducement and effect of China's growing number of engagements, in recent times, has been revived by the growth of SSTT, induced by China in developing nations (Saxena, 2014). Transfer of technology to Saudi Arabia from China, which is classed as a south-south transfer, is insufficiently studied.

The Deputy Governor of the General Investment Authority for the Investment Attraction and Development Sector, Sultan Mufti, has mentioned a 100 percent increase, during the first half of 2019, in the number of Chinese firms functioning in Saudi Arabia, as against the same period of the previous year (Al-Talal, 2019). Furthermore, Mufti announced, "Under Vision 2030, there are many priority sectors, which represent opportunities for various global companies to invest in Saudi Arabia, particularly in sectors such as petrochemicals, mining, renewable energy, manufacturing and energy" (Al-Talal, 2019). Mufti commented on the impact of the trade war between the United States and China, "In general, Chinese companies affected by the China-America trade war are limited, not all companies, we always try to strengthen and encourage Chinese companies to go all over the world to research and study economic opportunities" (Al-Talal, 2019). China's Vice Premier, Han Zheng, and Saudi Arabia's Crown Prince, Deputy Prime Minister and Minister of Defense, Mohammed bin Salman recently co-chaired a high-level steering committee meeting. During this meeting, Han suggested that the two countries ought to strengthen mutual political trust, improve cooperation and communication, as well as to support each other's basic interests. Moreover, he recommended that they improve pragmatic coordination regarding energy, finance, infrastructure construction and high-tech as well as to reinforce the Saudi Vision 2030 and the synergy of the Belt and Road Initiative (Xinhua, 2019). The following sections classify various sectors in Saudi Arabia implicated in the SSTT process with China.

1- Technologies Transferred Categorization

a) Oil refining technology. China is, by far, a technologically advanced state. It is not, however, that China is all about transferring technologies to the kingdom, without obtaining some expertise as well. Although being nowhere near ranking an oil producer, China maintains an interest in technologies associated with adding value to the "black gold" produced elsewhere. Xinhua (2018b) reported there to be a jointly established venture called YASREF or the Yanbu Aramco Sinopec Refining Company that was co-created by Saudi Aramco and China Petrochemical Corporation. The article went on to show why Saudis sourced the technology by informing that the Yanbu joint venture was considered the world's most advanced, efficient, and safest (Xinhua, 2018b), yet this report is not the only one to show the transferrable technological capability of Saudis. Saudis do have the expertise to share, as shown by Total (2020), which described Aramco and Total as shaping the world's most efficient integrated petrochemicals and refining platform. This technology China does need, for CAERC (2014, p.119) explained that the country maintained a petroleum-refining industry of its own, which remains to be improved, as follows from CPN (2010) stating that China had plenty of what were small-scale and technically backward oil refineries (CAERC, 2014, p.119), which may underscore the relevance of the SA-China refining technology transfer.

In this case, the technology transfer falls under what Wahab et al. (2012, p.143) defined as the category of technology transfer via a formal market channel and its subcategories of international joint ventures co-created by countries with local ventures as well as foreign direct investment, which Wahab et al. (2012, p.146) characterized as the internalized mechanism or intra-company technology transfer from MNCs to their subsidiaries or affiliates in the country and warned about technology spillover possibility when the owner of the technology is no longer in a position to preserve the technology internally or internalize the complete value of its benefits. If FDI is considered involved in technology transfer, the energy sector features the most sought-after channel of technology transfer, according to Kathuria (2011, p.14). Furthermore, while the report by Xinhua (2018b) did not specify the possibility of the technology replication, its transfer in the context of the joint SA-based venture could lead to what Wahab et al. (2012, p.143) referred to as imitation when companies are well-placed capability-wise to learn and eventually replicate the new product innovation of form of organizational processes. Whether imitated or otherwise, energy is an important resource powering the military sector, among other things, and China has technologies to transfer to SA in this sector as well.

b) Military technology. Sometimes, technology transfer may be encouraged when a nation sees another bipartite format of technology-based cooperation yielding positive results in the form of military production, yet the military technology transfer may be stimulated otherwise. Al-Masri and Curran (2019, p.67) showed that Saudi Arabia was interested in the acquisition of refined and high-tech Chinese military technology and arms, while the People's Republic was set to sell, without there being any ideological or political underpinnings. This interest has materialized, as shown by Olimat (2014, p.225), who described the technology exchange as having started as early as at least 1988, the year that SA acquired 50 CSS-2 intermediate missiles with the capability of carrying a nuclear payload, with the agreement negotiated by Prince Bander Bin Sultan, the Saudi Ambassador to the US. The technology-importing interest did not subside with time, as seen in recent missile purchase reports, including that by Aljazeera (2019), which reported about the considerable escalation of the ballistic missile program by SA following the acquisition of technology from China, although the article did not confirm the missile-building capability of the kingdom that could have been developed by now. Apart from the missile technology, the kingdom proves itself interested in buying the technology that goes into assembling such aircraft as fighters. Olimat (2014, p.225) reported the Royal Saudi Air Force and the Defense Ministry of Saudi Arabia to be reviewing the JF-17 program, which is a joint production initiative by China and Pakistan, a potential plan being for the KSA to become a partner. Pakistan had already offered the JF-17 fighter to the kingdom with technology transfer and co-production (Olimat, 2014). The China-SA technology exchange qualifies as direct exporting, as defined by Wahab et al. (2012, p.143) who explained it as an externalized mechanism and an element of the inter-company technology transfer, which is implemented via the formal market channel. While reports hint at rather than confirm the replication of the missile technology by Saudis, the possibility of its reproduction, if confirmed, will indicate the imitation subcategory of technology transfer via non-market channels based on the transfer classification presented by Wahab et al. (2012, p.146). While these military technologies do not relate to space, China and SA find the space field a fruitful field where to exchange other technologies productively.

c) Space technologies. Xinhua (2018a) reported that China and SA had jointly unveiled three lunar images on June 14, 2018, which were obtained via cooperation on the relay satellite missions for Chang'e-4 lunar probe. The article specified the technological contribution of the kingdom while explaining that an optical camera installed on a

microsatellite called Longjiang-2 had been developed by the King Abdulaziz City for Science and Technology of Saudi Arabia (Xinhua, 2018a). While details are scarce, including in relation to the format of the interstate collaboration, the visible contribution of both states to the space research initiative, which follows from the report, may allow categorizing it as an international joint venture that presupposes technology transfer via the formal market channel (Wahab et al., 2012, p.146). Although there have been no reports about the transfer of other space-based technologies, including satellites enabling telecommunication, telecommunication is yet another field bringing the Chinese and Saudis for productive interaction aimed at technology exchange.

d) Telecommunication technology. Smith (2012) reported the telecom operators of SA to have been cooperating increasingly with Huawei Technologies, a Chinese telecom and network supplier, in recent years. The Chinese venture keeps providing managed services partnerships SA's Mobily 7020.SE, in addition to assisting with the construction and operation of high-speed Long-term Evolution mobile networks for three operators of Saudi Arabia (Al-Tamimi 2013, 132). Malapitan-Aguinaldo (2011) indicated that the Middle East's biggest pre-commercial long-term evolution network in SA was another essential project involving China (Al-Tamimi 2013, 132). That technological expertise was brought to the kingdom likely shows the involvement of the non-market technology transfer method and its subcategories of personnel movement, which Wahab et al. (2012, p.147) explained as the transfer of knowledge and technology via the movement of employees as well as temporary migration, which the researchers defined as the transfer of technologies via the temporary movement/migration of scientists, technical and managerial personnel to conferences, laboratories, and universities based in other countries, including developed ones. Constructed in SA are not only towers ensuring connection as China has brought its construction expertise richly shared in the kingdom.

e) Construction technologies. Garlick (2019) reported the conclusion of 1,8 trillion dollars' worth of a contract gained by China Railway Engineering to construct a high-speed railway to link Medina and Mecca. An agreement was also reached to build a Chinese mega-mall in the KSA (Garlick, 2019). Other construction projects granted to China that could involve technology transfer in some form or other, according to Drummond (2010), include the expansion of King Khalid University and the construction of 200 schools (Al-Tamimi 2013, p.132). Rather than travel to China along with construction technologies and labor implementing it, a variety of Chinese companies has struck commercial root in SA. Thus, for

example, China Daily (2012) specified that 62 out of 70 Chinese companies operating in the kingdom were construction ventures, with 16,000 people employed (as cited in Al-Tamimi, 2013, p.132). These employees cannot but be professionals from China, as follows from a finding made by Al-Tamimi (2013) of 2% of Chinese total workers abroad being based in China and that made by Alkhateeb, Mahmood, and Alkahtani (2017, p.101) who found the labor market of SA heavily dependent on the foreign labor. The reports retrieved do not feature the FDI formal market channel of technology transfer singled out by Wahab et al. (2012, p.147), for China won a tender through its bid instead of putting money into the railway project as an investor; nor do other construction projects mention any monetary input with an eye to a long-term return on investment. Still, the construction technologies do reflect the role of the movement of personnel and/or, potentially, temporary migration channel of non-market technology transfer. Such way or another, the construction sector is that which is currently often suspended over the novel pandemic, and China is the country to transfer its healthcare technology to SA, which can lead the construction and other sectors to come unfrozen by containing the virus.

f) Medical technologies. Radwan and Obaid (2020) reported that China and SA had signed a deal worth $265 million in an effort to combat COVID-19 and offered insight into the agreement by suggesting that the People's Republic was expected to supply 9 million test kits to the kingdom along with 6 test laboratories, and 500 specialist technicians. The KSA will now be well placed to perform up to an aggregate of 60,000 tests on a daily basis, including in a unique inflatable mobile laboratory. In the case of this technology, its transfer qualifies as direct exporting, according to Wahab et al. (2012, p.143). At the same, China has supplied the kingdom with technicians assisting with diagnostics, which indicates the involvement of the personnel movement subcategory of the non-market transfer channel (Wahab et al., 2012, p.147). Some technologies, however, are hard to identify from want of specific details any more than it is possible to establish the exact transfer channel involved.

g) A potential technology transfer: Rummier (2019) reported China and Saudi Arabia to have concluded 35 agreements signed at a joint investment forum in 2019. Among these were four licenses, the details of which, however, were not provided by the Saudi state news agency SPA (Rummier, 2019). Although not specified, the licenses qualify as technology transfer through the formal market channel and its licensing subcategory (Wahab et al., 2012, p.143), which Maskus (2003) explained as a form of externalized technology transfer that may be performed differently, be it within a joint venture or between unrelated

companies at arms-length across countries (Wahab et al., 2012, p.143). All of these technologies have been exchanged for a reason.

2. Reasons for an Interest in Technology Transfer

a) China's market opportunism & economic interests. If some countries supply specific technological products, it is because they can make use of the apathy of other potential suppliers that may see fit to abide by restrictive regulations, thereby keeping a supply deficit. Olimat (2014, p.225) explained that there were regulatory obstacles related to Missile Technology Control Regime, which puts considerable burdens on the export of remotely piloted aircraft, such as unmanned aerial vehicles, along with their technology that it is believed can be instrumental in carrying up to 500 kilograms' worth of payload over a distance of 300 kilometers, which may be nuclear, biological, or chemical in nature. Although non-mandatory, the regulation keeps plenty of technology holders from supplying the drones. The regulation and the non-supplying behavior of many other countries notwithstanding, China was described as filling the gap created by the missile control regime via the transfer of its CH-4 drone to Saudi Arabia, to name but this Middle Eastern nation (Olimat, 2014, p.225). The non-military exchange also reflects an interest of China in income generation. As Garlick (2019) showed, companies in China had considerable commercial interests in the kingdom. The regulation has not been the only impulse for China to make use of a specific market situation and engage in some form of technology exchange with SA. China is shown as the country to have capitalized on the loss of regional interest by Western powers like the US. Al-Tamimi (2013, p.132) stated that US suppliers had avoided the KSA in the wake of 9/11, whereas Asian companies rose in prominence, particularly Chinese ones. Allam (2010) visualized the trend by showing that the US share in Saudi trade had dropped from 20% in 2000 to about 13% in 2011, as IMF (2012) put it (Al-Tamimi, 2013, p.132). To be able to profit by a market situation, a country, however, needs its perception positive, which can be assisted by technology transfer as well.

b) China's influence expansion. While commenting on the rationales behind the involvement of China in SA-based railway projects, Drummond (2010) pointed to essential reputational dividends enjoyed by the People's Republic by stating that high-tech trains created new-found respect for Chinese-made product and engineering prowess as they came

picking up and dropping off passengers. The state-of-the-art rail system was defined as altering Saudis' perception of China that has presumably become a nation to emulate and respect, which it has overnight (Al-Tamimi 2013, 132). The railway completed in the context of the Belt and Road Initiative (Chong and Pham 2020, p.133) may be an element of soft power, which Nye (2004, p.5) defined as getting other people to want the outcomes that one wants, without them being forced to (Arif, 2017, p.94). Truly, Sparks (2018, p.92) defined the BRI as one of the soft power tools of China. The positive perception will also be of much use in the geopolitical arena where China may seek to use technology transfer for a particular purpose too.

c) China needing Washington's attention elsewhere. It may be that China could be trying to get the Middle East armed so as to deviate the attention of the US from itself to where weapons emerge en masse. The diversion of Washington's attention over developments in the Middle East is a clear possibility confirmed by Colby (2019) who warned that the US must not allow its military focus to be wrested away from Asia in the belief that a Middle-East-based threat, such as that posed by Iran, paled in comparison with Beijing's. What proves that China may need the US' attention distracted is the opinion of Professor John Mearsheimer (2010) of the University of Chicago who opined that the US would not suffer China to dominate Asia unchallenged. Therefore, provided that China rises, big trouble can be expected on the horizon (Paul, 2012, p.39). China's technology transfer may help distract the attention of the US by setting its principal ally, Israel, acting nervously. Bar'el (2019) acknowledged that the penetration of the Middle East by China had already given Israel a cause for concern.

Overall, the paper seeks to answer the following set of questions: Is the South-South China-Saudi technology transfer bipartite or unilateral? What forms does the transfer assume? Why is China that keen on technological exchanges? Addressing them will help prove the proposition that China-Saudi technology transfer is a bipartite exchange of technological expertise or products, although the kingdom is more often a technology recipient as China seeks to achieve specific economic, reputational, and geopolitical objectives.

Methodology

Methods & Limitations

In order to apply an efficient method of comprehending the undiscovered area, we adopted a qualitative case-study strategy (Yin, 1989). Furthermore, Cheng (2007), indicated the necessity of qualitative research for surfacing contextual dimensions in IB, such as variations between nations, whereas it is difficult to specify context features externally without experience. Furthermore, qualitative research may unexpectedly allow the discovery of a previously ignored phenomenon or the appropriateness of a specific theoretical perspective to it, which supplies a powerful insight for research agendas and innovative ideas. Although similar advantages can certainly be obtained from other research techniques, the typical theoretical open attributes of qualitative research have a greater potential for discovering novel phenomena worth exploring.

When it comes to specific tools, interviews had been intended to be conducted in Riyadh, Saudi Arabia's capital, so as to provide the data for this study, the first round of which was to have occurred during two weeks from late June to early July 2020. The plan was to conduct interviews in Riyadh with appropriate Saudi government agencies and Chinese firms whose businesses spanned a range of areas, including logistics, trade, investment, machinery, telecommunication, energy, contracting, and engineering. If successful, the interview could reveal the interaction of Saudi actors with Chinese agencies, the function of Chinese actors in major programs, the modes of contractual arrangements under which technology transfer transpires, the degree to which Chinese actors assimilate into local communities, and responsibility sharing between Saudi and Chinese actors. The ultimate outcome was expected to be a comprehensive portrayal of Chinese involvement in generating a novel TT in the south-south coordination setting.

Unfortunately, despite having aimed to collect primary data, the study's methodology had to be revised, since the study environment reshaped by the novel coronavirus has become less conducive to studies involving respondents. Since personal interviews require face-to-face meetings, which may prove dangerous in the current pandemic circumstances, and since general movement is limited unless vitally relevant, primary data production via the interview method was in jeopardy. Truly, the virus has led to employees and managers going cyber for

them not to suspend the performance of routine professional duties; hence, one had no way of talking to them in the intended interview mode. Unreachable were also employees in the Chinese main office who normally cooperate with all Chinese companies in Saudi Arabia. The office was found closed, without there being anyone to communicate with, and even email was none too useful. While surveys are more feasible, since they involve the contactless distribution of questionnaire forms via cyber channels, they would not have provided much-needed insight; hence, they could not be utilized.

Consequently, the decision was made to limit the research to the sample of cases compiled in the course of secondary literature review, which yielded a wide range of interesting results presented in the discussion and conclusion chapters that are to follow, which required the wide application of the analysis method enabling the breakdown of findings. The qualitative method was still of much use as a means whereby to discover chief trends in thought and get the staple reasons and motivations, including the ones driving technology transfer, as was the case study method, which allowed limiting the focus to a single technology exchange corridor (between China and the KSA), and it did so in relation to secondary sources. The chief limitation was that secondary reports did not contain the requisite number of details, which could allow the accurate categorization of transfer cases; hence, presumptive classification became essential. In other words, the lack of transparency was an obstacle, which complicated the interpretation of technology transfer cases in the secondary literature sample, which is where future research needs to focus, and personal interviews will provide insight into the nature of the technological exchange when life gets back to normal.

Ethics

That the project does not involve the compilation of data from primary sources, such as respondents, does not mean ethical standards could not have informed the project at its multiple stages where ethical behavior is normally put to the test in some way or other. Secondary literature, when reviewed, required transferring to the paper in the form of findings. To honor the right of original authors to intellectual property, each fragment of the outside content borrowed from secondary sources was provided with in-text citations, with the method of paraphrase used to convey the ideas embedded into the source text. The newest variation of APA was picked as the academic style and format applied throughout the project. The information borrowed was double-checked once transferred to avoid the unintended

replacement of the original information. The project contains no redundant information that would serve as a filler not contributing to the paper in any way possible. Rather, a certain amount of space was spared to commit it to the analysis of findings and the presentation of essential implications so that the project may receive much-needed inferential value.

Discussion

As found, China is not a multi-faceted technological superpower, which means that it has something to borrow, which can increase the accessibility of its own technologies and/or products based thereon, since they can be a part of the exchange bargain. China has technological gaps and needs likewise, which makes itself observed in the case of oil technologies. Obviously, it is the presence of resources that drives a government to develop technologies in a bid to maximize the value of the asset, which fetches more money, and in the knowledge that specific tradable resources can be depleted before long. Hence, the oil refinery sector sees the technology transferred from such an oil-rich Muslim state as the KSA to China that is set on generating oil products with an added value, which reflects an astute understanding that this is a way to gain more in the market as resources are naturally cheaper and more available than a product that took a technology-driven production process. Besides, China already has refining facilities using backward technologies though; hence, the acquisition of foreign knowledge allows avoiding much oil going to waste before a normal added-value commodity being produced or avoiding the output being of low quality, which can affect the quality of other commodities requiring the application of oil products or tarnish the reputation of China in the market if they are imported by other states, which is fraught with the loss of the market segment, and the country will miss out on a portion of revenue until finding a replacement if the soiled reputation allows that, which it may not. Cooperation was also observed in the space sector involving the supply of a Saudi optical camera for a Chinese microsatellite. Still, exposure to technology occurs during the exploitation of the end product rather than its production where its nature is more manifest as it can be seen how the technology proves useful or how it is employed; hence, the transfer of knowledge was likelier in the oil refinery case.

Furthermore, technology exchange does not always require the presence of the end product or involvement in its production as employees competent in technology can facilitate the familiarization of foreign countries with such when invited to the country, as observed in the telecommunications sector seeing workers arrive from China to assist with network

installation, and the same can be said of the construction sector as China Railway Engineering is busy building a high-speed railway to link Medina and Mecca, which has also necessitated the arrival of foreign specialists. A third example of temporary-migration-assisted technology transfer is that which involves the arrival of Chinese medical professionals who seem to increase the diagnostical competence of Saudi colleagues in relation to coronavirus. While most technologies in the set of cases cited indicate the transfer of knowledge from China to Saudi Arabia acting as its recipient and while the space sector involves the use of technologies from different countries in the joint undertaking, which may lead to potential two-way knowledge exchange, the military sector shows that the Saudi-China technology transfer can be reverse as the PRC sells refined military arms and technology, including ballistic missiles and air fighters, which has occurred since at least the late 1980s. Sometimes, the nature of exchange and technology is not to be identified as some deals that may potentially lead to technology transfer are not detailed at all; thus, 35 agreements signed at an investment forum by the two countries indicate a possible, albeit unconfirmed exchange.

Overall, typology-wise, Saudi-China technology transfer occurs through the formal market channel and the international joint venture subgroup (as is the case with the jointly established refining venture YASREF and microsatellite Longjiang-2); still, rather than be a venture in its own right, the space interaction case is more of a joint undertaking. At the same time, it is not obvious that the cooperation involves any communication of the technology-related information, that is, China could have not done other than supplied a ready-to-use camera and experts, without having to report any production details. Even if sent without accompanying specialists, use-related satellite information may not necessarily expose information regarding the technology as such. Still, while reports are scarce, Saudis are likely to have sent specialists looking to it that technology remains unimitated. It is not clearly specified either if the Chinese presence at the oil facility is aimed at curating or supervising production and if there is any legitimate or informal exposure to the technological side of production, which would unlock the transfer opportunity for its further replication at domestic facilities in the PRC.

The FDI subgroup may also be involved in the oil case, which may lead to technology spillover when its retention becomes unfeasible, yet this may likely be the case when a product is imported only to be examined in terms of how it could have been produced. If obvious in terms of components and their combination/assembly process, the product can

betray technological nuances. Still, oil-related products coming in the liquid form cannot be expected to tell much if anything about how the end product was achieved as there are no discernable components or assembly clues to be identified in case of intentional decomposition and further scrutiny except that some components may be identified as a result of chemical breakdown, yet the chemical process involved in production and aspects thereof, including the temperature of ingredients applied, may be a hard one to guess. There can be no denying either that spillover occurs as a result of direct exporting, which may lead to the replication of military technologies, such as missiles, which, however, may be unlikely, since the trade flow between the countries can be threatened over what can be defined as unsanctioned technology misappropriation if not theft. This technology appropriation may be unlikely unless commercial pragmatism wins, as is the case with the Sino-American trade not affected even by rich IP theft woes ever save now that there is a president with radical Chinese rhetoric. Given the pressure from the US, China needs to diversify its trade portfolio; hence, technology spillover and replication by Saudis following its exporting through the market channel may be tolerated.

By comparison, in the telecommunications sector, the non-market transfer method is the case involving the temporary migration of technology holders virtually who return to the home country once they are done establishing the telecommunication network. Technology departure may occur if there is no passage to Saudis in this case, or the technology may stand in the product of the cooperation. Still, for the exchange to be regarded as such, knowledge should be possible to replicate; hence, the transfer is valid if technological expertise is left despite the physical departure of Chinese telecommunications professionals. In the construction sector, the situation is much the same as the non-market channel of temporary labor migration was used to bring professionals who may have passed the railway-building expertise on to Saudi colleagues in the process. Another example of this way of technology transfer is presumed to be the case in the dispatch of Chinese healthcare providers to the KSA who boost the diagnostical capacity of local medical professionals while in the country.

The above-presented discussion has already laid evident some of the utility of technology transfer, including an increase in the merchandise offerings of China that can add value to oil via Saudi refinery technologies and sell the respective products at a profit. China is a market opportunist that sees an opportunity to meet demand, such as that in Saudi Arabia that needs its weapons high-tech. That the weapons are refined alone can contribute to the deterrent utility of the acquisition, apart from its physical presence, since the perception of its

quality that arises from an understanding of its technology exquisiteness associated with China will be keeping neighbors from any hostile maneuvers for fear of efficient and destructive military backlash. China also masterfully monetizes a specific market juncture. As a producer, it deems it appropriate to fill the KSA with remotely piloted aircraft that can carry a load, which may be nuclear. Put otherwise, exported is a dual-use technology that, although applied in civilian delivery, can be put to good use in the military sector where its potential can be actualized. The People's Republic makes up for a share of at least 7% lost in the decade after 9/11, which was almost a third of the American share. Thus open fluctuating market junctures technology exchange opportunities. The market, in turn, is influenced by exogenous developments, such as the terrorist attack, and the nature of each development, whether materialized or potential, may determine what technological field presents an opportunity for exchange and monetary gains that most often come with it.

China is sometimes not as much about securing monetary gains as using the transfer for geopolitical goals and maneuvers, since the construction of the up-to-date railway system in the KSA, for example, can foster respect towards China as the country contracted to complete the project will be associated with comfort and other benefits that come with railway; hence, the country may evoke nothing but positive emotions in Saudis from now on, which may be soft power at work. Hence, China may expect the kingdom to support it when once it finds itself embroiled in a diplomatic conflict. Another important thing with geopolitical implications that the transfer does is divert the attention of Washington, which seems crucial, seeing as how serious a threat China is in their rankings. Supplying Saudi Arabia can keep US allies like Israel tensed and render the situation in the Middle East very mercurial and even combustible, which will reduce the focus of the US on Asia and allow China to locally exert its influence undeterred to a greater extent. Still, it may be that not all that looks income-oriented is such. Some of these benefits like the railway construction may have a collateral value, such as economic, without China potentially seeking soft power use. It may aim at boosting connectivity in Saudi Arabia through the infrastructural improvement, which can allow moving Chinese goods faster and otherwise helping tradable goods' circulation, while its positive perception over its key role in beneficial railway construction can increase the receptivity of Saudis to Chinese commodities and enhance merchandise demand, the consumption rate, and the flow of goods.

Conclusion

From want of details and reports in some cases, categorizing the examples cited as a specific technology transfer type becomes challenging at times, which has required some presumption-centered classification based on the details available. Even so, many important findings have been presented, including category-wise. While the non-market way of exchange that largely comes in the form of temporary labor migration is often used, at other times, the transfer goes through market channels via formats that match direct exporting, FDI, and international joint ventures in terms of their essence/form. Whatever the channel, technology transfer is a dialogue in the case of Saudi Arabia and China in the sense that there is a bilateral movement of knowledge, including in the oil, military, space, telecommunications, construction, and medical sectors. How bipartite the dialogue/exchange is depends on technologies available determined by the local needs and resources of countries that stimulate the research and development of such technologies. Thus, for example, the abundance of oil is the reason for Saudis to have come designing refinery improvement options, which eventually led to technology creation that was refined enough to stir up an interest in China that sees fit to add value to imported oil via the technology.

In any case, another important takeaway is that many instances of technology exchange occur at the product level, and they may not lead to technology digestion by a product recipient or the country that does not own the technology. The spillover outcome enabling technology replication, although possible, may occur, albeit when the product allows inspection offering insight into the production process and composition of technology-based commodities. Such spillover is likely undesigned by a technology holder, and it may resemble theft. Even if it does, the quality of the interstate trade and technology dialogue is unlikely to suffer, which, however, depends on the juncture and factors shaping it, such as the trade war and the need for China to diversify its trade partners, which can facilitate the tolerant perception of technology imitation by Saudis if it does have place. China may be too interested in the cooperation, which may involve the transfer, to stop short of interacting with the KSA in various technological sectors. Hence, it is understandable why China appears a greater source of technologies based on the cases analyzed, since telecommunications, railway construction, medical technologies, and even military products and technologies are China’s. Where the exchange is equal is only in the space sector, and oil seems to be the only sector identified that demonstrates the expert dominance of Saudis, which cannot help but show the greater trade and geopolitical ambitions of China that seem to be driving a great

monetary input in research and development, which ironically seems facilitated by technology-assisted trade and soft power (geopolitical) gains. Either that or the sample of cases is not fully representative in part over the classified nature of cooperation deals as 35 agreements signed at a joint investment forum alone do not indicate who stands to gain and if the exchange has place. If made public, the nature of deals could potentially establish some parity, that is, equalize the interstate transfer that is tilted in favor of China thus far.

Likely, technology exchange does not occur unless beneficial to the parties involved as it provides trade-based income opportunities, sources defense-boosting knowledge that enhances the respective state's capability, and improves the image of countries, among other things. The technological exchange most often has economic underpinnings except when it is aid-oriented, as is the case with the coronavirus-related transfer when specialists come to the KSA, yet China may not be fully altruistic as this help can allow containing the pandemic where its consumer market lies, which expedites the resumption of trade in its usual volume, to say nothing of further experience for the Chinese medical professionals. Still, there are geopolitical elements to technology transfer as the railway project can boost the image of China in the kingdom that is likely to side with the PRC whenever relevant. Still, even influence expansion can have economic dividends as well, since the improvement of China's perception can make for an upswing in demand for the Chinese merchandise.

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