



## A Bio-Future for the US-South Korea Strategic Alliance

By Zeena Nisar

Technology is reshaping the security landscape of the 21st century. The nation that fully harnesses emerging technologies, such as artificial intelligence (AI) and biotechnology, will capture critical military, economic, and cultural advantages. China's national policies reveal an acute awareness of the importance of scientific and technological innovation in its pursuit of global competitive leadership. In the past decades, China has laid out national plans to harness emerging technologies, including biotechnology, as key enablers of industrial productivity, economic development, and geostrategic influence. These national plans include China's National Medium- to Long-Term Plan for Science and Technology Development (2006-2020), the 13th Five-Year Plan for Science and Technology Innovation (2016-2020), and the 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035 (2021-2025), all of which point to advanced technologies, including biotechnology, as a critical component for China's pursuit of global strategic leadership.<sup>1</sup>

The United States has similarly become attuned to the importance of establishing leadership in world-defining technologies. In its National Security Strategy released in 2022, the Joe Biden administration specifically outlined the importance of technological leadership in this century and that the “competition to develop and deploy foundational technologies that will transform our security and economy is intensifying.”<sup>2</sup> In a 2022 speech at the Special Competitive Studies Project Summit, National Security Advisor Jake Sullivan articulated the United States' new perception of technological leadership, one in which a “relative” advantage is no longer sufficient against (or vis-à-vis) rising competitors like China and in which the United States has to maintain “as large of a lead as possible.”<sup>3</sup>

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As strategic competition between the United States and China intensifies, like-minded allies and partners are aligning and deepening cooperation in critical new fora related to technology protection, economic statecraft, and supply chain security. With China ambitiously pursuing state-driven innovation in emerging technologies to secure its position as a global superpower and reshape global norms, the United States and its democratic allies and partners are finding themselves moving quickly and defensively in line to out-compete and out-maneuver China. Now, the United States seeks to realign, redefine, and strengthen its bilateral and multilateral relationships with like-minded partners in Europe and the Indo-Pacific region to pursue mutual aims in economic competitiveness and technology security. Efforts such as the US-EU Trade and Technology Council and the US-South Korea-India Trilateral Technology Dialogue in recent years highlight the growing importance and urgency of aligning international efforts to scale and secure emerging technologies amidst global disruptions, as well as a shared desire across many nations to promote domestic economic interests for more reliable and resilient technology supply chains.

The bilateral relationship between the United States and South Korea, or the Republic of Korea (ROK), has historically been characterized by a robust and long-standing military alliance. Against the backdrop of a rising China, the US-ROK alliance has responded by deepening cooperation beyond its traditional military scope to better encapsulate new security concerns tied to technology, supply chains, and economic vulnerabilities. What Presidents Biden and Yoon Suk-yeol call a “global comprehensive strategic alliance” between the United States and South Korea is a figurative moat to China’s technology-based threat to the global order, in which cooperation in emerging biotechnology will allow for this technology to develop within and reinforce a rules-based international order.

As an emerging technology sector, biotechnology is a critical component of this new global comprehensive strategic alliance. Emerging biotechnologies and biomanufacturing will provide strategic and economic advantages unseen before in this new century. Simply put, biotechnology is the manipulation of biological processes to develop certain products and technologies. Examples of biotechnology include bioengineered crops, medical vaccines, and even industrial materials such as bio-based cement.<sup>4</sup> As a foundational and emerging technology, biotechnologies can be deployed across sectors to improve the manufacturing of existing products, develop new medical therapies, generate more efficient and productive agricultural products, and much more. Biomanufacturing, a form of production that uses biological processes and biotechnologies to develop clinical and commercial products, holds immense

potential for onshoring critical supply chains for materials and medicines, a paramount issue within the US-China strategic competition. Moreover, these emerging capabilities to produce alternative and new products via biotechnology translate to strategic advantages on the battlefield, with recent innovations in shelf-stable blood and on-site drug manufacturing providing critical logistical agility for military operations.<sup>5</sup>

Biotechnology and biomanufacturing are intertwined with the larger priorities of the US-South Korea bilateral relationship, namely supply chain security and the securitization of technology development. For both nations, de-risking supply chains and maintaining technological leadership are critical in their approach to China's rise. Both the United States and South Korea have critical dependencies in China, and China has historically shown a willingness to leverage supply chain vulnerabilities to geopolitically retaliate and economically coerce other states.<sup>6</sup> With supply chain dependencies on China for active pharmaceutical ingredients and biomanufacturing, the United States and South Korea are urgently seeking to onshore these critical needs away from China. Moreover, as an emerging technology, biotechnology will contribute to economic, strategic, and military advantages that, if leveraged by China, threaten Indo-Pacific security.

This paper seeks to characterize the bilateral relationship with respect to biotechnology and outline the contours of possibility and pessimism for the future of the technology partnership between the United States and South Korea. First, the author outlines national, industry, and research commitments on biotechnology-related cooperation between the two countries and tracks the outcome of these commitments within the larger technology partnership. Then, the author outlines the opportunities and challenges that lie ahead for deepening US-South Korea cooperation in biotechnology and biomanufacturing. This paper will ultimately provide both policy and industry leaders with an understanding of the different facets of biotechnology and the different areas of cooperation within the US-ROK alliance.

### **US-ROK Commitments in Biotechnology**

Deepened commitments from political, military, research, and commercial leaders in biotechnology and biomanufacturing signal resilient and robust new ties between the United States and South Korea in this space. These commitments are often tied to broader, bilateral priorities for supply chain resiliency, technology innovation, and the securitization of technological development between the two countries. As China's state-driven policies seek

to obtain data, manufacturing, and know-how in this sector, the United States and South Korea have made commitments at all levels of society to leverage their respective leadership and strengths in biotechnology innovation to compete with China. Moreover, global disruptions to supply chains, such as the COVID-19 pandemic, have reaffirmed the urgent need for the United States and South Korea to strengthen international cooperation in order to generate resiliency in advanced technology supply chains.

At the national level, the United States and South Korea have publicly aligned policies to enhance alliance cooperation and leverage the respective strengths of both nations to maintain technological competitiveness against a rising China. Both nations possess strong innovation metrics with respect to research activity, human talent, investments, knowledge transfer, commercial innovation, and patent applications.<sup>7</sup> These strengths feature prominently in leader-level commitments between the United States and South Korea on technology cooperation and, more specifically, biotechnology. These bilateral commitments also overlap with the increasingly defensive nature of economic statecraft and technology protection controls implemented by both nations. Recent national and military commitments to deepen US-ROK alliance cooperation, specifically in biotechnology, are outlined below:

#### *May 22, 2022: US-ROK Leaders' Joint Statement*

On May 22, 2022, President Biden made his first state visit to South Korea since President Yoon's inauguration. During their first summit meeting, the two leaders highlighted a new shift in the traditional and long-standing alliance. The resulting joint statement began by reaffirming the deep security ties between the two nations, the US extended deterrence commitment to South Korea, and the shared goal for the complete denuclearization of the Korean Peninsula. The two leaders then outlined new parameters in the bilateral relationship in response to the evolving security landscape to include economic security and technology cooperation. This new forum of collaboration specifically outlined biotechnology and biomanufacturing, along with advanced semiconductors, quantum technology, AI, EV batteries, and autonomous robots, as critical and emerging technologies for enhanced public-private cooperation between the two nations. Presidents Biden and Yoon also highlighted resilient supply chains as foundational to these bilateral efforts in advancing critical technologies and affirmed deepened cooperation to address potential supply chain disruptions and prevent the adversarial use of these technologies in ways that undermine "national and economic security."<sup>8</sup>

*June 9, 2022: The US Department of Defense Deepens Collaboration with South Korea*

On the heels of President Biden's state visit to South Korea, the US Department of Defense identified five key technology areas for further cooperation and development with South Korea. These identified technologies included AI, communications technologies, quantum computing, biotechnology, and renewable energy generation and storage. These technologies are not only identified as critical for the defense partnership between the United States and South Korea but also serve bilateral efforts in fostering supply chain security.<sup>9</sup>

*December 13, 2022: The United States and South Korea Reaffirm Commitment to Deepen Economic Partnership at the Seventh Senior Economic Dialogue*

In December 2022, US Under Secretary of State for Economic Growth, Energy, and the Environment Jose Fernandez and ROK Second Vice Minister of Foreign Affairs Lee Dohoon convened the Seventh US-ROK Senior Economic Dialogue (SED). Under Secretary Fernandez and Vice Minister Lee reviewed the progress made after May 2022, underscoring the deepening economic and technology cooperation between the two countries. With regards to biotechnology, the United States and South Korea committed to strengthening cooperation in supply chain resiliency for health-related supplies, advancing health security efforts, including the Korea-US (KORUS) Global Vaccine Partnership, and enhancing bilateral collaboration on research and development (R&D) in critical and emerging technologies.<sup>10</sup>

*April 26, 2023: Leaders' Joint Statement in Commemoration of the 70th Anniversary of the US-ROK Alliance*

In April 2023, on the 70th anniversary of the US-ROK alliance, President Yoon met with President Biden in Washington, DC, for an official state visit. In the joint statement, the two presidents reaffirmed bilateral cooperation in economic security and critical and emerging technologies, including biotechnology, and established the Next Generation Critical and Emerging Technologies (CET) Dialogue.<sup>11</sup>

*December 8, 2023: The US-ROK Next Generation CET Dialogue*

In late 2023, US National Security Advisor Jake Sullivan and ROK National Security Advisor Cho Tae-yong convened for the inaugural US-ROK Next Generation CET Dialogue. Biotechnology was outlined as one of the six strategic technological areas most consequential to economic prosperity,

supply chain security, and the two countries' competitive advantages. As such, the United States and South Korea proposed new collaborations across industry, government, and academia. These collaborations included new bioeconomy research collaborations between the US National Science Foundation and the ROK Ministry of Science and ICT (MSIT), the launch of a track 1.5 dialogue in 2024 to accelerate bilateral R&D, identify active pharmaceutical ingredients, and build resilience in biopharmaceutical supply chains, and the expansion of ongoing collaboration between the US National Institutes of Health and the ROK Ministry of Health and Welfare to include talent exchange programs and research cooperation.<sup>12</sup>

The bilateral commitments in biotechnology are bolstered by other multilateral agreements with like-minded, democratic nations. Following the US-ROK Next Generational CET Dialogue in December 2023 and the US-India initiative on Critical and Emerging Technology (iCET) in January 2023, the United States, South Korea, and India convened a trilateral technology dialogue in Seoul in March 2024. The three nations reaffirmed commitments to deepen cooperation in critical technology sectors, align economic and national security interests in the development of these technologies, and build more resilient technology supply chains. In this trilateral dialogue, the three countries outlined opportunities for deepened cooperation in biotechnology and active pharmaceutical supply chains, along with other critical technology sectors such as semiconductors, telecommunications, and quantum technology.<sup>13</sup> Moreover, the August 2023 Camp David Summit between Biden, Yoon, and Japanese Prime Minister Kishida Fumio stressed the shared objectives in supply chain resiliency and technology security for critical and emerging technologies, including biotechnology.<sup>14</sup>

Beyond national-level commitments, US-South Korea cooperation in biotechnology is reinforced by commitments from industry and commercial stakeholders. In April 2023, on the sidelines of President Yoon's state visit, the Korea Biotechnology Industry Organization signed an MOU with the US Biotechnology Innovation Organization to strengthen ties in the bioeconomy, ranging from R&D cooperation to supply chain management. US and South Korean organizations represent approximately 12,000 and 6,000 firms, respectively, in the biotechnology industry.<sup>15</sup> The alignment of industry and commercial stakeholders in biotechnology signals that these bilateral commitments will be robust and resilient.

Moreover, the US and South Korean research and innovation ecosystems are deepening ties to align with the overarching national priorities of both governments. In May 2024, the ROK Ministry of Trade, Industry and Energy

(MOTIE) selected Johns Hopkins University to anchor a Global Industrial Technology Cooperation Center (GITCC), collaborating on R&D efforts in pharmaceuticals, medical devices, biomanufacturing, AI research in healthcare, and biomaterials.<sup>16</sup> This commitment deepens cooperation in biotechnology research and innovation between the United States and South Korea through growing ties in bilateral research collaborations and technology transfer.

The bilateral commitments are substantially bolstered by all levels of society, including political, research, industry, and military sectors. The holistic alignment of biotechnology innovation, development, and policy signals a robust future for bilateral cooperation in biotechnology.

### **Charting Progress in the US-ROK Strategic Alliance**

The strategic alliance has led to material progress in the integration and collaboration between the US and South Korean biotechnology ecosystems. In recent years, South Korean biotech entities have made significant inroads in the United States, with many establishing subsidiaries, headquarters, and investment funds in the United States.<sup>17</sup> The increase in bilateral research and innovation activity is in part due to ambitious South Korean initiatives to expand global R&D collaborations. In November 2023, MSIT released an R&D innovation plan for emerging technologies, increasing its budget for global R&D collaboration from KRW 500 billion in 2023 to KRW 1.8 trillion (approximately USD 1.3 billion) in 2024.<sup>18</sup> The South Korean government has also announced the expansion of the country's biotechnology R&D budget by 12 percent in 2024.<sup>19</sup> The United States has also taken measures to strengthen its leadership and outputs in biotechnology and biomanufacturing, most notably the 2022 Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy.<sup>20</sup> These unilateral and bilateral commitments have converged the two countries' biotechnology ecosystems.

In research, there has been an uptick in new collaboration between the United States and South Korea. As outlined earlier, MOTIE's establishment of a GITCC at Johns Hopkins University will foster bilateral R&D collaborations in pharmaceuticals, biomaterials, and biomanufacturing and further integrate the biotechnology ecosystems of the respective organizations. Moreover, this collaborative initiative has also drawn interest from the Korean private sector, given the strong demand for international research and technology transfer.<sup>21</sup> MSIT has also announced the establishment of the Boston-Korea Project to strengthen cooperation in biotechnology.<sup>22</sup>

Investment ties between the two countries have also grown in recent years. Overall, foreign direct investment (FDI) from South Korea to the United States has grown substantially over the past two decades, with FDI stock totaling USD 76.7 billion in 2023.<sup>23</sup> Moreover, in 2023, outbound South Korean capital to the United States reached a record high, more than any other country and usurping Taiwan as the largest investor in the US economy.<sup>24</sup> Although US FDI to South Korea has been trending upward to reach USD 35.6 billion in 2023, a 7.7 percent increase from 2022, it remains slightly below rates seen in recent years.<sup>25</sup> Nevertheless, for biotechnology specifically, two-way investment flows are supporting the integration of the US and South Korean innovation ecosystems by leveraging the respective strengths of the two nations in biotechnology and biomanufacturing.

South Korea has set national, strategic goals to become a “global vaccine hub,” and the United States is at the forefront of basic and clinical research in vaccine development.<sup>26</sup> It is, thus, unsurprising that this symbiotic space has seen an uptick in two-way investments. For example, South Korea-based SK Bioscience announced in 2024 that it would invest USD 2 million into US-based Sunflower Therapeutics to bolster SK Bioscience’s vaccine development and manufacturing capabilities with Sunflower Therapeutics’ yeast-based biomanufacturing technologies.<sup>27</sup> In addition, MOTIE has been reported to be in talks with US-based Thermo Fisher Scientific to outline potential US investments in production facilities in South Korea.<sup>28</sup> South Korean pharmaceutical firms have also increased efforts to expand their market presence in the United States through mergers and acquisitions of US firms.<sup>29</sup> In 2023, South Korea-based OSR Holdings, a healthcare holding company, merged with US-based Bellevue Life Sciences Acquisition Corporation with the aim of bringing the holding company onto the Nasdaq stock exchange.<sup>30</sup>

In venture capital, the connective tissue between the US and South Korean biotechnology innovation ecosystems is also rapidly growing. In 2022, US-based Orange Grove Bio and South Korea-based SV Investment established a new partnership for joint biotech collaboration in sourcing and developing therapeutics.<sup>31</sup> A few years later, Mirae Asset Financial Group, a South Korean investment firm, launched its first US fund focused on life science and biotechnology.<sup>32</sup>

As both the United States and South Korea seek to diversify supply chains and market dependencies away from China, there is a growing trend of new corporate collaborations that support South Korean firms entering the United



States and US firms entering South Korea. In 2024, US-based Radyus Research and South Korea-based Dt&CRO announced a strategic partnership to provide Radyus with testing services for Asia-based clients and provide support for Dt&CRO's clients entering the US market.<sup>33</sup>

For biotechnology and biomanufacturing, the United States and South Korea have made material progress in expanding corporate ties, increasing trade and investment flows, and strengthening market integration. Given that the majority of biotechnology R&D is done in the commercial sector, the increasing integration of the two countries' biotechnology ecosystems is evidence that strong and successful demand signals are being sent to the commercial sector to align with the aims of the US-ROK alliance. This expansion of alliance cooperation in biotechnology will support the goal of both countries to diversify supply chains away from China and support the secure development of this critical and emerging technology sector alongside allies and partners.

### **Future Opportunities for Strengthened Cooperation**

Although the United States and South Korea have made considerable progress in developing and strengthening alliance cooperation in biotechnology and biomanufacturing, there remain future considerations and opportunities for the two nations to achieve shared aims in building supply chain resiliency, economic security, and the secure development of this critical sector amidst rising tensions with China. Most notably, there are opportunities for the two countries to expand alliance cooperation in biotechnology to achieve mutually beneficial aims to reduce supply chain vulnerabilities in active pharmaceutical ingredients (APIs) and biomanufacturing, alleviate barriers to market entry, and build multilateral coalitions for technology protection and supply chain security. All of these objectives will be critical to the national and economic security of both countries amidst geopolitical disruptions and increasing Chinese economic coercion.

### ***Building More Resilient Supply Chains in Biotechnology and Biomanufacturing***

Both the United States and South Korea share key vulnerabilities in biotech supply chains. In the Biden administration's 100-day review of critical supply chains, APIs were a primary focus, alongside semiconductors, large-capacity batteries, and critical minerals. Given that generic drug shortages have been occurring in the United States for years, it is unsurprising that the review found that 87 percent of generic API production occurs overseas, estimating that China and India control substantial parts of the supply chain.<sup>34</sup> Similarly, South Korea is also reliant on China for API production, more so than India. In 2022,

South Korea imported USD 916.9 million in drug substances from China and USD 303.3 million from India.<sup>35</sup> To complicate things further, although there are leading API manufacturers in India, the nation also relies on China for three-quarters of its APIs used in drug production.<sup>36</sup> South Korea's direct and indirect reliance on China for APIs correlate to high risks to the nation's drug supply in the event of geopolitical disruptions. This was most evident during the COVID-19 pandemic when South Korea experienced acute shortages of acetaminophen, or paracetamol, a generic pain medicine that consists of APIs largely produced and exported by China.<sup>37</sup>

Given the shared interest of both the United States and South Korea in building more resilient API supply chains and finding alternative production capacity outside of China, there is an opportunity to deepen alliance cooperation and achieve mutually beneficial outcomes for the security of both nations. Currently, the most feasible alternative to China's API production capacity is India. The triangulation of interests between the United States, South Korea, and India in establishing more resilient API production has already emerged in the 2024 trilateral technology dialogue, where the three nations discussed opportunities to cooperate in active pharmaceutical supply chains. Moreover, both the United States and South Korea are setting targets to develop a domestic capacity for API production.<sup>38</sup> Building on this momentum, the two countries should continue to develop this area of alliance cooperation to secure more reliable drug supply chains.

There is also an overlap of interests in supply chain security between the United States and South Korea with regard to biomanufacturing. In September 2024, the US House of Representatives passed the BIOSECURE Act with bipartisan support. The legislation prohibits federal agencies from procuring, purchasing, or contracting biotechnology equipment or services from a foreign adversarial biotechnology company, explicitly naming Chinese companies such as the BGI Group, WuXi AppTec, and WuXi Biologics.<sup>39</sup> As a contract development and manufacturing organization (CDMO), WuXi AppTec's US operations brought in USD 3.6 billion in 2023, approximately 65 percent of the company's total revenue.<sup>40</sup> Given that the US biotechnology industry is entangled with Chinese CDMOs, the passage of the BIOSECURE Act into law will lead to a high demand for alternative CDMO services.<sup>41</sup>

The scaling and development of South Korean CDMO capacity offers a promising pathway to deepen US-South Korea cooperation in biomanufacturing amidst a seismic restructuring of supply chains. As part of its plan to become one of the top CDMOs in the world, South Korea-based Lotte Biologics recently

broke ground on its Songdo Bio Campus in 2024 as a part of the company's larger effort to expand its manufacturing capacity.<sup>42</sup> Other South Korean companies, such as Samsung Biologics and Celltrion, are also positioning themselves to capture key market demand for CDMOs from US biotechnology firms if the BIOSECURE Act is passed into law.<sup>43</sup> The future success of South Korean CDMOs integrating with the US biotechnology industry will require deliberate guidance and bilateral cooperation between the two allies to ensure biomanufacturing supply chains are resilient in the long term.

### *Strengthening Bilateral Ties in Agricultural Biotechnology*

There are opportunities for the United States and South Korea to strengthen bilateral ties in agricultural biotechnology to support mutual aims in food and economic security. Although the implementation of the Korea-US Free Trade Agreement (KORUS FTA) in 2012 has allowed for the development of robust investment and trade relations, there remain opportunities to smooth out certain regulatory barriers to market access for biotechnology between the two countries.

South Korea is the sixth-largest export market for US agricultural products. Robust agricultural ties between the two countries have flourished under the KORUS FTA, especially given that South Korea granted duty-free status to two-thirds of US agricultural products.<sup>44</sup> However, in agriculture, South Korea's regulatory system for genetically engineered crops is a barrier to the export of US agricultural biotechnology. According to the US trade representative, the approval process for new biotechnology products in South Korea is drawn out and inefficient, with five different agencies managing the process and data requests. This approval process is mandated by South Korea's Living Modified Organisms (LMO) Act.<sup>45</sup>

Fortunately, MOTIE recently proposed draft changes to the LMO Act that would introduce a policy for innovative biotechnologies and establish a pre-review system to exempt certain products from a full review. The United States engaged with MOTIE in the development of these draft amendments and continues to engage with the Korean government to streamline the regulatory process for agricultural biotechnology.<sup>46</sup> Looking forward, it would be highly beneficial for both nations to articulate the importance of agricultural biotechnology within the US-ROK strategic alliance as a driver of food, economic, and national security and continue efforts in streamlining and establishing regulatory transparency.

### *Multilateral Engagements and Cooperation*

Beyond the US-ROK strategic alliance, the two nations have converging interests in supply chain security and technology protection that could be leveraged within larger multilateral forums. As highlighted previously, trilateral engagements between the United States and South Korea with other like-minded partners, such as the US-South Korea-India technology dialogue, offer an opportunity for the United States and South Korea to leverage the capabilities and resources afforded by like-minded partners to achieve mutual security aims. For example, India possesses considerable API production capacity that could support US and South Korean aims to develop more resilient biotechnology supply chains. Moreover, within the recently established Bio-5 Coalition, the United States and South Korea are working alongside other like-minded nations, including Japan, India, and EU countries, to address global drug shortage issues and generate more resilient supply chains for health security.<sup>47</sup> Finally, there is a critical opportunity for the United States and South Korea to achieve mutual security aims in strategic economic competitiveness within the Indo-Pacific Economic Framework's recently established pillar on supply chain resiliency. With 14 founding member nations, this framework has four pillars: trade, supply chains, green energy, and tax and anti-corruption.<sup>48</sup> Within these larger multilateral frameworks and cooperative measures, there are considerable opportunities for the United States and South Korea to achieve shared aims in developing strategic economic and technological competitiveness while protecting critical technology sectors and vulnerable supply chains alongside like-minded allies and partners.

### **Challenges for the US-ROK Strategic Alliance**

Although the United States and South Korea have made material progress in deepening bilateral cooperation in biotechnology and biomanufacturing, certain obstacles remain to the US-ROK strategic alliance. Ambitious bilateral efforts to secure strategic supply chains and protect critical and emerging technologies can, at times, conflict with the political and economic realities facing both nations. These challenges include political shifts due to elections, the triangular relationship between the United States, South Korea, and China, and domestic economic constraints.

### *Political Shifts and Elections*

During South Korea's National Assembly election in April 2024, the opposition Democratic Party (DP) secured 175 seats, while the ruling People Power Party (PPP) only secured 108 seats. Given that President Yoon is a part of the PPP

and has three years remaining in his five-year term, South Korea will face political gridlock as the DP retains its legislative majority, which will most likely clash with President Yoon's agenda.<sup>49</sup> If South Korea aims to spur technological leadership and economic competitiveness in biotechnology, political consensus will be critical to create conducive policies for research, innovation, and cooperation in this industry, and recent bipartisan legislation from the National Assembly suggests this is possible.<sup>50</sup> The DP and PPP will have to find common ground in framing the economic and national security rationale for supporting technological leadership and strategic cooperation in biotechnology and biomanufacturing.

On the other side of the Pacific, there is some clarity insofar as the United States has elected former President Donald Trump. Yet, there remains a large degree of uncertainty regarding the resiliency of this new area of alliance cooperation in biotechnology. Across both the Biden and Trump administrations, there has been some consistency in utilizing economic statecraft and technology protection controls to counter China's economic and technological threat to the rules-based international order. For example, the first Trump administration severed US ties to Huawei, a Chinese telecommunications company, and the Biden administration upheld many of these Huawei-related restrictions and went further to tighten restrictions on the sales of semiconductors for 5G devices.<sup>51</sup> Given that the United States has frequently outlined the importance of biotechnology as a critical and strategic sector for economic competitiveness and national security, there can be some certainty that biotechnology will remain a strategic priority for the United States moving forward.<sup>52</sup> Whether this domestic focus on establishing global leadership in biotechnology translates to bilateral cooperation, however, is less certain.

### *Differing Perspectives and Vulnerabilities Surrounding China*

Although both the United States and South Korea share similar concerns over China's threat to the rules-based international order, the two nations diverge in their approaches and capabilities in countering this threat. The United States currently perceives China as the "only competitor with both the intent to reshape the international order and, increasingly, the economic, diplomatic, military, and technological power to do it." The 2022 National Security Strategy highlighted a three-fold approach to the US strategic competition with China: investing in domestic capabilities, aligning efforts with allies and partners, and competing responsibly with China.<sup>53</sup> US strategies to de-risk from China are well-known, ranging from the recent tariffs placed on imports of Chinese electric vehicles to the October 7 export controls placed on advanced

semiconductors, and are increasingly defensive and protective of emerging critical technology sectors.<sup>54</sup> It is indisputable that the United States and China are deeply entrenched in a great power competition.

On the other hand, South Korea is in a more precarious position within the larger US-China strategic competition. From the US perspective, South Korea is a “linchpin for peace and prosperity” and a strong ally in the Indo-Pacific.<sup>55</sup> From the Chinese perspective, South Korea is critically important to its regional strategy by influencing the geopolitics of the Korean Peninsula and creating a more malleable Indo-Pacific region for its interests.<sup>56</sup> As tensions rise between the United States and China, South Korea is increasingly becoming a key middle power in the region and, along with it, becoming increasingly exposed to the economic and geopolitical risks of being caught in the middle of two competing powers. With South Korea increasingly aligning with the United States in bilateral and multilateral efforts, China has responded harshly in expressing its disapproval, with China’s Ambassador to South Korea Xing Haiming going so far as to threaten that “those who bet on China’s loss will surely regret their decision in the future.”<sup>57</sup> This threat is not without weight, especially given that when South Korea installed a US THAAD system in 2017, China responded with retaliatory economic coercion.<sup>58</sup> Looking forward, South Korea must carefully navigate a precarious minefield of geopolitical, economic, and technology strategies—all while pursuing domestic interests amidst internal political gridlock.

### *Economic Realities*

The economic realities of South Korea present significant challenges to the full and whole-hearted embrace of bilateral technological and economic cooperation with the United States. For the past decade, the Chinese and South Korean economies have been highly integrated. China is a significant trading partner of South Korea, with China being the top destination for South Korean exports and imports.<sup>59</sup> Only recently has this economic reality begun to shift, with South Korean exports to the United States surpassing China in 2023.<sup>60</sup> Nevertheless, South Korea’s economic dependence on China will constrain its foreign policy. For example, China’s economic pressure in 2017 included retaliatory actions against South Korean consumer products, automobile sales, and companies.<sup>61</sup> Should South Korea align more closely with the United States in critical and emerging technology sectors, such as biotechnology, there is a high risk that China will retaliate with economic pressure in these sectors.

Domestic economic realities in South Korea may also constrain the nation's foreign policy and engagement in the US-ROK strategic alliance. Demographic shifts due to South Korea's aging population and low birth rate may begin to restrain the nation's economic growth. South Korea's long-term economic growth rate is predicted to be 1.9 percent from 2023 to 2030, 1.3 percent from 2031 to 2040, and drop to 0.7 percent from 2041 to 2050.<sup>62</sup> These predictions signal potentially stagnant economic growth for South Korea. Domestic considerations for an aging population and stagnant economic outlook will inform South Korea's technological and foreign policymaking in the next decade and beyond. For example, the potential for biotechnology to address critical medical needs of a population may be a higher priority for policymakers than the technology's potential for novel industrial manufacturing. As a critical technology sector and a component of the US-ROK alliance, South Korean commitments and investments in biotechnology may pressurize these economic and demographic constraints if the long-term benefits are not realized in time.

### *Reconciling US Economic Statecraft with Allies and Partners*

There lies an inherent mismatch between the United States' aims for economic statecraft and technology security vis-à-vis China and its bilateral and multilateral commitments to allies and partners that may eventually come to challenge the evolving strategic alliance between the United States and South Korea. As was outlined before, the national-level bilateral and multilateral commitments between the United States, South Korea, and other like-minded nations on critical and emerging technologies often stress the importance of these technologies to economic and supply chain security and technology protection. As these national-level commitments progress in biotechnology, they may soon encounter friction between shared concerns for economic and technology security and the domestic tools of economic statecraft.

Recent US controls on advanced semiconductors have illuminated the complications between domestic tools of economic statecraft and technology security and its profound implications for foreign policy. When the United States implemented sweeping new measures for export controls on advanced semiconductors in October 2022, it did so unilaterally. This unilateral move to use export controls was done so, reportedly, after inconclusive conversations with US allies earlier that year.<sup>63</sup> These export controls were met with concern from South Korea, given that South Korean companies such as Samsung and SK Hynix possess NAND and DRAM manufacturing plants in China.<sup>64</sup> These

firms would eventually go on to receive indefinite licensing waivers from the United States in an effort to smooth over concerns regarding semiconductor technology controls.<sup>65</sup>

Nevertheless, this fundamental divide between the domestic policy levers for technology and economic security and foreign policy has yet to be resolved. Looking at other emerging technology sectors, such as biotechnology, there is reason to believe that future unilateral measures from either the United States or South Korea will potentially come in conflict with the mutual aims outlined within this new global comprehensive strategic alliance.

## **Conclusion**

The biotechnology sector holds immense potential for the United States and South Korea to expand bilateral cooperation and the strategic alliance into new avenues for securing economic and technological competitiveness in the 21st century. Amidst rising tensions with China, there is a convergence of mutual aims between the two countries in strengthening and securing biotechnology and biomanufacturing as a critical and emerging sector for economic competitiveness and technological leadership.

Bilateral commitments have consistently included biotechnology as a critical technology for economic and national security, and working-level commitments between the two nations have shown participation from all levels of society in strengthening cooperation in this sector. Moreover, there remain opportunities to continue strengthening bilateral cooperation in biotechnology, given shared interests in de-risking biotechnology supply chains, increasing trade in agricultural biotechnology, and working toward mutually beneficial aims within larger multilateral fora.

However, there is some uncertainty in the current and future geopolitical landscape that may test the future of US-South Korea cooperation in biotechnology. Political changes due to elections, the triangular relationship between the United States, South Korea, and China, and domestic economic realities may constrain bilateral cooperation in biotechnology. To alleviate these constraints and ensure the future success of the US-ROK strategic alliance, US policymakers will have to reaffirm their commitment to the alliance, avoid positioning South Korea in direct conflict with China, and develop conducive messaging and policies that link domestic economic needs with larger security interests.



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