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Dividing Heaven - Effects of the Wolf amendment on the developing system of global space governance

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Abstract

This paper investigates how the U.S. policy limiting NASA's bilateral cooperation with China, colloquially known as the "Wolf amendment", is influencing the developing system of global space governance. As technological advancements improve access to outer space, policymakers around the world are crafting institutions that will regulate humanity's access, participation, and activities in the final frontier. However, the rapid pace of technological advance is creating policy challenges faster than policymakers can address them. While international space policymaking continues to trend toward voluntary norm building and emphasis on national laws rather than firm international treaties, the policies of perceived leaders will remain key drivers of norm and infrastructure development. As the current dominant space actor (the United States) and an increasingly influential space power (China) are effectively barred from working together in major space projects, the challenge international policymakers face becomes greater. While the Wolf amendment is already an oft debated subject, its true effects on international collaboration remain poorly understood. The Wolf amendment is only a small piece of the overall U.S. – China space relationship, yet it exerts significant influence on the patterns of interaction between the two space programs with implications for the greater system of global space governance. This presents key findings from a research project that analyzed congressional hearing transcripts, legal documents, personal letters, research reports, and public statements utilizing a qualitative complex systems approach to identify how the Wolf amendment exerts influence upon the political systems within which the amendment is embedded. Matching this analysis to current trends and patterns occurring in these systems enables an understanding of how the Wolf amendment is influencing the evolutionary trajectory of global space governance. The findings of this study reveal that the persistence of the Wolf amendment's influence forces the U.S. - China relationship to remain primarily competitive, rather than cooperative, in space exploration activities. With U.S. policymakers preventing participation in major joint activities with China, the creation of multiple spheres of influence in the development of space-based infrastructure becomes inevitable. Given current patterns of development, such a division of influence will likely lead to a persistently fragmented and competitive environment in outer space. These outcomes will exacerbate challenges for international policymakers working to secure the sustainable usage of outer space, but may also create opportunities for a wider range of space actors.

Keywords: Wolf Amendment, U.S.-China, International Cooperation, Global Space Governance, Policy Implications

Acronyms/Abbreviations

CNSA - China National Space Administration
CMSA - China Manned Space Agency
COPUOS - United Nations Committee on the Peaceful Uses of Outer Space
DoS - U.S. Department of State
ESA – European Space Agency
ISECG - International Space Exploration Coordination Group
ISS - International Space Station
MCB - ISS Multilateral Coordination Board
NASA - National Aeronautics and Space Administration
NOAA - National Oceanic and Atmospheric Administration
OSTP - Office of Science and Technology Policy

1. Introduction

The regulation and governance of outer space activities has been under development for over 60 years. Each year new countries and new companies join the mission to make humanity a truly spacefaring species. While colonies on Mars and beyond-earth mining operations may not yet exist, the process of developing the laws, norms, and standards that will influence humanity's extraterrestrial activities has already begun. This decision-making process and the influences it may have, both known and unknown, on the future of humanity's next steps into outer space lie at the heart of this research paper. More specifically, what future outcomes have already been determined by today's space policies, and can a close evaluation of contemporary outer space governance offer better insight into what challenges and opportunities await? This paper presents an investigation and analysis of one particular policy that lies between the United States and China, the two actors who are most likely to have a significant influence on the development of humanity's extraterrestrial future. That policy is known as the "Wolf amendment".

In 2011, the United States Congress voted to accept Public Law 112-55. Section 539 of that bill, commonly known as "the Wolf amendment", stipulated that the National Aeronautics and Space Administration (NASA)

could not "*develop, design, plan, promulgate, implement, or execute a bilateral policy, program, order, or contract of any kind to participate, collaborate, or coordinate bilaterally in any way with China or any Chinese-owned company*" [1]. This law effectively created a legal barrier between the U.S. and China in their ability to cooperate on civil space projects. The United States has had a mistrusting relationship with the People's Republic of China since the beginning of the Cold War, but the Obama administration had seen space exploration as an opportunity to foster cooperation between the two powerful nations. With his amendment, Virginia Congressman Frank Wolf largely brought those cooperative efforts to an end.

The debate over whether the United States should cooperate with China in space activities has been hashed out in many forms for decades [2]. This paper is not intended to weigh in on the merits for or against such bilateral cooperation and therefore avoids a rehashing of the primary arguments of that debate except for offering necessary background context. Rather, this research explores how the institutionalized reduction of cooperation between two of the world's predominant government space actors is likely to influence the ongoing development of the institutions that will guide humanity beyond Earth's cradle. Specifically, the research question posed in this thesis is: How is the Wolf amendment influencing the evolutionary trajectory of the system of global space governance?

As with any research that explores theoretical outcomes, this paper has limitations and does not offer conclusive answers or policy prescriptions. Rather, it is the intention of the author that the findings within will provide insights that will inform discussions between policymakers, both in the United States and internationally, who are working on the long-term sustainability of space activities. Existing policy debates about the Wolf amendment tend to focus solely on the security risks of allowing China to catch up to the U.S. technologically [3, 4]. By presenting a broader understanding of this complex issue, this research can expand the scope of current debates. The findings in this paper reveal how the Wolf amendment exerts influence and demonstrate how global space governance may develop because of this influence.

2. Background

The main overarching trend in the system of global space governance is an increase in overall complexity. There is an ongoing introduction of new and diverse actors with space-based interests, combined with new space activities and patterns of interaction between actors. The emergence of the private sector as a serious contributor to space based activities has caused many to consider this a new era of space exploration [5]. New countries are regularly becoming active in space with their own burgeoning space programs or increasing investments in space-oriented technologies. While this new stage of space history is celebrated by many space enthusiasts, a larger field of actors comes with new challenges such as maintaining the long-term sustainability of activities in outer space. As more and more players add objects into Earth's orbit, there is increased pressure to address the risks posed by lacking situational awareness, space debris, and in-space military conflicts. Additionally, having more voices at the table makes it more difficult to reach consensus on international agreements.

Space policy trend reports, including the comprehensive Global Space Governance Study led by Ram Jakhu and Joseph Pelton, suggest that global space governance is trending toward a decentralized and less rigid policymaking structure [6, 7]. Today, space policymakers are focusing on establishing norms through a combination of non-binding "soft" agreements and national level best practice laws [8]. Some nations continue to call for firm space treaties, particularly developing nations who fear being left behind in space activities in which they are not yet capable of participating [9]. However, most major space-faring countries, particularly the U.S., specifically refuse to pursue any new legally binding treaties as the current policy focus is on easing restrictions rather than creating new ones.

In such a political environment, the actions of perceived leaders will be particularly significant on the developing system of global space governance. Elite actors will set precedents, enforce (or not) international norms, and drive international discourse through their actions. It is within this context that understanding the potential effects of a forced divide between two such elite actors becomes meaningful.

Incidentally, while conducting this research it became quickly apparent that while the Wolf amendment is recognized as a controversial political issue, it is not recognized as having significant potential influence on international space policy development. Instead, the International Traffic in Arms Regulations (ITAR) restrictions are far a more commonly discussed barrier to cooperation with China as they more clearly have immediate economic implications for a much wider range of actors. Furthermore, eight years after its establishment there is still significant disagreement over what it is that the Wolf amendment actually prohibits [10]. This paper targets these two knowledge gaps by first describing how the Wolf amendment exerts influence, then by following this influence to where it will be most impactful for global space policy development.

3. Theory and Methods

3.1 Theory

The research presented in this paper is derived from a much larger graduate thesis project on the Wolf amendment [11]. That thesis utilized a qualitative complex systems framework to more deeply investigate the Wolf amendment's place within the U.S-China space relationship and the larger system of global space governance. This paper presents key findings from that thesis work, and therefore does not dive deep into theory. However, the complex systems framework utilized in that thesis heavily influences key assumptions and implications presented in this paper. Therefore, it will be briefly introduced here to help the reader understand these assumptions.

Complex systems theory refers to the blanket term for a collection of theoretical ideas and concepts that focus on the behavior of systems that display complex, chaotic, and dynamic qualities. Complex systems are open, embedded within other systems, and influenced by non-linear causality [12]. They are "living" systems that evolve and are capable of adjusting to changes within the system. They are heavily path-dependent with particular influence coming from initial conditions [13]. Global climate patterns, living organisms, and socio-economic systems are all complex systems [12]. Each may function in different ways, but they all demonstrate the same complex traits and behaviors.

Complex systems thinking has found a wide range of applications in the social sciences [13] but has only recently become a theoretical approach utilized by scholars of International Relations [12, 14]. The theoretical framework for this research focused on the complex system concepts of feedback loops, trends and patterns, and path dependence to identify how the wolf amendment is influencing the development of global space governance. By identifying the historical and ongoing patterns of behavior between various actors within a system, it is possible to illuminate that system's current trajectory. By identifying existing and potential feedback mechanisms and path dependent processes, such as the Wolf amendment, it is also possible to recognize where evolutionary trends are less likely to go. With this information combined it is possible to determine the direction that a system's evolution appears to be taking.

3.2 Methods

Utilizing the theoretical framework outlined above, the process for conducting this research was divided into two components. The first was analyzing the Wolf amendment itself by identifying how the amendment operates as a feedback modifying mechanism. The conditions that led to the establishment of the Wolf amendment, how it functions legally, practically, and through discourse, as well as its potential longevity were all investigated in this research component. The second component was identifying and analyzing the patterns and developments occurring within the social systems that the Wolf amendment is embedded within. These systems are primarily the U.S.-China space relationship and the system of global space governance. Other systems were considered during this process including the overall U.S.-China political relationship, however for practical purposes this analysis focused on the two primary systems.

This research utilized both primary and secondary data sources to conduct a thematic analysis searching for patterns and trends. Primary data sources included congressional hearing transcripts, legal documents, press releases, personal letters, and public statement transcripts. Secondary data sources included research documents, trend reports, journalistic pieces, podcast and video interviews, and books from well-known space policy scholars. Background interviews and conversations with persons involved in space policy development helped inform themes to investigate in these documents. Occasionally these conversations helped confirm themes that emerged in limited documents.

What follows is by no means an exhaustive presentation of findings, but a selection of significant narratives to best contribute to existing discourses on the Wolf amendment. For a more detailed view of this investigation, please refer to the original thesis material [11]. Section 4 will focus on the most significant effects of the Wolf amendment to demonstrate how it exerts influence. Section 5 is a discussion on how the Wolf amendment's influence may impact the global system of outer space governance.

4. Findings

4.1 Basic Restrictions of the Wolf Amendment

In 2011, U.S. Congressman Frank Wolf inserted a small amendment into that year's appropriations bill. The appropriations bill is responsible for outlining the annual U.S. government budget and allocating funds for each of the various government agencies. The "Wolf amendment" was only one paragraph in 150 pages of budget details affecting the many agencies that comprise the federal government. At the time, Congressman Wolf was the chair of the United States House Appropriations Subcommittee on Commerce, Justice, Science, and Related Agencies. A powerful position that is responsible for allocating finances for each of the civilian space agencies, including NASA. Congressman Wolf introduced language into the portion of the bill that outlined NASA's budget, effectively limiting the civil space relationship between the U.S. and China. The Wolf amendment stated:

"None of the funds made available by this Act may be used for the National Aeronautics and Space Administration (NASA) or the Office of Science and Technology Policy (OSTP) to develop, design, plan, promulgate, implement, or execute a bilateral policy,

program, order, or contract of any kind to participate, collaborate, or coordinate bilaterally in any way with China or any Chinese-owned company unless such activities are specifically authorized by a law enacted after the date of enactment of this Act." [1]

Despite the seemingly straightforward language of the amendment, how this restriction applies in reality is far from straightforward. The most obvious restrictions emanating from the Wolf amendment pertain to scientific cooperation. However, the restrictions do not detail how they should be applied and as a result, much attention has been given to understanding the nuances of the amendment. A NASA science website has a frequently asked questions (FAQs) page dedicated to detailed explanations on what the amendment restricts for researchers working with Chinese colleagues or students [15]. The information on this page highlights how, when put into practice, the Wolf amendment creates complicated boundaries for American-Chinese collaboration. For example, a NASA funded researcher may utilize Chinese published research, but only if it is publicly available online. If the researcher must request access to the published work, then they cannot use it [15]. Similarly, NASA-funded researchers may visit Beijing for scientific conferences, but only if the conference is clearly multi-national and "widely-attended". One of the more surprising "frequently asked questions" asks whether researchers are even allowed to discuss general science topics with Chinese counterparts. In response, NASA's webpage states:

"*General scientific discussions do not constitute a bilateral policy, program, order, or contract and thus are permitted. However, these discussions must not involve discussions of bilateral collaboration between NASA and Chinese entities*" [15]

In large part, much of the uncertainty on the amendment's restrictions stems from past confusion. In 2013, organizers for the Second Kepler Science Conference at NASA Ames Research Center denied entry to several Chinese graduate students. The organizers claimed that the Wolf amendment barred Chinese citizens from stepping foot inside NASA facilities, and apologized for what that they considered to be a "deplorable" ban [16]. In reality, the ban was a function of a temporary moratorium resulting from a security review that barred access to NASA facilities for citizens from certain countries, including China [17]. The conference organizers had believed the moratorium still stood and, mistakenly, that it was a requirement of the Wolf amendment rather than a separate and unrelated requirement.

Regardless of the restriction's origins, news of the event soon spread to academics across the U.S. and abroad that their Chinese colleagues and students were barred from attending the Kepler Conference, resulting in outrage and a public boycott of the event [18]. This outcry marked what was, for many, the first public introduction and large-scale awareness of the Wolf amendment. These events led to Congressman Wolf writing a public letter which chastised the head of NASA, and explained that the conference was a multi-lateral event and thus was not intended to be covered by his amendment [19]. In the end, the ban on Chinese participation was lifted for the event and Chinese participants were invited to reapply. However, the confusion surrounding the event cemented the Wolf amendment's reputation for heavy restrictions.

Interestingly, Georgetown Law School researcher Hannah Kohler points out that while this exchange surrounding the Kepler Conference clarified that the Wolf amendment did not bar Chinese visitors from multi-lateral events at NASA facilities, the question nevertheless arose again later that year [20]. A new draft of Wolf's amendment was signed into law in January 2014 that included a slight adjustment in language. The subsection language changed from:

2011 Draft- *"[t]he limitation[s] in subsection (a) [precluding bilateral coordination] shall also apply to any funds used to effectuate the hosting of official Chinese visitors at facilities belonging to or utilized by NASA"*

to,

2014 Draft- *"[n]one of the funds made available by this Act may be used to effectuate the hosting of official Chinese visitors at facilities belonging to or utilized by NASA" [20].*

Kohler suggests that this change strengthens the previous restrictions and effectively bars visitors from the Chinese government or Chinese companies regulated by the Chinese government even at multi-lateral events held at facilities owned or paid for by NASA funds [20]. Also added, was a clarified approval mechanism enabling NASA to request congressional permission to run bi-lateral projects or host certain events with Chinese participation in circumstances where no perceived risk of technology transfer exists. Consequently, this loophole in the Wolf amendment also makes it easier for Congress to terminate or restrict any space-related project with China deemed politically undesirable. These seemingly contradictory changes make project planning difficult and disconcerting for any NASA science project managers who may want to collaborate with Chinese counterparts. As a result, NASA scientists are likely incentivized by this regulatory climate to avoid partnership with Chinese researchers altogether rather than manage uncertainty of a politically challenging and/or volatile collaboration.

Beyond NASA, the Office of Science and Technology Policy (OSTP) has more directly confronted the limits and consequences of the Wolf amendment. The Obama administration originally took the stance that, constitutionally, the Wolf amendment should not apply

to any action that could be considered the foreign policy imperative of the President [3]. In a 2011 appropriations subcommittee hearing on President Obama's annual science budget request, John Holdren, head of the OSTP, made this position clear. The reply from Representative Culberson, a supporter of Wolf's amendment was equally clear:

"I note in your response to the chairman that the administration has decided that negotiations the president conducts are an exemption to the policy adopted by Congress… if anyone in your office, or at NASA, participates or collaborates or coordinates in any way with China, you're in violation of the statute. And frankly, you're endangering your funding and NASA's funding". [3]

Despite this exchange, Holdren continued to conduct bi-lateral dialogue with the Chinese government, pointing to a Justice Department opinion suggesting that such actions were within President Obama's constitutional authority to permit. In response, Congressman Wolf petitioned the Government Accountability Office (GAO) to determine whether or not Holdren's dialogue with China violated his amendment and if the Justice Department's opinion was legally valid. The GAO found Holdren to be in violation of the amendment and the Justice Department opinion as not the proper authority to determine constitutionality [3]. As a result, the Obama administration was forced to comply with the Wolf amendment by curbing OSTP led dialogues with their Chinese counterparts. One noteworthy point in this exchange was Congressman Culberson's explicit threat of endangering OSTP and NASA funding if cooperation was pursued. It is in the power of that threat that we can see how the Wolf amendment's power could reach beyond what is explicitly stated.

Despite the Wolf amendment's ability to block certain forms of dialogue and projects, the United States and China do still maintain a degree of civil space cooperation via the U.S. Department of State (DoS) and the National Oceanic and Atmospheric Administration (NOAA), both of which are left out of the Wolf amendment's restrictions. In November 2017, The Chinese National Space Administration (CNSA) and DoS hosted the third U.S.-China civil space dialogue in which recent successful cooperative projects were highlighted and future opportunities for cooperation were discussed [21]. Both NASA and the OSTP have been invited to take part in each of the civil space dialogues, and Charles Bolden himself was given congressional permission to attend the first two rounds of the dialogue [22]. A fourth round of the civil space dialogue has been announced for fall 2019 [23]. While the Wolf amendment does allow some room for conducting bilateral space dialogue between the U.S. and China, cooperation on the largest projects in space remains firmly blocked.

4.2 The Wolf Amendment and Human Space Exploration

In 2018, President Trump instructed NASA to create plans to significantly reduce or end funding of the ISS by 2025 as part of an economic strategy for space project funding. There are concerns that retiring the ISS prematurely will unnecessarily kill a major source of income for developing commercial space companies that rely on revenue derived from providing services to the ISS [24, 25]. Currently there are hopes that a large portion of the $3 billion annually spent by NASA can be covered through opening up the station to the commercial sector or to new partner countries. In June 2019, NASA announced detailed plans to enable commercial opportunities onboard the ISS [26]. Policymakers and space industry leaders however, remain doubtful over whether a viable commercial market could be self-sustained without significant government support [27, 28].

In the absence of a clearly viable private sector takeover of the ISS, adding new partner countries would seem a promising solution. Here China might seem an ideal partner in terms of budget capability and desire to participate, but the continued restrictions put in place by the Wolf amendment suggests that invitation is unlikely to occur. Technically the Wolf amendment does not bar Chinese participation in the ISS project because it is a multilateral project. However, there is evidence to suggest that it has been an effective barrier preventing the steps for inclusion to be made.

While, the amendment itself does not explicitly mention any type of project that is particularly prohibited, it appears that the amendment's intent was to primarily block cooperation on large projects such as the ISS. During a press conference at the 2014 International Astronautical Congress, NASA Administrator Charles Bolden explained that, "*The prohibition is aimed mostly at human spaceflight, so we don't collaborate or cooperate with [China] there*" [29]. During his tenure as Administrator, Bolden was openly opposed to this restriction and appeared to support the idea of Chinese participation in the space station [30]. In 2012, a Canadian newspaper reported that the ISS partner agency administrators held a meeting to discuss the potential of incorporating the Chinese space program into the ISS project. This article caught the attention of Representative Wolf, who responded with a letter to Bolden detailing his opinion that China was not welcome in the ISS project. In his letter he wrote:

"*As Chairman of the Appropriations subcommittee that funds NASA - and the author of the statute banning bilateral cooperation with the Chinese – I believe that any effort to involve the Chinese in the [ISS] program would be misguided, and not in the national interest"* [31].

Wolf's letter, combined with similar public statements, demonstrate that the limitations of his amendment should be read as including more than what is explicitly written within it. In this case, Bolden and NASA would be at odds with Congress, and their source of funding, if they continued to pursue a working ISS relationship with China. Therefore, while the Wolf amendment does not expressly prohibit Chinese inclusion, it does effectively achieve the same goal. This restriction likely applies both ways: while China is effectively barred from joining the ISS, NASA will be barred from participating in any Chinese space station projects.

A few months after the U.S. shut down its Space Shuttle program, the Chinese launched their first prototype space station: Tiangong-1, or "Heavenly Palace-1". By 2016 they had launched an upgraded twin, the Tiangong-2 station. This station was the second in a planned series of prototypes to test space station technology before beginning the development of a larger, multi-module station more comparable to the ISS. The first module of the Tianhe, or "Harmony of the Heavens", station is planned to launch in 2020 [32]. The station will be about a quarter of the size of the ISS but will reportedly be open to astronauts from around the world.

The China Manned Space Agency (CMSA), the agency responsible for station development, has already begun establishing agreements through the UN to make this larger station an international project [33], and they have put particular emphasis on creating participation opportunities for developing nation space programs. "*China is offering very attractive terms, conditions and features that [the] commercial sector is going to have a horrible time trying to compete with*," said commercial space station entrepreneur Robert Bigelow, during a press briefing, about the Chinese station's potential impacts on his company [34]. ESA and Roscosmos have also expressed significant interest in participating in the project, with European astronauts already learning Mandarin in order to collaborate more closely with their potential Chinese counterparts [35].

The continued persistence of the Wolf amendment, and current U.S. congressional discourses, suggest that NASA will not be allowed to participate in any Chinese space station projects. Considering that the ISS is planned to be decommissioned in 2025 (pending further extensions), this could hypothetically lead to a scenario where, perhaps temporarily, NASA will be the only major space agency without access to an orbital space station. This potential scenario is already a concern for U.S. policymakers. In a 2017 congressional hearing dedicated to investigating options for the ISS after 2024, this scenario was repeatedly discussed [24]. Additionally, it was evident in the hearing that having NASA participate in the Chinese station was not being considered as a potential opportunity for post-ISS planning. The focus is instead on the next American led international project.

Currently in development is the NASA led mission Artemis, which aims to establish a sustainable presence on the moon to with the long-term goal of enabling humans to go to Mars [36]. A significant component of this mission is a project currently known as the Gateway. The scope of the Gateway project has undergone significant changes during the course of its development, but the goal is to develop key infrastructure for lunar and deep space exploration [37]. As a miniature cousin of the ISS, the Gateway will be a small station in cislunar orbit intended to serve as a critical gathering point for launching missions to and from the Moon and, eventually, to Mars. Like the ISS, the station will be constructed by putting together different segments over time, with the first component scheduled to launch in 2022 [38]. Also like the ISS, the Gateway is intended to be an international project.

There have been several proposals from the ISS partner agencies, collectively known as the Multilateral Coordination Board (MCB), offering potential station components for the Gateway [37]. The partners have also released proposed international guidelines for space habitat construction to be utilized for the first time on this project [39]. However, there remains a great deal of uncertainty over the level and type of international cooperation that will occur on the project, and recent changes to the timeline have reduced opportunities for initial international cooperation [40]. The MCB continues to express a joint commitment to ensuring the gateway is an international endeavor [41], but there are still many logistical hurdles that need to be overcome.

A full sharing of responsibility on projects of this size comes with increased debate over design plans, strategies, and sharing of resources [42]. This has been a source of contention on the ISS, where budget struggles between nations have led to seemingly petty divisions, such as when Russian Cosmonauts were not allowed to use toilets on the American side of the station [43]. If the Gateway functions as a U.S. station with other countries supplying parts, then decision-making processes become simplified. However, this would come at the cost of reducing the incentives other agencies have to support the project. Sergei Krikalev, former director of human spaceflight for Roscosmos, showed at the 34th Space Symposium that this uncertain level of collaboration is likely to be contentious.

"We see this new international initiative as a sequel of the International Space Station program to be built under the same principles ... as an international project without the primacy or the priority of one of the participating partners," he said of the Roscosmos position on the Gateway. *"I believe the most important issue today is establishing an international legal framework for cooperation on construction of a cislunar*

station, similar to the ISS program" [44]. With the proposed 2022 initial component launch date, there is not much time to develop extensive international negotiations on these issues. Thus, whether the Gateway will genuinely become a "sequel" to the ISS remains to be seen.

It also remains to be seen if the Chinese space program will get to participate in the project. If NASA leads the project then it will likely need to make bilateral agreements with the various international partners that come on board. This type of partnership with China is expressly prohibited as long as the Wolf amendment remains in effect. However, even if the project was made into a multi-national forum it remains highly unlikely that this project would be deemed acceptable for Chinese participation. At a 2019 forum on U.S.-China space cooperation put on by the Secure World Foundation, NASA Senior Policy Advisor Patrick Besha explained: "*As for what lies ahead, ultimately, NASA is a science and technology agency. We don't dictate international relations. We follow the mandates that are provided by the White House and Congress. On the topic of cooperation, they are currently very clear." [10]*. As a result, it is unlikely that the U.S. and China will cooperate in developing a cislunar station, or any other station, in the foreseeable future.

4.3 The Wolf Amendment's Longevity

An interesting aspect of the Wolf amendment is that it must be renewed every year. Each annual budget requires new legislation to determine how each government program will be funded. In 2015, NASA administrator Bolden stated that this policy toward cooperation with China was "temporary" [30]. Based on personal communications with senior officials at NASA and space policy analysts familiar with the issue, there was a tacit expectation that once the amendment's author and primary supporter had retired, the amendment would likely fail to be renewed in the next budget bill. However, this expectation was dependent on Congressman Wolf's successor holding different views.

Instead, his successor as Chair of the committee was Representative John Culberson. Culberson not only shared Wolf's opinions on the Chinese government, but he had also attempted to introduce a predecessor of Wolf's amendment in 2010 [45]. Thus, despite Wolf's departure, his amendment has continued to remain in effect as the members of congress responsible for NASA's budget continue to support it. Rather than diminishing in influence as Bolden had predicted, recent versions of the amendment have expanded to include the newly recommissioned National Space Council to the list of government bodies restricted from conducting bilateral relations without congressional approval [46]. This suggests that without a major political shift, the Wolf amendment will remain in place for the foreseeable future.

In 2018, such a political shift appeared to have occurred in the U.S. House of Representatives, as a Democratic Party takeover in the midterm elections led to a complete change of appropriations committee leadership. Despite this shift, the current 2020 appropriations bill working through congress still contains the Wolf amendment [47]. This may be again surprising to observers who expected the amendment to fade away without Republican Party leadership. Personal communication on May 28, 2018 with a policy advisor for a Democratic representative who has been vocally supportive of potentially collaborating with China helps explain why the amendment persists:

"*This is not a partisan issue as currently Congress and NASA have not seen [the Wolf amendment] prohibition as holding back our own exploration programs… If we do explore removing the Wolf Amendment, close study would be necessary to evaluate the national security implications including potential benefits to US space exploration and US China relations. These discussions may not happen in the near term, but they will become necessary at some point."*

Furthermore, even if the Wolf amendment failed to be renewed, current political discourses suggest it is unlikely that the barrier between U.S. and Chinese cooperation would fade away as well. Prior to becoming the current NASA administrator, a particularly vocal advocate of the Wolf amendment during his tenure in congress was Representative Jim Bridenstine. In a 2016 congressional hearing on whether the U.S. was "losing the space race to China", Bridenstine expressed concern about the Obama administration pursuing cooperation with China:

"Unfortunately, NASA under this Administration seems more focused on forcing partnership with China than in maintaining our leadership. Former Chairman Frank Wolf was a leader on this, and our country is grateful for his work… any NASA bill should permanently codify the restrictions on cooperation with China while also discouraging others from partnering with the Chinese" [48].

Prior to his confirmation as NASA administrator, Bridenstine vowed to compete, rather than cooperate, with China in space activities [49]. More recently, he has expressed that he maintains his view that China's activities in space are "aggressive" [50]. If the principles of the Wolf amendment reside with the administrator of NASA, then it is unlikely that the amendment's elimination alone would do much to ignite a more cooperative relationship with the Chinese space program.

5. Discussion

The findings in this paper demonstrate that the continued existence of, and support for, the Wolf

amendment establishes an effective and potentially long-term barrier between the U.S. and China in major space projects. But how might this impact the future of global space governance? According to conversations with delegates to the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), the one aspect of space that is becoming more cooperative is that of exploration. Deep space and human exploration missions typically catch the most public attention and are associated with the greatest prestige. Playing an active role in space exploration can grant soft power to those capable of doing so [51]. These projects are also often the most difficult and can be prohibitively expensive, so the momentum to work together is strongest toward this goal as more partners can contribute more resources. While spacefaring countries are expressing more interest in pursuing cooperative exploration projects, the institutions to coordinate such cooperation are yet to be fully established.

Human spaceflight missions have been, and will continue to be, key drivers in the development of space infrastructure and the political framing of space activities. As of 2017, 13% of all spaceflights ever launched had been associated with the ISS alone [24]. This one, albeit massive, project has been a huge driver for the development of the modern space industry. Additionally, the station continues to be a significant source of prestige and soft power, as it creates an opportunity for men and women from countries without full space capabilities to take their first 'steps' in space [52, 53].

Whoever has influence over the infrastructure that supports human spaceflight will influence future space developments. In an environment where it is becoming increasingly difficult to come to consensus over international space policy issues, highly influential decisions can be made more quickly by consensus between key elite actors. The political decisions made around human spaceflight programs in the near future will determine if there remains a unitary collection of elites, or if the elites will fragment into factions. Determining who these elite players are and how they are organized will direct this outcome.

The ISS MCB agency partners have demonstrated their capacity for policy leadership by designing and proposing international space exploration guidelines. In 2018 the MCB partners, led by NASA, released a comprehensive draft of technological standards meant to guide best practices in human space exploration and to promote interoperability between space players [39]. These standards were released publicly to gain feedback and participation from other national and commercial space actors, increasing their legitimacy. Furthermore, it is still very possible that the MCB will become the main decision-making body for the Gateway as it further develops. If it does, it would be reasonable to recognize the MCB as the main gathering of elite space actors, comparable to a UN Security Council of space. But, as this research has established, one of the problems with the long-term credibility of the ISS MCB is that it may never include China.

China is commonly recognized as becoming the second most influential space power following the U.S., and its absence in the ISS MCB leaves a key influencer out of the process. Outside of space issues, the Chinese government has demonstrated that when they not allowed to equally participate in major international affairs, they will create parallel competing institutions [54]. With interest from other countries to participate, the Chinese space station could become a parallel sphere of influence with the Chinese at the center. If the Chinese space program continues to be blocked from the MCB and Gateway project via the Wolf amendment and its supporters, then there will exist two competing sources of elite influence. Due to the prohibitively expensive nature of these projects, most countries will not be able to participate in both. Therefore, there is likely to be competition between the two to incorporate more partners to gain more influence and funding.

One potential alternative to a two-power infrastructure-based dichotomy is a forum such as the International Space Exploration Coordination Group (ISECG). The ISECG is a voluntary cooperation mechanism for sharing information between agencies with goals of human and robotic space exploration [55]. It is most notably responsible for creating the global exploration road map, which is the collective space exploration plan for all participating space agencies. The cislunar orbital station concept was originally introduced as one of two potential space exploration trajectories outlined in the original 2011 Global Exploration Roadmap [56]. The Chinese space program was not an original participant, though the CNSA said they would happily join the ISECG if offered an invitation [57]. Therefore, the first two versions of the roadmap in 2011 and 2013 did not include Chinese input or projects. However, the Chinese did eventually join the group as the 2018 version of the roadmap included the CNSA as a participating member and heavily emphasized Chinese projects [58].

Currently, the ISECG is made up of 19 space agencies including the ISS partners plus China, India, Ukraine, the United Arab Emirates, Korea and Australia. With participation from all the most capable actors, there is potential for this body to become the defining forum for elite civil space actors. However, it is unclear whether it will simply serve as a communication channel or eventually become a source of international standards or governance in the same way that functioning project groups such as the MCB have been. Additionally, there are no ISECG projects that will drive the development of

space infrastructure in the same way that a space station or moon base project would.

Another challenge for forums such as the ISECG, is that countries with developing space programs such as South Africa, Brazil, and Iran have voiced complaints that they are not treated as equal participants when planning international space policy [59]. Countries without space programs at all fear being left further behind as wealthy countries develop space policy without their input [60]. As more States develop space capabilities, norms and agreements that emerge from forums that do not include all interested parties are likely to have less and less perceived legitimacy. Recognizing this challenge, achieving full consensus amongst all stakeholders has been a guiding principle for COPUOS [61]. However, the slow process of gathering full consensus from all participants in forums such as COPUOS is likely to continue to incentivize elite actors to move forward alone or in smaller groups. Therefore, conditions will be ripe for the formation of multiple spheres of influence.

Within this context, the Wolf amendment's persistence creates a strong possibility that cooperative space projects will fragment into at least two different blocks of political influence. In an environment where new international treaties are becoming non-operative, the U.S.-China divide in space projects may indicate a persistent, bi-polar order in global space governance. In the context of these evolving systemic trends, the Wolf amendment remains only a driver, rather than a root cause. But by applying basic principles of complex systems thinking to the Wolf amendment, it is possible to recognize how the amendment exerts influence upon these systems.

As U.S. policymakers feared losing their leadership and dominance in space, the Wolf amendment emerged as a tool to help maintain a sense of security against a rising China. This created a positively reinforcing feedback loop: not allowing China to become a cooperative or collaborative partner with the U.S., thereby pushing China to create its own competing projects, which in turn perpetuates the fear of a rising opponent, and thus the cycle as a whole. The increasing resilience of these patterns has created the possibility of a long-term division in the spheres of influence in major space projects. In such a scenario, U.S. policymakers will have legitimized an external sphere of influence where it has little to no authority, thus risking the very leadership those policymakers fear losing.

6. Conclusions

This paper has presented the manner in which the Wolf amendment exerts influence, and the implications of this influence by briefly discussing the conditions in which that influence exists. Primarily, the Wolf amendment prevents Chinese participation in major U.S. civil space projects. By doing so, it does not prevent most cooperation in space between the two countries, but rather it perpetuates an effective perception that the two nations do not, and should not, work together. This lack of potential cooperation in major space activities perpetuates the perception of China as an opponent to the U.S. in space, and encourages the discourse that the U.S. should fear losing its outer space dominance. This self-reinforcing divide between the U.S. and China in space activities is particularly significant given current trends in global space governance. As international space policy trends towards decentralized and voluntary norm-building rather than firm laws, the roles and actions of perceived leaders will become more influential. As major space exploration projects develop without the U.S. and China participating in joint endeavors, it is increasingly likely that a divide in major government funded space projects will occur. As these projects are likely to be particularly influential in both soft-power norm-building and space infrastructure development, this divide will likely have significant influence on the future development of space governance.

The trajectory outlined in this paper can be construed as both a negative and positive result depending on one's perspective. On one hand the trends outlined here suggest that the United States and China will maintain a competitive and potentially conflictual relationship in space, meaning international policymakers working to maintain the peace and long-term sustainability of outer space activities have a challenging task ahead of them. With international space policy becoming increasingly led by national level precedents, developing countries with less space capabilities will likely have little influence over the direction that humanity takes in space. However, a division in international space leadership may create a scenario where such developing countries may stand to benefit.

If the U.S. and China are forced to work separately, the possibility of the two sides competing for partners and resources will likely create more opportunities for other actors to get involved in the long-term. Instead of a single hegemonic center with all the major players working together, there may be a bi-polar or multi-polar space order with a wider potential spread of the benefits of space as the two sides compete for influence and competitive advantage. Such an outcome might seem negative for those in the U.S. who want to see America maintain its leadership status and dominance in space. However, there is an argument to be made that such competition or conflict is a catalyst for technological development that the U.S. space industry needs to more rapidly explore the cosmos. For those who desire to see NASA develop the technology to send humans to Mars, perhaps the boost in urgency and funding created by a perception of competition with China is a positive outcome.

Regardless of perspective, the immediate value of this research is in addressing the gap in the international policy dialogue surrounding the existence of the Wolf amendment. This paper is meant to help fill that gap and bring attention to the big picture implications of the decisions being made in space policy circles today. It is clear that very few of the individuals involved in international space policymaking have concerns over the Wolf amendment and its potential influence on the future of global space governance. Those that do openly debate the Wolf amendment tend to have a security focus that investigates the risk that cooperation with China could pose to the United States. While this is a crucial aspect of discussing the Wolf amendment, a more holistic perspective suggests that there is much more to discuss. It may be impossible to say where humanity will end up with its political structures when we become an interplanetary species, but the relationship between the United States and China in outer space will likely have significant influence on that outcome. The early decisions that will determine our future are being made today, therefore it is a worthy endeavor to investigate the path we have chosen.

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