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The Rising Tide of Technology Denial against China

Abstract

China's bid for technological advancement proceeds with unprecedented vigour. Procuring technological know-how from foreign sources, often in violation of global norms pertaining to the protection of intellectual property (IP), has been a prominent component of China's tech strategy. Therefore, many of the world's repositories of technology now feel compelled to introduce a strategy of technology denial in their relations with China. This essay gauges the degree of disaffection that has surfaced across the developed world towards China's various methods of technology acquisition and provides an overview of the emerging technology denial strategies. It is observed that there is substantial heterogeneity in the developed world's response, with convergence against certain Chinese practices and ambivalence in the case of others. The essay explains this heterogeneity by observing both systemic and unit-level factors.

Keywords: *technology denial, China, investment screening, export controls, espionage, JV requirement*

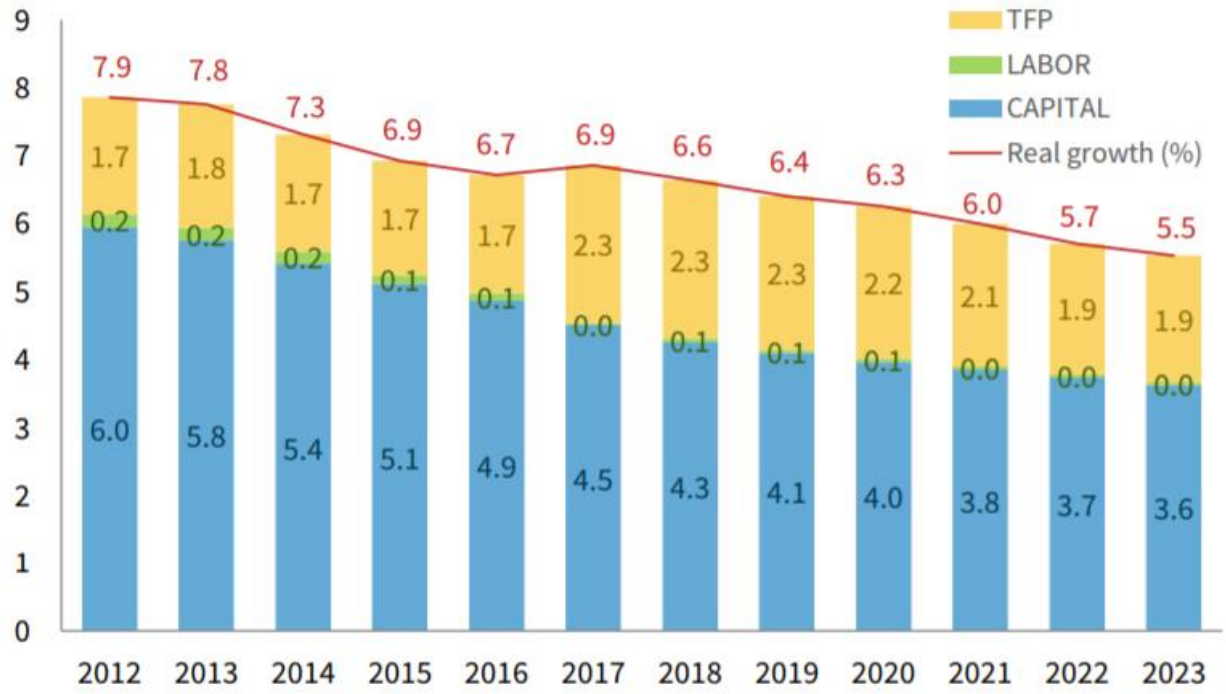
China's bid for technological advancement proceeds with unprecedented vigour. Its leaders and policymakers recognise that averting a protracted growth slowdown in the long run is incumbent on developing competencies in high value added economic activity, of which technology is a prominent component. Furthermore, emerging as a world leader in advanced technologies is inextricably linked to China's sense of national pride (Feigenbaum 2017), giving the endeavour an additional thymotic motivation. China's sense of urgency vis-a-vis technological development, since the turn of the millennium, has manifested in a strategy that relies extensively on state-driven industrial policy to bypass market exigencies and expedite the transition to high value added activities (Wubekke et al. 2016). Procuring technological know-how from foreign sources, often in violation of global norms pertaining to the protection of intellectual property (IP), has been a prominent component of this strategy. Moreover, much to the consternation of the world's developed economies, China's attitude towards IP and technology transfer did not sufficiently adjust, even as per capita income levels rose and the economy emerged as the world's second largest. As such, many of the world's repositories of technology now feel compelled to introduce an element of technology denial in their relations with China.

This essay gauges the degree of convergence that has taken place in the developed world against China's varied methods of technology acquisition, provides an overview of the emerging technology denial strategies and attempts to explain divergences where they exist. It is found that there is substantial heterogeneity in the developed world's response, with convergence against certain Chinese practices and divergence in the case of others. These are found to accrue from a number of domestically relevant factors such as institutional antecedents and the intensity of economic relations with China as well as those pertaining to the system of international politics.

China's Appetite for Foreign Technologies

China is at a stage in its economic development where it must seek new sources of surplus accumulation to maintain high growth. The productive forces unleashed by China during its reform era have entered a state of diminishing returns. Moreover, according to economist George Magnus, 'many of the things China did in the past to overcome obstacles could only be done once'[1] (Magnus 2018). Composite data of China's GDP growth in recent years are depicted in Figure 1 and illustrate how capital and labour accumulation contribute increasingly less to the Chinese economy. When an economy reaches this stage in its development – as middle income economies tend to – maintaining growth necessitates boosting total factor productivity (TFP), or innovation in the economy. According to a 2015 McKinsey report, China must generate two to three percentage points of annual GDP growth in TFP to consistently achieve its growth targets. Technological advancement plays an integral role in the generation of TFP and is therefore a salient policy objective in China.

Figure 1: Growth Accounting Assumptions for China's GDP Growth, 2012-2023



Source: International Monetary Fund as quoted in Wright and Rosen (2018)

Innovation and technological advancement in an economy are facilitated with the help of two main drivers, namely a demand-pull and technology-push (Vivarelli 2014; Dosi 1982). The former relies largely upon the composition of market demand for technological commodities, and receives impetus from factors that lie

[1] Magnus refers to things like joining the WTO, boosting labour participation, urban consolidation and boosting secondary enrollment (p. 11).

exogenous to the innovators themselves. 'Demand-pull' innovation, therefore, generally faces greater limitations in the short-run and is more incremental in nature. In contrast, a technology push constitutes an attempt to bypass the constraints attendant with market determination. China's endeavours belong largely to the latter category, and have involved not only extensive expenditure in Research and Development (R&D) and subsidies to technology firms, but also a concerted effort to absorb technological know-how from foreign sources. Absorption of foreign technology is considered a catalyst whereby domestic innovation and advancement in technology can be expedited.

Numerous policy documents coming out of China in the last two decades have categorically encouraged the acquisition of foreign technology as a nifty method of accelerating technological advancement beyond naturally achievable rates. As early as 2006, the cumbersomely titled 'National Medium- and Long-Term Program for Science and Technology Development (2006-2020)' (MLP) called for a strategy of Introducing, Digesting, Absorbing and Re-innovating (IDAR) foreign technology and IP with a view to achieve 'indigenous innovation' (United States Trade Representative 2018). The mechanisms whereby IDAR can be conducted were subsequently fleshed out in a document entitled 'Opinions on Encouraging Technology Introduction and Innovation and Promoting the Transformation of the Growth Mode in Foreign Trade,' and include the following main methods: equity investments in foreign tech firms, technology transfer requirements for inward Foreign Direct Investment and establishing foreign R&D centres, espionage, importing foreign technology and human capital exchanges (Cheung 2014). Figure 2 illustrates China's tech acquisition methods as detailed by the US Department of Justice.

China's appetite for technology only intensified with Chinese President Xi Jinping's ascension to power in 2012, as he was faced with an economy witnessing significant productivity losses. Additionally, and importantly, the technonationalistic drive in China's innovation ambitions has visibly gained momentum under Xi. For instance, Chinese media and officials have recently likened its strides in high-speed rail, mobile payment, bike sharing, and e-commerce to the 'four great inventions' (papermaking, gunpowder, printing and the compass) China pioneered in historical times (Jakhar 2018). Given this, the Made in China 2025 plan (MIC 2025), although it departs from the MLP with a broader manufacturing focus and lesser emphasis on 'indigenous innovation' (Kennedy 2015) would not jettison the IDAR approach for accelerated progress in the high-tech domain. According to a widely cited report generated by the Mercator Institute for China Studies (MERICS), while the Chinese ultimately hope to shed dependence on foreign technologies, the MIC 2025 plan nevertheless encourages acquisitions of foreign technology in cutting-edge fields such as robots, robot core components, semiconductors and high-end machine tools, where China's competencies lag behind considerably (Wubekke et al. 2016).

Figure 2: China's Tech Acquisition Methods

Source: Department of Justice (2018)

As such, the impulse to facilitate IDAR is far from being depleted, realising which, the world's developed economies are embracing the need to mount a more deliberate strategy of technology denial against China. In the following sections, the paper will evaluate the developed economies' threat perceptions vis-a-vis Chinese tech-acquisition, as well as their strategies to counter them, highlighting the fact that disaffection towards China's conduct in the domains of IP and technology transfer is of varying severity in different parts of the developed world and it also varies across China's absorption methods. This will be illustrated by analysing the sentiment in select parts of the developed world as they pertain to the aforementioned methods of IDAR employed by China to expedite technological advancement. The analysis emphasises how the extent of grievance in a particular country is conditioned, not only by a security dilemma, but also by domestic conditions and attitudes concerning the regulatory role of the state, market freedom as well as economic interdependence with China. These are operationalised by observing internal legislative debates, the present state of relevant institutions and reporting on the subject of China's tech acquisition.

Tech-seeking Investment

Most of the action taken to deny China access to technology has arguably taken place in the domain of inward, tech seeking investments. Following the

announcement of MIC 2025 in 2015, Chinese tech-seeking investments surged in the US and Europe, marking a watershed moment in their threat perceptions towards the Chinese innovation drive. As per an exhaustive database generated by the Heritage Foundation, Chinese investments in American tech firms tripled in the year following the announcement, reaching a peak of USD 10.7 billion in 2016. Likewise, Chinese investments in Europe were also directed at the tech sector in a larger manner than before (Hanemann and Huotari 2017) – in tech-rich Germany, investments rose ten-fold in that single year and included high-profile acquisitions of robotics manufacturer, Kuka AG and automobile giant Daimler AG (*Bloomberg* 2018a). In France, while China ranked 35th among foreign investors in 2010, the tech-acquisition drive of 2016 propelled it to the 12th rank (Seaman et al. 2017). Chinese capital inflows to tech firms have also taken place to lesser, but significant, degrees in France, the UK, Canada, Australia and Israel (Klein 2018). While it is generally conceded that ascertaining whether a particular transaction is informed by the Chinese state's IDAR approach is a difficult task, the Trump administration has taken an especially risk averse attitude towards Chinese investments.

It has been noted for instance, that tech-seeking investments were afforded far more attention than other acquisition methods in the 2018 report prepared by the office of the USTR under section 301 of the USA's Trade Act (Roach 2018). Subsequently, the US Congress swiftly passed the Foreign Investment Risk Review Modernization Act (FIRRMA) in a bid to strengthen the Committee on Foreign Investment in the United States (CFIUS), the executive body responsible for screening inward investments for national security risks. The move specifically targets China by mandating periodic reporting of its investment activity, and bringing joint ventures under the CFIUS purview, plugging what has been considered a major loophole China has exploited (Cornyn 2017). The strengthening enjoyed bipartisan support in the US Congress – to illustrate, lobbying groups including top firms like IBM and Siemens, failed, despite efforts to get the JV element of the bill jettisoned (Mohsin and Brody 2018; Bartz 2018).

FIRRMA also calls upon CFIUS to harmonise its procedures and priorities with investment screening mechanisms of advanced European economies. It is certainly poised to do so, as concerns regarding Chinese investments have surfaced in the European 'Big 3' economies. However, the sense of resolve, the institutional antecedents for investment screening and the preferred mode of defence, discernibly vary among the three.

To be sure, the leaders of Germany, France and the UK were rankled by the sudden upsurge in Chinese acquisitions of crown jewels in the exuberance that followed the announcement of MIC 2025 (Jennen and Buregin 2018), and promptly took steps to tighten investment regulations[2]. Germany and the UK, however, have

[2] In December, 2018, German legislators lowered the threshold for investments that were eligible for review (Hansen and Nienaber 2018). In the UK, the Conservative Party promised the establishment of investment screening in its 2017 election manifesto. Subsequent reforms to the investment screening regime have taken cues from the American CFIUS (Cleary Gottlieb 2018), and, while it is uncertain when they will come into effect, the UK government is expected to thoroughly review up to a 100 deals per year, a dramatic increase

done so from a fairly low base. Germany, lacking a sufficiently robust institutional framework to block China's tech-seeking investments, was forced to rely on its central bank and cabinet to do so in 2018 (Beninca et al. 2018; *Reuters* 2018a; Delfs 2018). Germany's inertia with respect to investment screening has also been attributed to internal rifts pertaining to Berlin's China policy, with advocates of open capital markets mounting a formidable opposition to protectionist moves (Stanzel 2017). The UK, similarly, has 'conventionally occupied the far-liberal wing' and considers the economic opportunity costs of state interference too high (Adams and Gratowski 2017). Britain's permissive attitude has meant that investment in Informations and Communications Technology (ICT), a proxy for tech-seeking investments, accounted for 22.5 per cent of total Chinese investments in the UK during the 2000-2016 period – a sizeable chunk (Seaman et al. 2017). As such, despite tending towards denial, strictures in the UK and Germany are unlikely to reach the levels witnessed in the US.

France, meanwhile, has a more robust review mechanism, conducted by the French Minister of Economy, to contend with national security considerations. In the case of France, however, the sense of grievance is not singularly attributable to China's tech-seeking investments – it serves to bear in mind that the 2014 iteration of national security review strengthening was inspired not by China, but by General Electric's acquisition of a national champion. France's approach towards restricting Chinese tech-seeking investments is known to be fairly cautious (Le Corre 2018) and has revolved more around mobilising support for investment screening through the European Union (EU). In this endeavour, despite opposition from free market adherents and those financially dependent on China, notable progress has, indeed, been made. Spearheaded by France and Germany, the EU Parliament, following negotiations with the EU Commission and the EU Council, agreed on proposed screening measures in February 2019, and the EU-wide mechanism is expected to come into effect in March 2019 (Venit and Berneman 2019). Under the new regulations, the EU Commission will perform reviews of transactions based on a template that bears resemblance to the FIRRMA stipulations. The legislation states that members must give the Commission's suggestions 'due consideration' and provide justifications when they are ignored. Moreover, the 14 EU countries that currently do not have investment screening mechanisms will be required to put them in place. As such, while the process is not free from weaknesses, a convergence with the US regarding Chinese investments is certainly underway in the European Union.

The same can be said for the case of Israel, whose leaders have been persuaded by the Americans to prioritise the development of a national security review, despite receiving a relatively small amount of Chinese FDI. The Israeli endeavour to strengthen screening suffers from the same lacuna observed in the UK and Germany, however, in that its policymakers are now charged with building a review mechanism from the ground up – according to a former Israeli National

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given that hardly any transactions currently invite scrutiny (Potter 2018). In December, 2018, the French Parliament passed a bill that will enable authorities to hone in on investments in 'sectors of the future,' in a move bearing some parallels to the CFIUS strengthening (Nauges and Roudergues 2018).

Security Adviser, 'investment in major civilian infrastructure (has not been) viewed as a national security concern or even a diplomatic issue' (Nagel 2018). This means that specifics will need to be negotiated with opposing interest groups and it will be a while before the Israeli mechanism can approach the regulatory stringency observed in the US. Japan has strengthened screening procedures as well, citing leaks to China, although the particulars of the move are closely guarded and not publicly disclosed (*Nikkei Asian Review* 2017), precluding a closer analysis of the factors behind it.

Canada and Australia, both technologically advanced countries, appear to be on another track altogether vis-a-vis their engagement with Chinese tech-seeking investments. Chinese investments in Canada are relatively meagre and have been concentrated largely in the mining and energy sectors (McMaster 2014). Moreover, unlike the USA and European countries, Canada has always boasted an unusually robust investment screening mechanism. It is one of the few countries that conduct 'net-benefit' tests for inward investments, a method that is known to give the Canadian government far-reaching and arbitrary authority over transactions on overtly political bases (often involving employment and labour-related matters). The sentiment in Canada, therefore, overwhelmingly leans towards jettisoning the net-benefit test and liberalising the investment screening system (Safarian 2015; Gordon 2012; *The Globe and Mail* 2018).

Consequently, technology denial through investment screening is hardly a priority for the incumbent Liberal government in Ottawa. Quite to the contrary, the Canadian government has opened its doors to Chinese tech-seeking investors, allowing a number of investments to pass without review and even going so far as to reverse some objections made by the previous Conservative government (Rodal et al. 2019; RCI 2018). Canada's goal to diversify inward investment flows away from the resources industry to promote its fintech and advanced manufacturing sectors, combined with a bid to reduce dependence on inflows from the US are also factors (Ye 2018). As such, Canada is poised to become a coveted destination for Chinese tech-seeking investment in the years to come. Canadian tech companies are known to possess lower valuations than American ones making them better buys for Chinese investors, particularly in the domain of Artificial Intelligence (AI) (Lee 2018). The US and Europe are, thus, unlikely to find much success in co-opting Canada in restricting Chinese tech-seeking investments, although the US has enough leverage to lean in and police certain deals. Interestingly, the same can be said for Australia, despite its souring ties with China in recent years.

Like Canada, Australia too, possesses opaque investment screening legislation, giving the government significant discretionary authority to review investments based on a loose notion of national security (Kirchner and Mondschein 2018). While sentiment against Chinese investments is reported to have reached palpable heights in Australia, this has been limited to purchases of electricity grids and agricultural land, which allegedly enabled Chinese interference in Australian politics (*The Straits Times* 2018). With respect to technology-intensive sectors, Australia appears less wary. In a speech delivered in October 2018, Australia's Secretary to the Treasury noted that Chinese investments in technological sectors such as renewable energies, biotech and the medical sector had reliably delivered

growth and productivity increments (Gaetjens 2018). Reflecting the corporate sentiment in Australia, the Head of Asia and International Markets for KPMG Australia indicated that China's need to invest in technologies would prove 'positive for Australia' (*KPMG* 2018). Investments in Australia, much like Canada, tend to be concentrated in the resources sector, making it likely that the Australian government will welcome a diversification in inward investments to reduce capital costs for priority sectors such as tech. As such, it is highly suspect whether souring ties will make itself felt in the tech-sector.

It is evident from the above discussion that the USA's regulatory stringency with respect to tech seeking investments is a function of its newfound competitive posture vis-a-vis China as well as the institutional antecedent in the form of CFIUS – something which the rest of the developed world largely lacks. Varying economic and geopolitical opportunity costs of investment screening are salient in explaining why divergence between the US, Europe, Israel, Canada and Australia is observed in multiple gradations of disaffection against China's tech seeking investments.

Market for Technology – Joint Venture Requirements and R&D Centres

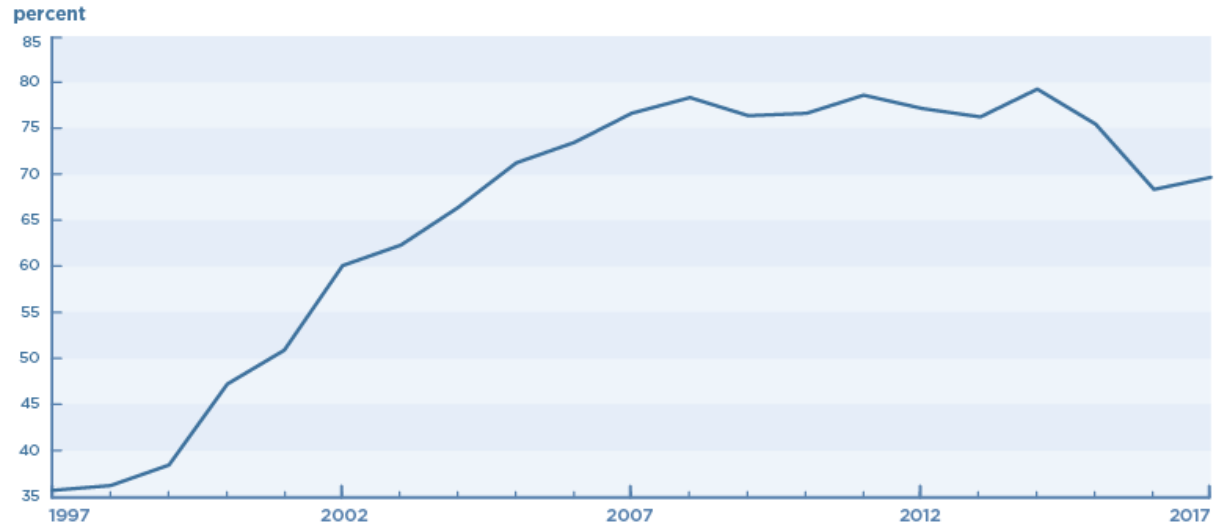
China also incentivises foreign firms to transfer technology to local entities by offering access to its markets in return. Joint Ventures (JV) requirements, wherein foreign companies can only supply to the Chinese market if they transfer technology to a local firm, have received a great deal of attention in developed economies. While outright coercion is not generally part of the playbook, it is effectively ensured that being competitive in the Chinese market is rendered incumbent on entering into a JV with a local firm and transferring technology (USTR 2018). China's economy has benefited tangibly from this modus operandi – according to a study, Chinese firms in an International Joint Venture (IJV) are, on average, more productive than non-IJV firms and also produce more patents (Jiang et al. 2018). The same study also documents that the absorption of technological dividends is highest if the IJV is done with an American firm. Similarly, another study finds that China has gained five per cent in domestic consumption from these policies (Holmes, McGrattan and Prescott 2015). On the production side, China's success in high-speed rail and new energy vehicles is documented to have been facilitated through forced technology transfer (FTT) (Prud'homme and von Zedtwitz 2018).

Market access is also used to urge foreign companies to set up R&D centres in China. According to a study, it is estimated that 54 per cent of the foreign-invested R&D centres set up were drawn in by the promise of access to Chinese markets (Jolly, McKern and Yip 2015). In an investigation conducted by the Information Technology and Innovation Foundation, an American CEO of a telecommunications company reported that his company was only allowed to sell to Chinese telecom companies on the condition that it would set up an R&D centre in the mainland (USTR 2018).

To be sure, while China's regulatory environment has become more amenable to wholly foreign-owned enterprises in the past two decades (Jiang et al. 2018; Lardy 2018), the data suggests that JVs have made somewhat of a resurgence in recent

years (see Figure 3). According to calculations of the Rhodium Group, USD 165 billion of equity out of a total USD 430 billion of American enterprises in China is held by local Chinese firms (Rosen 2018). Similarly, foreign multinational companies (MNCs) were expected to have set up 1800 R&D centres in China by 2018 according to projections (Yip 2017), undoubtedly aided by concessions from the state.

Figure 3: Share of inward FDI in wholly foreign-owned enterprises (1997-2017)



Source: Lardy (2018)

The sense that FTT contributes to an erosion of competitiveness is particularly acute in the US. The 2018 USTR report gives expression to the USA's frustration with China's conduct in this regard by revealing that it has promised to abandon the practice on at least eight occasions since 2010, and states that the office considers China's denial of forced transfers 'unsupported by the evidence and unconvincing' (USTR 2018). In fact, in order to contend with such transfer, initial drafts of the FIRRMA bill had even conceived allowing CFIUS to review all outbound investments, although industry lobbying succeeded in getting the provision dropped[3] (*Gibson Dunn* 2018).

The sentiment is largely shared by other developed economies. Unlike the case of inward investments, the proposition that China's FTT are a threat to competitiveness is more readily accepted in the developed world. Official assessments made by the EU report that technology transfer to China was a major concern among firms and even prescribe them a list of precautions, while urging China to abandon its policy (*European Commission* 2013; *European Parliament* 2011; *European Communities* 2008). The EU was especially jolted by the acquisition of British semiconductor company, ARM's Chinese JV by local investors, and challenged the transaction at the WTO (Dahad 2018). In November, 2018, the EU Chamber of Commerce in China lamented in a press release that despite

[3] It was thereafter decided to tackle the issue of tech companies handing over technology for market access through a strengthening of the export control regime.

promises, not much had materialised in terms of reductions in market access strictures (*European Chamber* 2018).

In 2018, the French and German ambassadors to China urged it to abolish JV requirements in an article published by the Caixin magazine (*Caixin* 2018). The automotive enterprises of France and Germany, in particular, have bristled at China's strict JV requirements in the sector (Clover 2017) – 55 per cent of total German automotive FDI in China went towards JVs in which Chinese firms held majority stakes (Hanemann and Huotari 2018). Both Germany and France have been driven to call for greater reciprocity in the market access sphere (Rose 2018). Japan too, joined the US and EU in pressuring China to abandon FTT through the WTO in November, 2018 (Katz 2018). Moreover, in the cutting edge fields of aviation and semiconductors, China has reportedly leveraged the size of its markets to play off American and European players against one another, with the aim of facilitating technology transfer through JVs in the process (Ma 2018; Thomas 2019), creating another source of animus towards China. In the case of Canada, China's FTT are less of a concern, although the Canadian Security Intelligence Service took stock of the phenomenon in a 2018 report (*Canadian Security Intelligence Service* 2018).

The concerns surrounding China's JV requirements appear legitimate - Holmes, McGrattan and Prescott (2015) empirically estimate that advanced economies[4] lose about 0.4 per cent of consumption on account of tech transfer to China. Even so, the charge against JV requirements is being led largely by the US in the form of its ongoing tariff war with China. The US is resorting to protect its technology by compelling structural change in China through the imposition and threat of penalties. Few other methods currently appeal to the Americans - as mentioned above, charging CFIUS with blocking certain outbound investments was considered as courting executive overreach, and negotiations have repeatedly failed to influence conduct. Little illusion exists at this point that the bilateral trade balance is hardly at the core of tensions. Tariffs are, in fact, the USA's method of signalling a strong desire to see structural change in China's economic relations with the world. Importantly, however, this has enabled the rest of the world's developed economies to shoot from the USA's shoulders.

For instance, according to a senior EU trade official 'the U.S. should exploit the leverage from the tariffs war to bring China to the (WTO) table' (Katz 2018). In May 2018, the top trade officials of the EU and Japan joined the USA in a joint statement decrying JV requirements, around which time they also extended their support to the USA's WTO complaints against China's FTT (*Financial Times* 2018; Blenkinsop 2018).

Another notable effort of the US and its partners to threaten penalties on China has been to spearhead and support a slew of trade agreements involving developed and emerging economies that include stricter chapters on IP and State Owned Enterprises (SOEs), in what appears to be partially motivated to compel China to

[4] The authors include the US, Western Europe and Japan in this category.

choose between isolation or integration into the global economy. President Trump's withdrawal from the Trans Pacific Partnership (TPP) belies the fact that the agreement contains the 'most advanced and detailed' IP and SOE standards ever seen (Goodman 2018). Similar standards have been subsequently introduced in the USA's trade agreement with Canada and Mexico, as well as in the agreement between the EU and Japan - a reputed American policymaker has suggested that these moves are, in part, motivated to incentivise China to toughen up on IP and forced transfer (Dollar and Cutler 2019).

In conclusion, China is under palpable pressure to unlink market access from technology transfer with the developed world being fairly united in their opposition, even if there is no particular convergence in terms of action taken in the developed world. Any trade deal with the USA will be incumbent on China promising, and delivering upon, certain structural changes, of which FTT will undeniably be a key component. In this regard, the incumbent US administration enjoys rhetorical support from across party lines and international borders. Put alternatively, the buck has been successfully passed to the US. The developed world's divergent actions in this domain appear to be explained by this systemic impulse.

Espionage

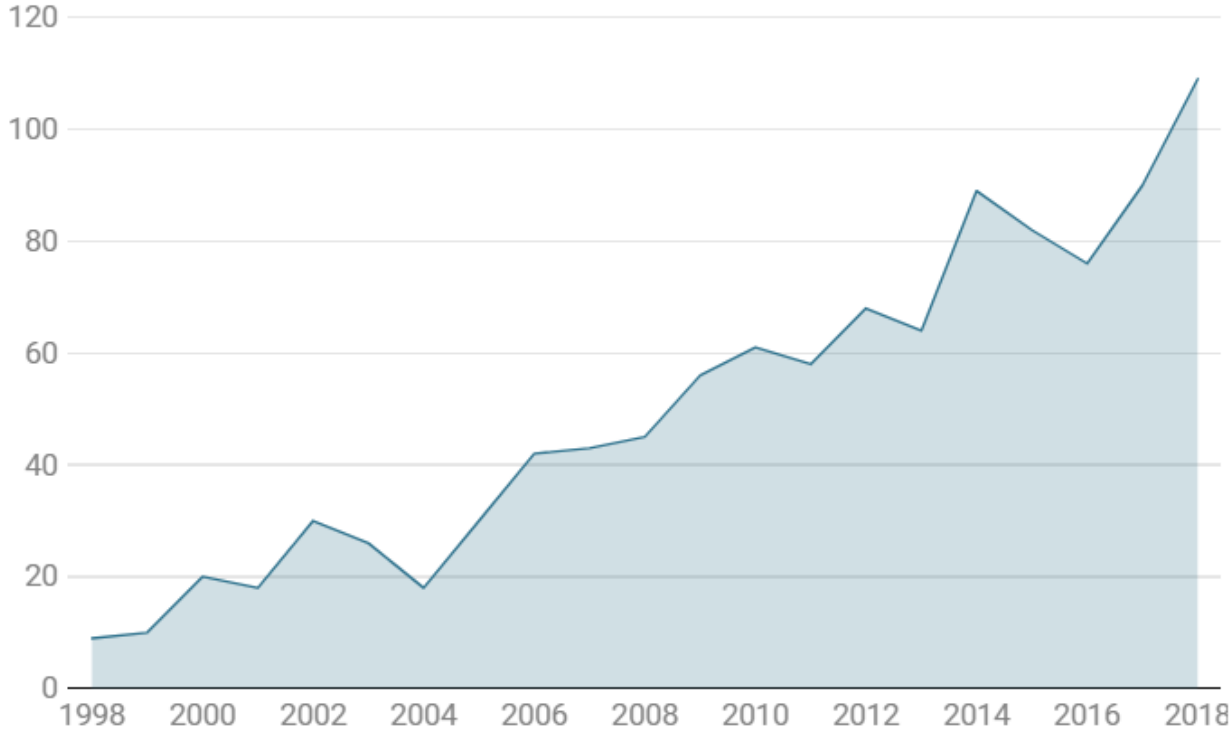
China's espionage includes a wide range of techniques, both in the physical and cyber domains and is targeted at commercial, military as well as dual-use technology. Western firms have been subject to Chinese cyber espionage techniques which are believed to have continued despite China having signed a number of agreements since 2015 to desist from hacking for commercial gain (Laskai and Segal 2018; *Reuters* 2017). In addition to these methods, China's tech-related espionage has included physical theft of trade secrets via company insiders and human intelligence operatives recruited primarily by China's People's Liberation Army (PLA) and Ministry of State Security (MSS) (*White House* 2018; *USCC* 2017). As such, China's espionage activities have been termed a 'whole of society' approach (Harrell 2018; Stock, Bott and Horn 2019).

Annual losses to the USA and Europe merely in the cyber domain have been estimated at USD 400 billion and EUR 60 billion respectively, with China playing an outsized role (NBR 2017; Cerulus 2018). In the last seven years, China has been linked to 90 per cent of all espionage activities in the USA (Geller 2018). Espionage, especially in the cyber form, is a cost efficient technique of acquiring technological know-how and, as such, China's intrusions have been made felt in a number of developed countries – according to the US China Economic and Security Review Commission (USCC) notable breaches have taken place in Taiwan, Finland, Australia, Norway and Japan (*USCC* 2017).

Economic espionage, being a criminal activity in all countries, is naturally of grave concern to the victims. Questions regarding opportunity costs of state intervention hardly apply to this issue. Still, much like with the other tech acquisition methods the USA's sense of grievance has worsened quite rapidly relative to others – according to the head of a reputed cyber intelligence firm, the Trump

administration is committed to holding China to a higher standard on espionage than the Obama administration (Porter 2018). Indictments for economic espionage in the US (of which, as mentioned above, China accounts for the largest proportion) have risen significantly since 2016, following a drop in the previous year when the US and China signed the non-binding agreement (see Figure 4). Notable cases include the indictment of spies accused of infiltrating a French aviation company and stealing American turbofan technology and that of two spies belonging to the notorious Advanced Persistent Threat 10 (APT10) group[5] (*FBI* 2018; *The Guardian* 2018). Additionally, it is being increasingly acknowledged in the US that in the absence of an extradition arrangement with China, indictments will not be sufficient to alter its behaviour (Lewis 2018; Goldsmith and Williams 2018). In testimony delivered to the USA's Senate Judiciary Committee, a senior member of a D.C. think tank recommended clamping down on espionage by deploying targeted sanctions on offenders and beneficiaries, tracking human intelligence operations, allowing victims of cyber espionage to 'hack back' and, of course, empowering the US Justice Department to handle more cases and deliver stricter penalties (Harrell 2018).

Figure 4: Economic Espionage Indictments in the US



Source: *NBC* 2018

[5] APT10, a hacking group known to be based in China, has reportedly targeted more than 45 organisations, stolen hundreds of gigabytes of sensitive information from high-tech firms in industries such as health care, biotechnology, finance, manufacturing, and oil and gas. The attackers targets included top organisations such as NASA and even the US Navy (*FBI* 2018).

The USA has had some success in co-opting allies in its vocal opposition to Chinese espionage. China has received condemnation from the Five Eyes alliance for abrogating the commitments it made in prior agreements to desist from commercial espionage, and the EU is considering a joint response to rein in Chinese hacking groups (*Bloomberg* 2019). Other allies including Germany, Japan, Sweden, Switzerland, Australia, New Zealand, Canada, Denmark, Sweden, and Finland, have followed suit (Barfield 2019). In Australia particularly, uneasiness with China's infiltration has breached tolerable thresholds.

In May, 2018, former Australian Security and Intelligence Organisation (ASIO) chief, Dennis Richardson, was handpicked to perform a broad review of the country's security and intelligence laws (*The Sydney Morning Herald* 2018a). Just a month after this, the Australian Parliament passed sweeping new espionage laws that add a new, albeit small, division on trade secrets theft to Australia's National Security Legislation[6] (*The Parliament of the Commonwealth of Australia* 2018a). Importantly, following reports that internet traffic destined for Australia from Europe and North America was unusually rerouted through China using Chinese-origin telecom equipment, there is reason to believe that economic espionage and tech theft will become a greater concern for the Australians (Demchak and Shavitt 2018; McKenzie, Grigg and Uhlmann 2018).

The Americans have also faced little difficulties in co-opting Taiwan in its endeavours. Taiwan's advanced semiconductor industry, which carries out parts of its manufacturing activity in China, has for long been subject to Chinese cyber-attacks as well as human infiltration (*Taiwan News* 2018; Wu 2018). Taiwan's response so far has involved mitigating the risk of espionage by shifting manufacturing units out of China – these include Lite-On Technology, a Taiwanese consumer electronics manufacturer; Quanta Computer; and a group of seven companies that are suppliers for Apple (Li 2019). Each of these was confronted with concerns from their American clients regarding risks of Chinese espionage. Taiwan's tech denial stance is also aided by the fact that it has cultivated best practices with respect to counterespionage such as tracking individuals with sensitive information, polygraph tests and staff buildups (Mattis 2014).

Despite a mounting front however, success in tackling Chinese espionage is not a foregone conclusion due to a number of reasons. Firstly, certain partners are arguably dragging their feet. Germany and France, both victims of China's espionage, have assessed the damage in reports but remain relatively quiet on the subject, choosing to address the issue through the EU mechanism much like in the case of inward investment. According to a BBC report, as late as December 2018, UK officials had expressed a need to maintain geopolitical distance from both the US and China, with the chief of the MI6 stating that 'Power, money and politics is going east, that's the political reality we need to adjust to' (Corera 2018).

[6] The bill inspired intense debate in Australia's policy circles. The proposed draft of the bill went through 60 revisions before it could be passed, and much of the contention had to do with what critics suggested was casting the authorities' net too wide by bringing economic issues under the purview of National Security Legislation (Power 2018; *The Parliament of the Commonwealth of Australia* 2018b).

Unanimity within the EU on espionage is also reportedly lacking, no doubt due to economic dependencies on China (*The Straits Times* 2019). Strong buck-passing tendencies appear to be operative in the case of opposing Chinese cyber espionage with American allies counting on it to bear much of the costs and risks. Hopes of addressing the issue of espionage through trade negotiations are waning, however, much to the chagrin of the developed world. In the case of Taiwan, despite a greater threat perception towards Chinese espionage, experiences domestic legislative inertia that constrains its ability to effectively conduct counterespionage - for instance, concerns regarding overreach prompted Taiwanese President Tsai Ing-Wen to veto an overhaul of security regulations in 2017 (Mattis 2017). Evidence also suggests that bolstering information sharing and cooperation between the USA and Taiwan is imperative to mounting a successful counterespionage front (NBR 2018; Mattis 2017).

Secondly, whether or not companies that are victims of Chinese espionage will sufficiently cooperate with their governments is uncertain. It is well known, for instance, that American corporations with investments in China have largely refused to back Washington in initiating proceedings in the WTO or enacting sanctions against China out of fear of retribution (Sullivan 2019).

Thirdly, the alleged hijacking of internet traffic mentioned above also illustrated that China could conduct economic espionage in ways that did not violate the terms of its 2015 agreements. It also highlights the fact that with Chinese manufacturers increasingly winning contracts to build 5G telecom infrastructure for developed economies, more robust safeguards will be necessitated if espionage is to be reliably countered. The USA's diplomatic efforts to exclude Huawei from supplying telecom equipment to the developed world have been met with limited success. As such, it is highly uncertain at this point whether espionage as an avenue of tech absorption will be closed off to China in the way that other avenues have. In the case of espionage, both systemic buck passing tendencies as well as unit-level economic relations with China generate a divergence in the responses.

Reverse-engineering of High-Tech Imports

While today China is undeniably an innovation hub in its own right, it was regarded as an economy reliant on the imitation and reverse-engineering of imported foreign technology just a decade ago. A policy paper published by the Stockholm International Peace Research Institute (SIPRI) in 2015 comprehensively documents how China developed its military industrial base from the ground up through arms purchases from the West in the 1980s, and through purchases of dual-use items after the West imposed an arms embargo on China in the wake of the 1989 Tiananmen Square incident[7] (Brauner, Bromley and Duchatel 2015). Reverse-

[7] While concerns regarding human rights and the militarisation of the South and East China Seas prompted the USA and its European allies to impose strict restrictions on sales of complete weapons systems to China, the UK and France in particular continued to supply dual-use equipment, most of which eventually found use in the PLA.

engineering of high-tech imports have also been useful in the development of non-military technologies in China.

To be sure, most developed economies, on account of being principally committed to free market, simply will not allow the state to encroach on ordinary exporters of goods that embody advanced technologies. Therefore, technology denial in this case is limited to restrictions on exports that have discernible implications for national security and, as such, is carried out largely in the domain of military technology. Moreover, only in the US is the export control regime perceptibly in the process of strengthening – other developed economies are adhering to the status quo on export controls at this point. That the American strengthening of export controls is motivated by concerns regarding China's rise and competition in the tech domain, however, is difficult to deny.

In fact, it was through the FIRRMA bill – a piece of legislation written particularly due to China-related concerns – that the Export Administration Act of 1979 was replaced with the Export Control Reform Act (ECRA) of 2018. Moreover, the ECRA spawned directly out of the debates on CFIUS reform – instead of endowing CFIUS with the authority to review outbound investments and courting overreach, it was decided to regulate the export, re-export, or transfer of certain technologies. The new legislation includes an element that is specifically aimed at technology-denial vis-a-vis China. Under section 30 of FIRRMA, it calls for the identification new 'emerging and foundational technologies that are essential to the national security of the United States' and which could potentially be controlled from being transferred to China (*US Congress* 2018a). This will allow American authorities to tackle China's acquisition of a broader range of cutting-edge commercial and dual-use technologies that are currently in various stages of development. The stated objective is to identify technology sectors where export control regulation will achieve technology denial without hampering the development of American technologies. The Trump administration has already utilised these new executive powers to restrict the sale of high-tech inputs to Huawei, putting severe stress on the Chinese company.

Interestingly, the bill also contains the seed of a high-tech industrial policy[8]. The ECRA requires an interagency body to analyse funding requirements to maintain 'superior military capabilities, especially with respect to potential peer and near peer military or economic competitors' (*US Congress* 2018a) – read China. The bill also requires that the interagency body administering controls and CFIUS coordinate their activities to minimise leakages of technology to competitors.

While other developed economies are not currently in the process of strengthening export controls, the FIRRMA bill conveys the USA's desire to push for the inclusion of the to-be identified emerging and foundational technologies in the lists of multilateral export control regimes. It is too early to tell, however, whether the

[8] While convention suggests that the US is principally averse to broad industrial policy, more signs have become apparent since the passing of the ECRA. For example, in February 2019, the White House released a statement expressing a commitment to dominate 'industries of the future.'

USA will enjoy any success in this endeavour to co-opt allies. Only in Australia is a similar strengthening even being considered - in 2018, Australian lawmakers called for an independent review of its extant export control legislation, the report for which was only released in February 2019 (Vivienne 2018). While China's technology acquisition is definitely the inspiration for development - the Australian Strategic Policy Institute (ASPI) has been consistently advocating strengthening controls against it (Shoebridge 2018; Joske 2018) - it is yet to be seen what a final bill would look like and whether it would approach the USA's level of stringency.

To be sure, certain military technologies will continue to be available to the Chinese through cooperation with Russia, and to some extent the rest of Europe, as has been the case since 1989 – in March 2019, for instance Russian defence manufacturer Rostec entered an agreement with the Aviation Industry Corp of China to develop state of the art military helicopters, with the transfer of aviation technologies being a prominent aspect of the partnership (*Asia Times* 2019). However, insofar as the US is a pioneering force in emerging technologies such as AI and core inputs such as semiconductors, it is the expected deprivation from these technologies that constitutes a significant setback to China's tech ambitions. The USA's use of export controls to cut Huawei off of semiconductors and operating systems has already displayed how disruptive American hostility can be to China's tech sector on its own. That the remainder of the developed world has not quite followed suit, despite possessing Cold War-era export control architecture, is testimony to the instrumentality of systemic rivalry in generating divergence between the US and the rest in this domain.

Human Capital Exchanges and Linkages

China also utilises human capital exchanges, through students, talent programmes and research collaborations, as a conduit through which technology can be acquired. This particular effort, in fact, came before all others and was considered relatively innocuous. As early as 1988, under a strategy devised by the State Council, Chinese students were sent largely to the US and Australia to receive technical training, with the aim of ultimately facilitating technology transfer from the US in particular (Zweig and Rosen 2003). Then General Secretary of the Communist Party of China (CPC), Zhao Ziyang, had highlighted the utility of 'storing brain power overseas,' despite the detriment of a temporary brain drain (*The Economist* 2008). This proved to be a fairly prescient policy move. By 2017, around 1.5 million Chinese students had pursued education overseas with the technologically advanced US and EU remaining the most popular student destinations (*Ministry of Education of the PRC* 2018). More importantly, China is enjoying increasing success in absorbing these students back into the local workforce as wages in the country increase- while only one in 10 overseas students returned to China in 2000, by 2017 this figure had shot up to eight in 10 (Youyou 2018).

The contribution of returnees to China's technological capabilities has been visible – according to one study, 'among 65 returners interviewed in high-tech zones in Hangzhou, Guangzhou and Wuhan, nearly half had imported technology of which 71 per cent was state-of-the-art while another 23 per cent was new for China'

(Zweig and Rosen 2003). Even so, there is a notable wedge in Western economies' perceptions towards Chinese international students. Like in the methods of tech acquisition discussed in the previous sections, perceptions in the USA have ostensibly worsened significantly more than those of others. In June, 2018, the State Department shortened visa lengths for Chinese students studying aviation, robotics and advanced manufacturing, and the Trump administration is reportedly considering ramping up vetting procedures of Chinese international students, particularly in STEM fields (Zengerle and Spetalnick 2018; *The White House* 2017). While official statistics have not been released, Chinese students are increasingly raising complaints against severe delays in visa processing that are shrouded in opacity (*Caixin Global* 2019).

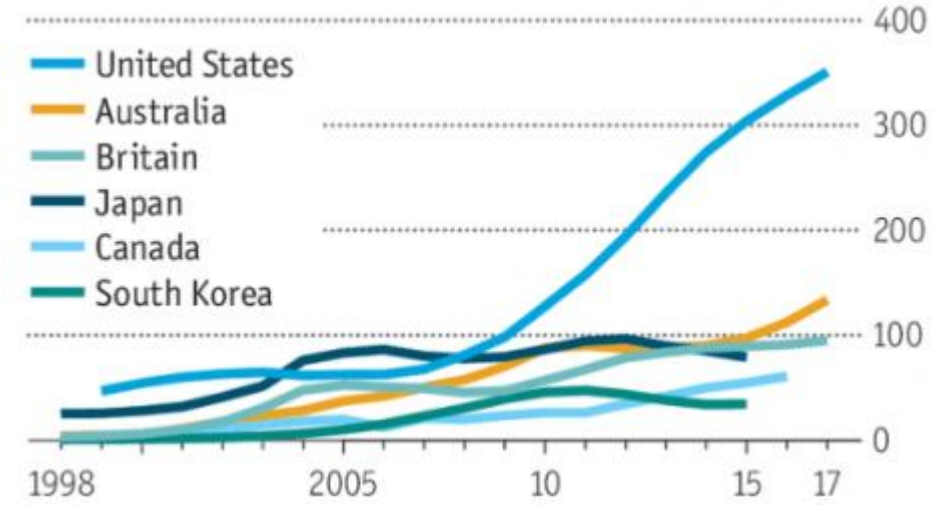
At this point, it is worth noting that while debates surrounding Chinese international students in the US are avowedly motivated by espionage concerns, the case of curtailing technology transfer through international students in STEM fields is qualitatively different from that of other types of espionage in the USA's technology denial strategy on account of the opportunity costs that such a move is bound to entail. Chinese international students in the US pay roughly USD 12 billion per year in tuitions according to the Department of Commerce (*The Economist* 2018), a sum which universities would not be able to generate from locals or other international students. A report by the Hoover Institution housed in Stanford University notes that Chinese students make significant contributions to American universities' research activities, and those that remain in the US make a 'sizable contribution to American society, to the US economy, and to technological innovation and the knowledge base in numerous fields' (*The Hoover Institution* 2018). On this account, the notion of restricting the intake of Chinese students - unlike other measures to tackle espionage - has come up against significant pushback from the policymaking community and universities (Cooper and Sachs 2018; Wu 2019). In an open letter entitled 'MIT's Relationship to China,' the university's Associate Provost declared that although it would comply with the US government wherever necessary, the sentiment among faculty and administration was that engaging with China was beneficial to the institution and will continue to be so (Lester 2018). Faculty of Harvard, Princeton, Yale and Stanford have followed suit in lobbying against strictures (Zengerle and Spetalnick 2018).

The tension in the USA between the state and sub-state actors with respect to Chinese STEM students is palpable. Among the rest of the world's technologically advanced economies, however, only in Australia has sentiment worsened similarly. Moreover, like in the cases detailed above, Australia's disaffection is motivated more by Chinese influence in the political process than by technology acquisition per se. These two countries, especially the USA, also receive a majority of Chinese international students as is depicted in Figure 5. In the year 2018, it was estimated that the USA and Australia accounted for 33.1 and 19.6 per cent of total Chinese students studying abroad – this arguably contributes to their sense of being targeted (Huang 2018).

In Europe, the UK receives the largest proportion of Chinese students studying abroad. However, perceptions towards Chinese students have not experienced the same downturn. To the contrary, the UK has made it easier for Chinese students to study there. In June 2018, the UK added China to their list of 'low risk' countries

for student visa applications, in an attempt to absorb Chinese students that are expected to be restricted from the US and Australia (Kendal 2018). Canada, the fourth most popular destination for Chinese students studying abroad, is heavily dependent on such students for university revenues – according to Moody's 'Chinese students make up nearly two-thirds of the international student body at the University of Toronto, more than one-third at the University of British Columbia and almost one-fourth at McGill University' (*Global News* 2019). Canada's disposition is to keep doors wide open. Therefore, the Trump administration is fairly isolated in its bid to stifle tech transfer through strict entry visa rules. Not only are there serious internal reservations regarding such a move within the USA, but American allies too are actively undermining its efforts.

Figure 5: Chinese Students Abroad



Source: *The Economist* (2018)

In addition to 'storing brain power overseas,' China's efforts also include attracting foreign talent to contribute to domestic tech ambitions. This is another method which the USA is alone in mounting opposition to. Through its 'Thousand Talents Plan', Chinese universities are provided with extra funding for the express purpose of using grants to attract foreign expertise, particularly in STEM fields, in a move that the US' National Intelligence Council (NIC) claims is an effort 'to facilitate the legal and illicit transfer of U.S. technology, intellectual property and know-how' (*Bloomberg* 2018b). It is estimated that roughly 6000 Western scientists and researchers have been awarded grants of at least USD 146,670 on conditions that they work in China (*Financial Times* 2019). Of these, 2,260 recruits – over a third of the total – are American experts, 44 per cent of which belong to medicine, life and health sciences; 22 per cent to advanced industrial technologies; 8 per cent to computer sciences; and 6 per cent to aviation/aerospace and astronomy (*Bloomberg* 2018b). A senior FBI official in December, 2018, labelled the programme as non-traditional espionage and recipients of the award have become subject to stricter visa procedures and suspicion, with the National Defense Authorization Act of 2018 specifically urging universities to maintain guard. Federal agencies including the National Science Foundation, National Institutes of Health, Department of Defense and Department of Energy are taking steps to screen research activity that could have ties to Chinese talent programmes

(Ambrose 2019). This has led Chinese authorities to drop mention of the plan in official statements and urge recipients to conceal the fact of their grant (Huang and Lo 2019).

Another aspect of China's human capital exchanges that has received remarkably little attention from authorities in developed economies is the PLA's research collaborations with Western universities. According to Joske (2018), during the period 2006-2017, PLA scientists, largely from China's National University of Defence Technology (NUDT), co-authored approximately 4,500 peer-reviewed publications primarily with universities in the US, the UK, Canada, Australia and Germany and to a lesser extent with those in Singapore, Sweden and the Netherlands. In the same report, the author also indicates that Western governments are acutely disconnected from universities and have been lax in compelling them to account for national security considerations in their research activities. In the US, the threat of revoking federal funding was, indeed, recently used to compel the Massachusetts Institute of Technology (MIT) to sever ties with Huawei and ZTE (*Reuters* 2019), and will likely be used further with respect to other national security concerns. Only in Australia does a similar imperative appear to be emerging with the ASIO chief urging Australian politicians to remain 'very conscious of the possibilities of foreign interference in our universities' (*South China Morning Post* 2017).

To be sure, human capital exchanges with China confer significantly large bounties on developed economies. It has been observed, for instance, that while America-based researchers lead the world in the field of AI, a sizeable chunk of these are actually of Chinese origin (Ma 2019). With a broad consensus prevailing regarding the gains from openness to Chinese researchers, it is highly unlikely that American allies will follow suit in bringing China's human capital exchanges under duress – the medium-term sustainability of such a mode of technology denial is highly debated even within the US.

Conclusion

While China's voracious acquisition of technology has definitely emerged as a concern for developed economies, there is a fair deal of heterogeneity in their responses to it and the degree of unity enjoyed in opposition varies further across the different methods China employs since the opportunity costs associated with blocking each method is varied.

With respect to China's tech-seeking investments for instance, while barriers are palpably rising, some states will play a countervailing role – this may be due to geopolitical and geoeconomic reasons such as in the case of Canada, Australia and some Eastern European states; lack of institutional wherewithal such as in the case of the UK, Germany, Israel; and free market orthodoxy such as in the case of Scandinavia. Similar discrepancies persist in the area of espionage where systemically induced buck passing tendencies appear to be operative. In the other aspects discussed in this paper, the USA is more isolated still. Only the USA has taken steps to strengthen its export control regime in order to curtail China's access to emerging technologies - among other developed economies only in

Australia is a similar strengthening even being advocated. Lastly, with respect to human capital exchanges, American allies, barring Australia, are discernibly undermining the USA's strictures by opening their doors to more Chinese students, researchers and talent programmes. While the USA's tariff impositions have ostensibly set in motion the abolition of the JV requirement, mounting an effective technology denial in other domains will require greater unity, something which is currently lacking.

A significant part of the USA's willingness to incur costs in its tech denial strategy against China is a function of its economic hegemony, and, as such, is not seamlessly replicable in other non-hegemonic developed economies. Unlike other technologically advanced economies, in the case of the US, China's progress in the tech domain threatens not only firm profits but also its technological leadership which has a more thymotic foundation. Additionally, the USA's economic hegemony allows for a relatively symmetric economic relation with China than other countries which are more dependent - this permits a more confrontational stance than would be palatable for others. Lastly, decades of economic hegemony, and the impulse of preservation attendant with it, means that America's domestic institutions have for long contained the seeds for such strategic competition; the case of CFIUS and export controls bears testimony to this. By contrast, corresponding institutions in the rest of the developed world are relatively fledgling and equipped for more defensive measures than for a concerted strategy of technology denial per se.

Moreover, it is imperative to note that a dominant strategy for most non-hegemonic, developed economies is to pass the buck to the US, while hedging to ensure gains are secured as China rises. Therefore, while China is certainly facing an increasingly challenging environment for external tech absorption, primarily on account of the USA's hostility, it is not likely to be confronted with a complete cut-off.

Even so, this hostility is prompting a recalibration in China's strategy for progress in this domain. China's leaders are aware that in relying on foreign technology as a catalyst for domestic advancement, its progress became subject to the tenor of policy outside of China, something which policymakers can hardly aspire to control. This sensitivity has long been a source of insecurity in China. Ultimately, therefore, a volatile environment for external absorption will only convince Chinese policymakers and leaders of the need to achieve self-reliance in the tech domain. One should expect a gradual shift in gears from a more externally dependent tech-drive to one based on local R&D, possibly in a scaling up of Huawei's model of development. China's success, or lack thereof, at making domestically-driven technological progress in time to ameliorate its multifarious macroeconomic woes will arguably be one of the most portentous developments of the 21st century.

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No: 29| Apr 2019	Materials related to Republican-era China in the National Archives of India	Madhavi Thampi
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